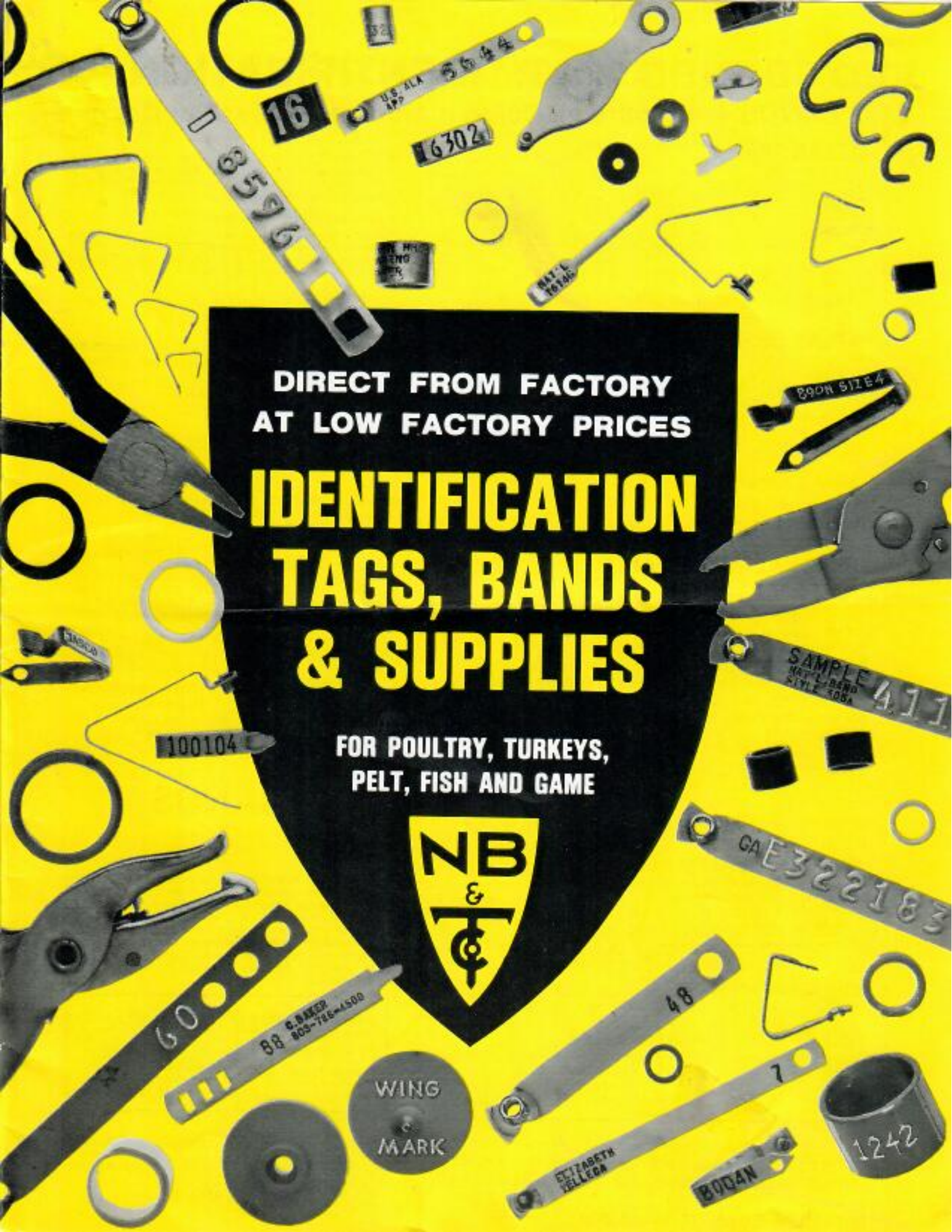
TAGS II
GH ~~SALAZS~~ FILE

PART 2 OF 2


DIRECT FROM FACTORY
AT LOW FACTORY PRICES
IDENTIFICATION
TAGS, BANDS
& SUPPLIES
FOR POULTRY, TURKEYS,
PELT, FISH AND GAME
NB
&
WING
MARK

Manufacturers of IDENTIFICATION TAGS for
AGRICULTURE • HORTICULTURE • BIOLOGICAL AND SCIENTIFIC RESEARCH •
RABIES CONTROL AND ANIMAL LICENSING • ELECTRICAL AND INDUSTRIAL USES

NATIONAL BAND AND TAG COMPANY

Established 1902 • • GENERAL OFFICES: 721 YORK STREET NEWPORT, KENTUCKY 41072, U. S. A. • • Phone: Area (606) 261-2035

University of Hawaii
Hawaii Inst. of Marine Biology
Coconut Island-PO Box 1346
Kaneohe, HI 96744
Attn: George H. Balazs, Asst.Marine Biol.

November 16, 1979

"OUR 77th YEAR"

Dear Mr. Balazs:

With reference to your October 10 letter, I am sorry that I have not written to you sooner, but your first letter got lost in the shuffle around here so thanks for your reminder. My brother, Jim, has corresponded with you in the past concerning these turtle tags but recently we have departmentalized so to speak, and in the future, I will be handling this type of inquiry.

I checked through purchasing and we are able to purchase this inconel 625, however, we found that it's expensive and they have advised us that there will be an $800.00 to $1000.00 minimum order required. This would mean that the 5000 tags that you mention in your order would have to be figured at $200.00 per 1000 for just material alone. Or, if you could use 10,000 tags, this material cost would drop to $100.00 per 1000.

We have had several requests to make the turtle tag in the larger 49 size with the 681 locking mechanism and have, in fact, done this using monel, per sample enclosed.

The other size is the one which you have been using, the 681, which you seem to have found satisfactory for your projects. Naturally, if we order two different sizes in the inconel, there would be the $1000.00 minimum order on each size. Therefore, we would like for you to send us, if possible, a list of all of the other possible users of such a tag or tags an- I would like to contact them and tell them of your recent success using the inconel in your 3 year program and by doing so, perhaps, get them to place orders so we can further cut into this large material cost outlay. If I have your permission to tell them about your good results with inconel, let me know. Also, perhaps, you could have some sort of an article in your Marine Turtle Newsletter which might further help generate orders. As far as the exact cost per 1000 of these tags, I still don't know until I can get some good idea of the amount of tags to be used. All I know at this time is the inconel is available, we can manufacture it into two different size tags with the same type locking mechanism and after the need has been determined, and the orders placed, we can begin manufacturing.

November 16, 1979

George H. Balazs
University of Hawaii
Kaneohe, HI

I would estimate at this time after the first order is received, we would anticipate shipment in about 2½ months. Please allow this much lead time.

Once again, I am sorry for not getting back to you sooner. Thank you for your continued interest in our products. If I can be of further assistance or you have any further questions, please contact me personally.

Yours truly,

NATIONAL BAND AND TAG COMPANY

Tom V. Haas

Tom V. Haas, Manager

TVH:lc/2

CONFIDENTIAL

December 26, 1980

Dear Mr. Haas:

I must go through the attached formalities required by the University of Hawaii. In the formal price quotation letter that you send me, please be certain to state that 5000 is the minimum number of tags that you can produce for such an Inconel order. The total price should come to $2,951, but this must be broken down to reflect the cost of shipping and die alteration. I suggest the following: tags- $2,800 at 56¢ each; die alteration- $120; shipping- $31.
All of the details listed in the attached letter should be included in the formal price quotation. You should also probably note at the end of your letter that this would be the last such order that you can produce for me for the forseeable future, due to equipment constraints. Please do not mention the possibility of a future government subsidity contract.

I have enclosed a check for $500 for the payment of a portion of these tags as I indicated in my letter to you dated December 23, 1980.

Thank you for your patience in this matter.

Sincerely,

George H. Balazs

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

December 26, 1980

Mr. J.R. Haas
National Band and Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

The purpose of this letter is to request a price quotation for sea turtle tags manufactured from Inconel alloy grade 625. The records of your company will show that in 1976 you porduced a special order of these highly corrosion-resistant tags for our Institute. It will now be necessary to obtain an additional supply of these same tags, with the specifications as follows:

Stamping: 1/16" letters stating WRITE HIMB
UNIVERSITY
HAWAII 96744

Numbering: 3/16" numbered 5051 consecutively through 10050
(if minimum order is less than 5000, please specify)

Style: self-piercing Inconel alloy grade 625, with the dimensions of 70mm in length, 8mm in width, and 0.5mm in thickness.

Your price quotation should also include shipping, insurance, and any die alteration charges that may exist.

Your rapid response to this inquiry would be greatly appreciated.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:lb

23 December 1980

Dear Mr. Haas:

Following some discussion with my fiscal officer, I have found that slightly greater difficulties exist with respect to payment than I had originally anticipated. It will now be necessary for me to submit a University Purchase Order for the $2,950.17 prior to recieving the invoice from you for this amount. It is absolutely essential that the date on the invoice be later than the date on my Purchase Order. I would therefore like to ask you to delay sending the invoice for $2,950.17 until I can provide you with a Purchase Order number. This should not take any longer than two weeks.

I am sorry that this problem has come up, but I am sure it can be solved in short order. The invoice for $500 to my home address (see attached) can be sent immediately- hopefully by December 31.

This letter is being sent by air mail special delivery, therefore the original attached letter mailed a few days ago may not have reached you yet.

Sincerely,

George H. Balazs

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

December 20, 1980

Mr. J.R. Haas
National Band & Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

Thank you for your letter of December 8th, which I received yesterday upon my return from field studies at French Frigate Shoals. It was indeed welcome news to learn that my Inconel 625 tags have been manufactured and are now in shipment to Hawaii. I look forward to receiving the order within the next few weeks.

The production of 7300 tags, instead of the originally projected 5000-6000, presents me with some financial problems, but I believe that this can be resolved without causing delay in payment. I should emphasize, however, that I am pleased that you were able to make this larger number of tags. The invoice that I have received (copy attached) lists a total charge of $4,250.17. In place of this invoice, I would like you to prepare and mail three separate invoices. The number of tags and die alteration charge should be divided proportionately to each of the three. The invoices should be prepared for the following amounts:

1. $2,950.17- to G.H. Balazs, Univ. Hawaii at Manoa, Hawaii Institute of Marine Biology, Box 1346, Kaneohe, HI 96744
2. $500.00- to G.H. Balazs, 992A Awaawaanoa Place, Honolulu, HI 96825
3. $800.00- to G.H. Balazs, 992A Awaawaanoa Place, Honolulu, HI 96825 (invoice marked PAID, as the result of $800 check which I sent to National Band & Tag Co. during late 1979)

Once again, I want to sincerely thank you and the other members of your family business for the excellent service and assistance that you have rendered to my research project. I wish all of you a healthy and prosperous New Year.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:lb

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University of Hawaii
Hawaii Inst. of Marine Biology
Coconut Island, P.O. Box 1346
Kaneohe, Hawaii 96744
Attn: George H. Balazs, Asst. Marine Biologist

November 3, 1980

"OUR 78th YEAR"

Dear Dr. Balazs:

I am sorry to have not answered your September 11th letter sooner, but until I had some definite shipping information on the Inconel 625, I did not want to get your hopes too high. However, this morning I received word from the Connecticut mill that 60 pounds of Inconel was shipped by them Friday the 31st. We expect delivery this week and if all goes well, 5000 to 6000 tags will be on their way to you by December 1st. I still don't have a definite idea of the price, the quantity - but we will stamp the tags as you require and we will begin with the number 5051 per your instructions. An acknowledgement of the order is attached. I have instructed our department not to mention this order to any other turtle researchers per your request. As soon as I know these tags are manufactured, I will notify you as to their shipping date.

Once again, thank you for your patience in this matter and I feel very optimistic that these Inconel 625 tags will soon be a reality.

Best regards,

NATIONAL BAND AND TAG COMPANY

Tom V. Haas

Tom V. Haas, Manager

TVH:lc/2

ACKNOWLEDGEMENT

Manufacturers Of Identification Tags For:
Agriculture — Horticulture — Biological and Scientific Research — Rabies Control and Animal Licensing — Electric and Industrial Uses

NATIONAL BAND AND TAG CO.
Phone: Area (606) 261-2035
721 YORK ST., NEWPORT, KY. 41072 U.S.A.

CLASS	DATE ENTERED	N.B.&T. ORDER NO.
421	11/03/80	56727

REFER TO THESE NUMBERS WHEN YOU INQUIRE

IT IS IMPORTANT THAT YOU REVIEW OUR INTERPRETATION OF YOUR ORDER (STAMPING, NUMBERING, STYLE TAG, ETC.) AND ADVISE US IMMEDIATELY IF THERE ARE ANY CHANGES OR CORRECTIONS TO BE MADE.

HAWAII AT MANOA, UNIV. OF
HI. INST. OF MARINE BIOL.
BOX 1346-COCONUT ISLAND
KANEOHE HI 96744

(FOR SHIPMENT IF OTHER THAN ADDRESSEE)

UNV. OF HI AT MANOA. GEO. BALAZSA
HI. INST. OF MARINE BIOLOGY
BOX 1346-COCONUT ISLAND
KANEOHE HI 96744

94853 GEORGE H. BALAZS

THIS IS NOT A INVOICE - DO NOT PAY

QUANTITY ORDERED	DESCRIPTION	UNIT PRICE
6,000	1005-681MONEL TAG INCONEL 625 NUMBERED: 5051 THRU 11,050 STAMPING: "WRITE HIMB UNIVERSITY HAWAII 96744"	XXXXXXX M To be advised
1	SETUP CHARGE (DIE ALTERATION CHARGE) STAMPING: 1//16" TYPE NUMBERS CENTERED ON FLAT SURFACE OF POINT END, READING LEFT TO RIGHT FROM THE POINT STAMPING ON FLAT SURFACE OF THE HOLE END READING LEFT TO RIGHT TO HOLE END SEE F/T 035805 AND SAMPLE ATT. FOR REF. PLEASE CENTER CONSECUTIVE NUMBERS ON FLAT SURFACE AS BEST POSSIBLE	XXXXX E To be advised.

CUSTOMERS ORDER NO.	CUSTOMERS ORDER DATE	SHIP VIA	DELIVERY REQUESTED	ANTICIPATED SHIPMENT WEEK OF	TERMS	
LETTER	10/30/80	INS PP	12/15/80	12/05/80		FOB NEWPORT NET 30 DAYS

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University of Hawaii at Manoa
Hawaii Institute of Marine Biology
Box 1346-Coconut Island
Kaneohe, HI 96744
Attn: George H. Balazs

December 2, 1980

"OUR 78th YEAR"

Dear Dr. Balazs:

I am happy to report that this morning we have finally completed the manufacture of your Inconel turtle tags. With the material we received we were able to manufacture 7300 of these tags starting with number 5051 up through 12,350. Needless to say, this was quite a time-consuming ordeal and really put our punch press and dies to the test. This hard Inconel 625 material is certainly something our punch press operators have not experienced very often. The 7300 tags will be shipped to you tomorrow by Insured Parcel Post and should arrive within 3 to 4 weeks.

These tags will be billed to you at $553.00 per 1000 plus the $175.00 die make-ready charge. I am sure they will do a good job for you in your turtle research and, hopefully, this supply will last you until we can have better luck with the Federal grant that Larry Ogren is working on so we can produce these tags more economically. It is quite obvious after our experience in manufacturing these tags from Inconel that a very heavy-duty punch press is a must.

Once again, thank you for your patience this past year as I realize you were bound and determined to obtain the finest turtle tag available anywhere. I am sure you will find this is the case when you receive your tags. Lots of luck with your turtle research and I hope to read of your progress in the Marine Turtle Newsletter.

If we can be of any service in the future, please do not hesitate to contact my brother, Jim, or myself.

Sincerely,

NATIONAL BAND AND TAG COMPANY

Tom V. Haas

Tom V. Haas, Manager

TVH:lc/2

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University of Hawaii at Manoa
Hawaii Institute of Marine Biology
Box 1346-Coconut Island
Kaneohe, HI 96744

December 8, 1980

"OUR 78th YEAR"

Attn: George H. Balazs

Dear Dr. Balazs:

Following up our letter to you dated 12/2/80, we were pleased to be able to supply you the additional quantity of Inconel 625 tags. The tags have been shipped, we hope you take receipt speedily and without difficulty.

Tag pricing was finalized at $553.00 per 1000 plus setup and transportation. I believe I have previously expressed to you my sentiments concerning the cost of these tags. But even this cost does not render compensation for the encountered production problems, interruptions, etc. For example, the life of the dies (type, numbering equipment, perforators, etc.) used to produce the 7000 inconel tags is commensurate to die life required to produce 2½ million standard tag units. Transposed into dollars -- for every inconel dollar, the equipment could have turned $17.00 of standard units. Normal production time was extended twelve fold for the 7000 tags. While we can estimate production time and interruptions; die and equipment life is an intangible that just can't be figured. For these reasons, we will not again manufacture tags from the inconel material using our standard production equipment.

My brother, Tom, mentioned to you in his letter of 12/2 the Federal grant or funding i.e. Larry Ogren, Panama City, Florida that would provide for the proper equipment development, procurement and subsequent production of inconel tags. I want to re-emphasize the importance of the consummation of this project, as it is only through this project and our successful participation therein that we would undertake future production of inconel tags.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH:lc/2

CUSTOMERS ORDER NO.	ORDER DATE	TERMS
LETTER C	10/30/80	FOB NEWPORT NET 30 DAYS

CLASS	INVOICE/ SHIP. DATE	SHIPMENT	N.B.&T. ORD. NO.
421	12/03/80	12/03/80	56727

NATIONAL BAND AND TAG CO.

Phone: Area (606) 261-2035
721 YORK ST., NEWPORT, KY. 41072 U.S.A.

94853 GEORGE H. BALAZS

REFER TO THESE NUMBERS WHEN YOU INQUIRE

ORIGINAL INVOICE - 2 COPIES)

THIS IS THE ONLY INVOICE YOU WILL RECIEVE. TO ASSURE PROPER CREDIT TO YOUR ACCOUNT:

① RETURN THE ATTACHED COPY WITH YOUR REMITTANCE OR LIST OUR INVOICE NUMBER(S) ON YOUR CHECK.

② PAY THE COMPLETE AMOUNT INVOICED OR SEND WRITTEN EXPLANATION OF ANY DEDUCTIONS.

③ PAY FROM THIS INVOICE . . . . . NO STATEMENT IS SENT UNLESS ACCOUNT IS PAST DUE.

THANK YOU

HAWAII AT MANOA, UNIV. OF
HI. INST. OF MARINE BIOL.
BOX 1346-COCONUT ISLAND
KANEOHE HI 96744

SHIPPED TO: UNV. OF HI AT MANOA. GEO. BALAZSA

QUANTITY THIS INVOICE	DESCRIPTION	UNIT PRICE	AMOUNT
7,300	1005-681MONEL TAG INCONEL 625 . NUMBERED: 5051 THRU 11,050 . STAMPING: "WRITE HIMB UNIVERSITY HAWAII 96744" .	53.00 M	4,036.90
1	SETUP CHARGE (DIE ALTERATION CHARGE) . STAMPING: 1//16" TYPE . NUMBERS CENTERED ON FLAT SURFACE OF POINT END, READING LEFT TO RIGHT FROM THE POINT . STAMPING ON FLAT SURFACE OF THE HOLE END READING LEFT TO RIGHT TO HOLE END . SEE F/T 035805 AND SAMPLE ATT. FOR REF. . PLEASE CENTER CONSECUTIVE NUMBERS ON FLAT SURFACE AS BEST POSSIBLE .	175.00 E	175.00
	PREPAID FREIGHT		38.27
		PLEASE PAY THIS AMOUNT OR ADVISE IN WRITING	4,250.17

MANUFACTURERS OF IDENTIFICATION TAGS FOR:
AGRICULTURE — HORTICULTURE — BIOLOGICAL AND SCIENTIFIC RESEARCH — RABIES CONTROL AND ANIMAL LICENSING — ELECTRICAL AND INDUSTRIAL USES

ON DOMESTIC SHIPMENTS THERE WILL BE A 1½% SERVICE CHARGE (EQUIVALENT TO 18% A YEAR) ON ALL INVOICES WHICH ARE NOT PAID IN FULL BY END OF THE MONTH FOLLOWING MONTH OF PURCHASE.

UNIVERSITY OF HAWAII
Hawaii Institute of Marine Biology
Coconut Island · P. O. Box 1346 · Kaneohe, Hawaii 96744

September 11, 1980

Mr. J. R. Haas
National Band & Tag Company
721 York Street
Newport, KY 41072

Dear Mr. Haas:

The tag inscription information supplied on the attached form should once again appear on the Inconel tags which you are currently producing. This should read:

WRITE HIMB
UNIVERSITY
HAWAII 96744

The numbers should be consecutive starting with 5051. I realize that this duplicates numbers that appeared on small Monel tags (sizes 1 and 3) made for me during May 1977. However, these small tags have only been used on captive turtles, thereby virtually eliminating the possibility for confusion.

I hope that this order is continuing to progress without difficulty. To avoid possible conflicts with other turtle researchers eager for Inconel tags, I would like to request that you do not mention this special order to others.

I look forward to hearing from you with respect to a possible delivery date.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:md

Enclosure

Manufacturers of IDENTIFICATION TAGS for

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University of Hawaii at Manoa
Hawaii Institute of Marine Biology
PO Box 1346 Coconut Island
Kaneohe, HI 96744
Attn: George H. Balazs, Asst. Mar. Biol.
& Deputy Chairman, IUCN/SSC Mar.Turtle Grp.

July 17, 1980

"OUR 78th YEAR"

Dear Dr. Balazs:

Confirming our telephone conversation on 7/15, I was successful this morning in reaching the source for the Inconel 625 and the order has been placed. We expect delivery of the material in about 12 weeks. We are looking for a quantity of material to be delivered that will produce from 5000 to 6000 tags. The tags will be the size 681, the same as furnished on on your order of March 1976. Tag cost will be in the area of from $500.00 to $600.00 per 1000 plus a $175.00 die make-ready charge. At this time, I can't determine the exact tag cost as it depends upon the quantity of material that we eventually receive. Whatever quantity of material is received, we expect to run out in your tags so we will need from you number series and lettering that you want to appear on the tags. We will need about 4 to 5 weeks for tag production after the material is received.

I am glad that this small quantity of material is finally being made available to us and hopefully all will work out satisfactorily. I will advise you of developments as they occur.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH:lc/2

University of Hawaii at Manoa
Hawaii Institute of Marine Biology
PO Box 1346 Coconut Island
Kaneohe, HI 96744
Attn: George H. Balazs, Asst. Mar. Biol.
& Deputy Chairman, IUCN/SSC Mar.Turtle Grp.

July 17, 1980

"OUR 78th YEAR"

Dear Dr. Balazs:

Concerning our telephone conversation on 7/15, I was successful this morning in reaching the source for the Inconel 625 and the order has been placed. We expect delivery of the material in about 12 weeks. We are looking for a quantity of material to be delivered that will produce from 5000 to 6000 tags. The tags will be the size 681, the same as furnished on on your order of March 1976. Tag cost will be in the area of from $500.00 to $600.00 per 1000 plus a $175.00 die make-ready charge. At this time, I can't determine the exact tag cost as it depends upon the quantity of material that we eventually receive. Whatever quantity of material is received, we expect to run out in your tags so we will need from you number series and lettering that you want to appear on the tags. We will need about 4 to 5 weeks for tag production after the material is received.

I am glad that this small qaantity of material is finally being made available to us and that all will work out satisfactorily. I will advise you of developments as they occur.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Hans

JRH:lc/2

1-30-80
This is a copy of the letter sent to you on 1-17-80.
TVH

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

28 March 1980

Dear Mr. Haas:

Concerning your letter of March 25th, please be advised that, in my opinion, we have not reached a degree of economic unfeasiblity for the production of Inconel 625 tags. It is simply not logical for us to continue to tag turtles with Monel and watch the tags corrode. Your estimated $600 to $800 per 1000 is still a realistic price when compared to all the other expenses that we have in this type of work. I therefore urge you to proceed with an order at your earliest opportunity. We must, however, be very certain that the Inconel 625 that you order is of the same quality as the material used in my previous shipment. Will the supplier be Hunington Alloys?

I feel certain that Larry Ogren will support my position in this matter. Let us move ahead with all due speed.

Best regards,

George Balazs

cc Larry Ogren

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University of Hawaii at Manoa
Hawaii Inst. of Marine Biology
P.O. Box 1346 Coconut Island
Kaneohe, Hawaii 96744

March 25, 1980

"OUR 77th YEAR"

Attn: George H. Balazs, Deputy Chairman
IUCN/SSC Marine Turtle Group

Dear Dr. Balazs:

Earlier today I sent you a copy of (enclosed) correspondence I had with C. J. Limpus in Townsville, Australia explaining the availability of the Inconel 625. A copy of the correspondence was also sent to Larry Ogren. In recent months, I have contacted five nickel alloy companies recommended by International Nickel in Huntington, West Virginia. All turned me down on the availability of the Inconel 625 except one. The one company informed me yesterday that if I would place an order within 30 days, they would propose to make delivery in ten months -- they would not guarantee delivery schedule and the price at time of shipment would prevail. These are very difficult conditions under which to work and plan.

In January I estimated to you the cost of the Inconel 625 tags would be at least double the cost of the monel tags or $200.00 to $400.00 per 1000. Based on current information, the cost of the Inconel tags would jump from $600.00 to $800.00 per 1000. The material has increased three times over what it was in January!

The supplier of the material is sending me a confirmation of his proposal in writing. But I believe we have reached a degree of economic unfeasibility, what do you think?

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH:lc/2

AUSTRALIA
QUEENSLAND TURTLE RESEARCH
NATIONAL PARKS AND WILDLIFE SERVICE
PALLARENDA
TOWNSVILLE 4810, AUSTRALIA
ATTN: C. J. LIMPUS

March 25, 1980

"Our 78th Year"

AIR MAIL

Dear Mr. Limpus:

Supplementing our letter to you dated March 24, 1980, just today we received telephone information from a nickel alloy company advising that they could supply Inconel 625 material to us in 10 months if we would place our order within the next 30 days.

The availability of the Inconel 625 has been "on again/off again" for the past 8 months.

We are attempting a purchase of the Inconel 625 in cooperation with Larry Ogren of Panama City, Florida and Dr. George Balazs of Kaneohe, Hawaii and we are relaying this current material availability information to them with a copy of this letter.

Sincerely,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH/sls
4

cc: Larry Ogren
cc: Dr. George Balazs

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April 3, 1980

"OUR 78th YEAR"

University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P.O. Box 1346 Coconut Island
Kaneohe, HI 96744

Attn: George H. Balazs, Deputy Chairman
IUCN/SSC Marine Turtle Group

Dear Dr. Balazs:

I am in receipt of your March 27th letter to my brother, Jim, and in his absence, I am answering. As I am sure you are aware, we are working with Mr. Larry Ogren as he attempts to obtain a Federal grant which we need for machine modifications to produce the Inconel turtle tags. After this grant has been received and it goes out on bids and if we are, in fact, the low bidder, the machinery needed to make such a tag can be assembled. I am sure you are aware of the material availability situation and at this writing, it looks like we do have a positive source for the Inconel 625 but, once again, all this hinges on when our order is placed which in turn hinges on the results of the Federal grant.

I realize you are as concerned about this project as we are and as soon as we have some positive indications, we will let you know.

Yours truly,

NATIONAL BAND AND TAG COMPANY

Tom V. Haas

Tom V. Haas, Manager

TVH:lc/2

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

SE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

April 7, 1980

Mr. J. R. Haas
National Band and Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

Dr. George Balazs has recently informed me of the difficulty with acquiring Inconel 625 tags. Please let me reiterate Dr. Balazs' statements of need for Inconel 625 tags for sea turtle research. Monel is much more susceptible to corrosion than is Inconel and can no longer be considered as a substitute for Inconel. Even though the unavailability and exorbitant prices of Inconel are puzzling, considering its widespread use as electrical heating elements, the estimated prices of $600 to $800 per 1,000 do not preclude purchase of Inconel 625 tags by sea turtle investigators.

Therefore I hope you will proceed with production of Inconel 625 tags at available market prices while seeking less expensive sources of Inconel alloys that would be equally suitable.

Sincerely yours,

Jack B. Woody
Endangered Species Coordinator

cc: C. H. Balazs, Kaneohe, Hawaii
L. Ogren, Panama City, Florida 32407

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RABIES CONTROL AND ANIMAL LICENSING • ELECTRICAL AND INDUSTRIAL USES

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Larry H. Ogren
SEFC, Panama City Laboratory
3500 Delwood Beach Road
Panama City, FL 32407

January 24, 1980

"OUR 78th YEAR"

Mr. Ogren:

Following up my letter to you of 1/10/80, received correspondence from Dr. Balazs dated 1/15 and 1/17/80 in which he mentions being against the placement of a second hole in the tag to accommodate the point of the curl. If the majority of the using agencies are in concurrence, then I would suggest elimination of the hole as we agree with Dr. Balazs that the second hole could weaken the tag structure and could enhance susceptibility to corrosion. However, we did canvass several agencies a few years back with regards to the second hole and although the responses we received were few, some expressed a desire for a second hole to eliminate the possibility of the tag becoming entangled particularly on nets but in concensus of the majority, if the snagging possibilities are remote, then by all means, bid specifications should not include the second hole.

However, if you find that some agencies want the second hole and others do not, we can modify the die equipment to accommodate both at no additional expense, as long as we plan for this at the beginning. Once the dies are constructed, it would be difficult to alter.

Dr. Balazs mentions the standard width of 11/32" would probably be acceptable, please keep in mind this width will apply to both size 681 and 49 tag. Dr. Balazs did not mention anything concerning thickness, our suggestion was thickness in the area of .036" to .038". Once the thickness is decided upon, it will be used for both tag sizes.

Dr. Balazs indicated he sent you a copy of his letter dated January 15th.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

CC: Dr. Balazs
JRH:lc/3

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

SE

December 17, 1979

Mr. Tom V. Haas, Manager
National Band & Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

Dr. Balazs, University of Hawaii, recently showed me a letter from you which indicated your company was prepared to furnish Inconel tags for sea turtles at a price much more attractive than an earlier quotation we had received. We wrote your company some months ago on this same question and at that time it was indicated that the minimum order would be $50,000 and it would take up to two years to get geared up to produce them. With these two somewhat different responses, I am confused. Can you shed some additional light on the subject?

If the price is right, we are interested in ordering five to ten thousand Inconel tags, probably in the 49 size with the 681 locking mechanism if possible. Most, if not all these tags, would be provided to Mexico's Instituto de la Pesca to assist them in their ongoing sea turtle studies.

I am confident that if you could furnish Inconel tags at a realistic cost, you would see a world wide shift to this material. Although some of the early monel tags appear to hold up much better than those purchased in recent years, the need for a much more resistant tag is necessary. It is often the weakest link in many of the important research projects going on around the world.

I would greatly appreciate it if you would provide me with a fairly firm price estimate per 1,000 5,000 and 10,000 lots of Inconel 49 or 681 size,

with the 681 locking mechanism. Some idea of the time frame between ordering and delivery would also be helpful.

Thank you for your assistance.

Sincerely yours,

for Jack B. Woody
Endangered Species Coordinator

cc: Rene Marquez
ASDM
OES
G. Balazs

South Carolina
Wildlife & Marine
Resources Department

James A. Timmerman, Jr., Ph.D.
Executive Director
Victor G. Burrell, Jr., Ph.D.
Director of
Marine Resources Research Institute

January 10, 1980

Dr. George Balazs
P.O. Box 1346
Coconut Island
Kaneohe, Hawaii 96744

Dear George,

Hope you had an enjoyable holiday season. I heard on the radio this morning that the islands were having some bad weather.

In regards to the carapace tag, the fender washers, screw and lock nut are all made of 18/8 stainless steel. It is my understanding that this means the metal contains 18% chromium and 8% nickel. The screws and lock nuts are a shelf item, but the washer had to be made on special order. This is all the information I could get from the hardware dealer who has been working with me. I hope this is sufficient for what you need.

Hope all is going well with you, keep in touch.

Best regards,

Sally

Sally Hopkins, Biologist
Nongame and Endangered Species

SH/pk

P. O. Box 12559 □ Charleston, South Carolina 29412 □ Telephone: 803—795-6350

3 AUGUST 1979

DRAWN BY

DICK BROCK

TAGS USED ON A GREEN TWIG BY HIS FATHER

VERNON BROCK

1950s LAYSAD

IS.

A-113

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

December 11, 1975

Dear Nicholas:

For Canadians, happiness must certainly be an end to the mail strike! I received your letter of October 24 some weeks ago, however, as you are aware, it has not been possible to respond. At one point, I heard of an associate traveling to Toronto, but unfortunately I was unable to make contact in time.

Looking back over the past few months, it appears as if very little has happened in the area of sea turtle conservation. In all honesty, I sometimes wonder just how many people have a sincere interest in working for the preservation of these animals. Indeed, besides yourself and Dr. King, few of the contacts I have made seem to have much enthusiasm. Dr. King has informed me briefly of what took place at the London meeting on Mariculture, Ltd. Apparently the receiver has disassociated itself from Fisher and Naylor. The IUCN has granted some sort of a one year "grace" period, against the wishes of Drs. King and Carr. On the U.S. front, the National Marine Fisheries Service (Department of Commerce) has been effectively delaying action on the Federal proposal to list green, loggerhead, and Pacific ridley turtles as "threatened" species. Nearly total protection would result in the U.S. if this proposal ever gets passed (no importation, exportation, etc.). The next action in this case will occur on February 25 when a public hearing will be held in Washington, D.C. The National Canners Association requested the hearing, and the Department of Commerce capitulated. You may already be aware that this issue has been going on for nearly 24 months.

I am returning your copy of Frazier's paper. Thank you very much for the loan. This is certainly an interesting report, but I have many questions which hopefully we can discuss in person at a later date. I am particularly concerned about what basis was used for statement #2 in the Postscript under Green Turtle. I am also sending copies of all pertinent correspondence dealing with tag corrosion and Inconel alloy. I will be ordering 1000 Inconel tags in the next few weeks. At the high going price, I certainly hope they work better than Monel. In case you are not aware, Inconel consists ofapproximately 20% chromium, 8% molybdenum, 5% iron, 65% nickel, and small amounts of other elements (silicon, manganese, titanium, etc.). Monel is principally 2/3 nickel and 1/3 copper.

Last month I tried a very different sort of identification on my captive greens. I took two of the smallest (2kg) down to a tattoo shop here in Honolulu. The artist needed some convincing before doing the job (he's affraid of reptiles).

Thus far the ink has remained in place. An illustrative slide has been enclosed (return not necessary). I believe that tattooing offers some interesting possibilities for sea turtle marking. Our local shop can arrange to purchase the needle apparatus for me at a cost of approximately $150.00. If I ever get funded from the State of Hawaii I intend to explore this technique further. The needle runs on 6 volts and therefore could be operated easily in the field.

Concerning your proposal for two weeks of cooperative work at French Frigate Shoals, first let me state that I fully support the idea, and look upon such activity as being mutually beneficial (althought perhaps somewhat to my advantage). I believe that during your Hawaii stay I even went so far as to make a distinct invitation, provided all the "bugs" could be worked out. The largest obstacle as I now see it is the available space on the airplane. Simply stated, I am at the mercy of the Coast Guard for transportation. The U.S. Fish and Wildlife Service is the governing agency of the Refuge, but in order to get there you need the Coast Guard. This agency is quasi-military and as tied up in bureaucracy as they come. Presently, the plane goes every Thursday. I am notified on Wednesday morning if space is available for a particular flight. Frequently it is not. I know that this sounds very discouraging, but it is a situation I have had to live with. However, I do not believe that two weeks of cooperative summer workare impossible. There is now talk of a different plane being put into service starting April, 1976. This change would increase the weight capabilities by three fold and would solve a lot of problems. The other possiblity is the 180' Coast Guard vessel that takes bulk goods up there once every 4 months or so. I can always get space, however exact schedulings are made about a month in advance. If the present frequency holds, such a vessel should be going sometime in June. From what I have described, it can be seen that if your time allotement of the 2nd half of June is fairly rigid, our chances for pulling this off are decreased. In any event, I expect to have more information (on new plane, etc.) by March 1 at the latest. Can you wait that long before making plans? Would such a wait eliminate other potential field projects which you may be considering? Please be assured that I will do everthing possible to get the necessary transportation. I just hope that I can meet with success. Incidentally, transportation coming <u>back</u> from French Frigate Shoals is almost never a problem.

Another obstactle of lesser importance than transportation is one of citizenship. The islet (Tern) at French Frigate Shoals where the Coast Guard has their LORAN station is considered to be a military installation. Therefore certain papers have to be filled out for non-U.S. citizens. I guess its to make sure that one is not an "agent". This bureaucratic red-tape can be done about one month in advance and at that time I will ask you for the necessary personal data.

Let me now make some comments on the experiment itself. One of the problems that will confront us during the 2nd half of June is birds. Last June the sooty tern population alone on East Island numbered 20,000-30,000. Other nesting birds include albatrosses, shearwaters and boobies. How high would it be necessary to have the cloth? I think we will run into a collision problem with anything over 3 feet. We may still have a problem even with 3 feet. Albatrosses in particular often make a low gliding approach and, with a 6 foot wing span, quick turns are difficult. From a bird standpoint, the 2nd half of July would be much preferred. Many of the season's chicks have departed, and we can still expect 5 or so turtles a night. Another thought is that the nest preference study might be conducted in June on the islet of Trig. This site has (or had last season) far fewer birds than East.

The vegetation is also less than that of East. You may recall that I described to you the elevated west end of this island and how nesting turtles seemed to prefer the high ground (built-in bioaltimeter?). Last season Trig hosted 3-4 turtles a night during June. If we set up the experiment on Trig I would have to leave you alone some of the nights so that I could monitor East Island. We would always be in radio contact with one another and with the Coast Guard base, thanks to the radios Dr. King helped me to buy. Another thought-I believe more data sets could be collected than was indicated in your letter. Nest preference doesn't necessarily have to result in successful egg deposition (or does it?). Couldn't the false digs also be counted? When I talk about numbers of turtles per night, generally I mean successfully nesting turtles per night. Up to 50% more may actually be on the island during the night thatdo not experience success. That should just about cover all the points dealing with the proposed project. I am sure you will let me know how it all sounds.

I have a list in frontof me of various notes I wanted to mention to you. In order to shorten this letter, I hope you won't mind if I just list them off.

1. I was pleased to learn that my migration paper is set for publication in BIOLOGICAL CONSERVATION during early 1976.
2. Your letter to our Director was well accepted. I appreciate your action.
3. During the end of November I spent a week at French Frigate Shoals. During that time I caught 6 juveniles, 2 of which I had tagged 6 and 10 months ago. Very little, if any, growth was detectable. I now have an English copy of Schmidt's paper. His data were sparce, and I now should have at least twice as many recoveries as he had. The case is building for <u>very</u> slow growth under Hawaiian conditions. As you suggested, I still intend to wait for more recoveries before trying to work it into a paper.
4. During your visit I gave you a copy of a teletype report on a leatherback taken near Ponape. For some reason I now can't find the original, so could you send me a copy of your copy.
5. Your letter of September 4 to Dr. Carr really spelled out the problems nicely. Have you received a reply and, if so, what were the answers.
6. A small side project I would like to run next summer at French Frigate Shoals involves sound of various intensities and the response obtained from basking turtles. I have thought about making tapes containing different frequencies and playing them back on the beach. Both Hendrickson and Ridgeway suggested the possible role of sound in the animal's life cycle, but essentially nothing is known about what can be detected. Do you have any ideas along these lines? A basking site would seem to offer excellent possibilities for this kind of work.

Well that's about it for this time Nicholas. Please try to keep your mail system working properly- we have a lot of yanks living up there that need the mail to get their social security government checks!

Best wishes and Aloha,

GEORGE H. BALAZS

PS Linda also sends her best regards.

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The University of Arizona
College of Liberal Arts
Department of Biological Sciences
Tucson, Arizona 85721
Attn: Mr. Dave Owens

September 16, 1975

"OUR 73rd YEAR"

Dear Mr. Owens:

Thank you for your letter of September 4 with sample tag enclosures. The sample tags we recognize as our style 1005, size 49 Monel metal tags and you are correct in your assumption that this is the style, size and type of metal tag extensively used for marking sea turtles in research operations.

Was the water in your tank fresh or salt water? We have had previous reports of material deterioration similar to what is shown on your sample tags, but never before so severe over such a short period of time in a controlled closed tank experiment! Previous reports of this kind have come from biologist engaging in tagging sea turtles under actual field research conditions. The earliest that we have ever had reports of tag deterioration was after 12 to 18 months usage.

We understand sea turtles can live in fresh water for a short period of time but to keep them in sea water, they must have a constantly changing source of new sea water because they foul the water so quickly. Some pollutants have been determined to hasten deterioration. Deterioration is slowed down when you have a constant water flow condition. We would presume you conducted your experiment in Arizona and we understand there is quite a bit of alkali in the water and this too could hasten deterioration.

The main causes of deterioration have not been definitely determined, but the problem has been researched by metallurgists. I have had considerable correspondence on this exact subject with Mr. George Balaze, Jr., at the University of Hawaii at Manoa, Hawaii Institute of Marine Biology, P. O. Box 1346, Coconut Island, Kaneohe, Hawaii 96744, and thru the combined efforts of Mr. Balaze and other research agencies, it is hoped sufficient interest can be generated in a new material know as INCONEL 625, which is guarenteed deterioration proof by the metal companies. I am confident that Mr. Balaze will be

CONTINUED ON PAGE 2

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interested in your experiment and will gladly provide you with the data that has been gathered up till now on the monel tag deterioration vs. inconel 625. I am forwarding a copy of this letter to Mr. Balaze for his reference.

Could you let me know if conditions under which you conducted your research were conducive to electrolysis purposely or not. Electrolysis would not cause the deterioration unless the tags had come into contact with steel or some other metal.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH/pef/3

CC: Mr. George Balaze, Jr.

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BIOL. RENE MARQUEZ M.
APDO. POSTAL 79-052
COL. DOCTORES
MEXICO 7, D.F., MEXICO

APRIL 23, 1975

"OUR 73RD YEAR"

AIR MAIL

COPY

DEAR SIR:

RECEIPT IS ACKNOWLEDGED WITH THANKS OF YOUR LETTER DATED MARCH 25TH EXPRESSING YOUR INTEREST IN 10,000 STYLE 4-1005 SIZE 49 MONEL METAL EAR TAGS AND FIVE STYLE 4-1005-49S POW-R-CEPS TAGGING PLIERS.

FOR US TO PROCESS YOUR ORDER FOR THESE TAGS AND PLIERS IN THE FASHION THAT YOU DESCRIBE IN YOUR LETTER WOULD NECESSITATE OUR BREAKING OR DIVIDING YOUR ORDER INTO FOUR PARTS, EACH PART WOULD BE ENTERED WITH OUR FACTORY AS A SEPARATE ORDER. THREE ORDERS WOULD CONSIST OF 2500 TAGS AND ONE PLIER WITH A COST OF U.S. $386.31 EACH. THE FOURTH ORDER WOULD CONSIST OF 2500 TAGS AND TWO PLIERS WITH A COST OF U.S. $399.85. TOTAL AMOUNT IN U.S. DOLLARS WOULD BE $1,558.78. DIVIDING YOUR ORDER INTO FOUR PARTS SUCH AS THIS WOULD RESULT IN EACH ORDER HAVING A VALUE OF LESS THAN 5,000 MEXICAN DOLLARS (PESOS) AS YOU REQUEST.

THESE PRICES INCLUDE TAGS, APPLICATORS, SET-UP CHARGES, EXPORT SERVICE CHARGE, SURFACE PARCEL POSTAGE AND COMMERCIAL ALL-RISK INSURANCE COVERAGE FOR EACH SHIPMENT. THE LETTERING AND NUMBERING OF THE TAGS AS YOU SPECIFY ALSO INCLUDED.

WE ARE PRESENTLY PREPARED TO PROCEED WITH THE MANUFACTURE OF THESE TAGS UPON RECEIPT OF YOUR REMITTANCE BY DRAFT DRAWN ON ANY UNITED STATES BANK OR WE WILL SHIP WITH PAYMENT TO BE MADE BY LETTER OF CREDIT UPON PRESENTATION OF DOCUMENTS. IF YOU CHOOSE TO MAKE PAYMENT BY LETTER OF CREDIT, PLEASE ALLOW FROM 90 TO 120 DAYS FOR EXPIRATION. WE COULD SHIP THESE TAGS TO YOU WITHIN FOUR TO SIX WEEKS FOLLOWING RECEIPT OF EITHER PAYMENT OR NOTIFICATION OF ESTABLISHMENT OF IRREVOCABLE LETTER OF CREDIT.

PRESENTLY, WE ARE IN THE PROCESS OF NEGOTIATING FOR THE PRODUCTION OF THE TAGS FROM A MORE SUBSTANTIAL CORROSIVE-PROOF NEW MATERIAL KNOWN AS INCONEL. THE MONEL TAGS, WHILE HAVING BEEN USED FOR THE IDENTIFICATION OF MARINE ANIMALS INCLUDING SEA TURTLES, HAVE PROVEN TO BE GENERALLY SATISFACTORY, BUT A DEGREE OF LOST TAGS HAS BEEN EXPERIENCED WHICH HAS HAMPERED THE ACCURACY OF THE RESEARCH RESULTS. MONEL IS NOT ABSOLUTELY CORROSIVE-PROOF AND, AS A RESULT, IN CERTAIN INSTANCES DETERIORATION OCCURS WHICH ALLOWS THE TAGS TO FALL OFF THE ANIMALS ANYWHERE FROM SIX MONTHS TO THREE YEARS AFTER APPLICATION.

TWO OTHER AGENCIES WITH WHICH WE ARE PRESENTLY NEGOTIATING FOR ORDERS OF INCONEL TAGS ARE:

NATAL PARKS, GAME & FISH PRESERVATION BOARD
P.O. BOX/POSBUS 662
PIETERMARITZBURG 3200, REPUBLIC OF SOUTH AFRICA
ATTN: G. H. HUGHES, SR., PROFESSIONAL OFFICE FOR DIRECTOR

UNIVERSITY OF HAWAII AT MANOA
HAWAIIAN INSTITUTE OF MARINE BIOLOGY
P.O. BOX 1346, COCONUT ISLAND
KANEOHE, HAWAII 96744
ATTN: GEORGE H. BALAZS, JR., MARINE BIOLOGIST

THE THOUGHT BEING THAT IF THESE TWO AGENCIES AND POSSIBLY YOURSELF INCLUDED COULD COMBINE THEIR REQUIREMENTS FOR INCONEL TAGS, THIS WOULD ALLOW US TO MEET THE MINIMUM POUNDAGE REQUIREMENT FOR PURCHASING THE INCONEL MATERIAL FROM THE MILL SUPPLIER. PERHAPS, IF YOU WOULD CARE TO CONTACT THE ABOVE MR. HUGHES AND MR. BALAZS, SOME ARRANGEMENT OR AGREEMENT COULD BE MADE BETWEEN YOUR THREE AGENCIES FOR A COMBINATION ORDER WHICH WOULD PERMIT PRODUCTION OF THESE TAGS FROM INCONEL MATERIAL. THE DISADVANTAGES IN USING THE INCONEL WOULD BE:

(1) PRICE - THE INCONEL TAGS WOULD COST APPROXIMATELY $281.20 PER 1000.

(2) DELIVERY -- ABOUT 8 WEEKS WOULD BE REQUIRED FOR PROCUREMENT OF THE INCONEL AND WE WOULD HAVE TO HAVE ABOUT 4 WEEKS FOR PRODUCTION.

IF YOUR TAGGING PROGRAM WOULD ALLOW FOR THE PROCUREMENT OF THE INCONEL TAGS BOTH EXPENSE-WISE AND DELIVERY-WISE, WE WOULD RECOMMEND YOUR USE OF THE INCONEL TAGS RATHER THAN MONEL TAGS AS WE ARE ASSURED BY THE INCONEL METAL MANUFACTURERS THAT THE INCONEL TAGS WOULD IN NO WAY DETERIORATE AND, THEREFORE, THIS SHOULD BE OF GREAT BENEFIT FOR YOUR RESEARCH WORK.

THANK YOU FOR WRITING US AND WE AWAIT YOUR FURTHER WORD BEFORE WE PROCEED.

YOURS TRULY,

NATIONAL BAND AND TAG COMPANY

J. R. HAAS

JRH:LC/3

CC: G.H. HUGHES, NATAL PKS., GAME & FISH PRES. BD.
CC: GEORGE BALAZS, UNIV. OF HAWAII AT MANOA.

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University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P.O. Box 1346 - Coconut Island
Kaneohe, Hawaii 96744
Attn: Mr. George H. Balazs

February 14, 1975

"OUR 73rd YEAR"

Dear Mr. Balazs:

Thank you for your letter of January 28th.

The conditions you relate in your letter have been reported to us previously, that while use of monel tags is generally satisfactory there are reported instances of sever tag deterioation. This problem has been researched by the material supplier with results being highly technical and somewhat inconclusive. Basically, the report indicates that our working of the metal sometimes causes crevices or cracks which would be subject to deterioation by chemical reactions caused by conditions of salt water, air (or the lack of air), and flesh tissue. An unworked piece of monel can be submerged indefinitely without evidence of corrosion. It is our working of the material that causes conditions which could possibly cause it to corrode. Apparently, this is "the nature of the beast" or characteristics that are unavoidable, as the forming, drawing, indenting, etc. are necessary operations for the utilization of the tag.

We have inquired about the availability of a more corrosion resistance material, none of the stainless steels would qualify. A newer material known as Inconel could possibly give better results, but this material is not available in small quantities.

CONTINUED ON PAGE 2

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University of Hawaii at Manoa

Kaneohe, Hawaii 96744

February 14, 1975

Another alternative is production of our monel tag in a heavier thickness. This we have done previously, producing the tags from .040" monel, the heavier tag reduced the number of corrosion reports, simply because there was more material to begin with. The .040" monel can still be had by special order from the nickel mills. However, two and a half months would be required for shipment of the material and we would need an order for at least 15,000 tags to qualify for the mill's minimum. Enclosed are a few samples of the .040" monel tag for your examination.

Thank you for your letter, and we are sorry we can not give a more favorable answer.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas, Manager

JRH/pef/2
Enc.

August 22, 1975

Dr. George Hughes
Natal Parks, Game and Fish Preservation Board
P. O. Box/Posbus 662
Pietermaritzburg 3200
South Africa

Dear George:

I am sorry for the delay in answering your letter of June 10 concerning an Inconel tag order. I have circulated the information on this new metal to a number of loggerhead workers on the east coast of the United States with hopes of finding interest. The only correspondence received in this matter has been from Dr. Trillmich (copy enclosed) who was referred by Mr. Haas of National Band and Tag. Unfortunately, I am financially unable to order 2,5 00 tags as you suggested, however 1,250 could be covered. If Dr. Trillmich can also order 1,250, we seem to have the problem solved. I hope National Band and Tag can meet his time limitations of January, 1976.

I am convinced that in Hawaiian Chelonia loss from corrosion in Monel tags is significant, particularly with the more recently produced tags. Nicholas visited with me for a week on his return from Borneo and he indicated that workers at Trengganu were using the plastic Rototag. I seem to recall that you had problems with plastic tags and I wonder if you can provide further detail when time permits. I certainly hope that Inconel will prove to be a suitable material. If we can get the tags, I intend to double tag all turtles using both Monel and Inconel.

Sincerely,

George H. Balazs
Jr. Marine Biologist

mk

cc: Dr. Fritz Trillmich
Mr. J. R. Haas

October 15, 1975

Fearing Manufacturing Company, Inc.
490 East Villaume Avenue
South St. Paul, Minn. 55075

Dear Sir:

Agri-industries of St. Paul has suggested that I contact you concerning my interest in the possible use of Fearing plastic tags for sea turtles. Agri-industries has already sent me a sample of your line, which included Tuff-Flex, Tuff-Tex and King Tuff-Tex. I believe that the size and shape of the Tuff-Tex would be best suited for my purposes. I am, however, concerned about the weather-resistant properties of the plastic used. Do you have any reports on its use in saltwater and the effects of sunlight under tropical conditions? Also, I would like to know if you manufacture tags of the Tuff-Flex material in a size and shape of the Tuff-Tex?

Thank you in advance for any assistance that you can provide in this matter.

Sincerely,

GEORGE H. BALAZS
Jr. Marine Biologist

GHB:ec

May 30, 1975

Mr. J. R. Haas, Manager
National Band and Tag Co.
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

Concerning our earlier correspondence dealing with Inconel tags for sea turtle research, I am sorry to report that difficulties are being encountered in assembling a composite order for 5,000. It is my understanding that Dr. Hughes in South Africa will purchase 2,000 and, considering my own 1,000 requirement, we must still find an investigator that can absorb the remaining 2,000. Perhaps, Mr. Rene Marquez in Mexico has expressed an interest to you in this new product.

Incidentally, contrary to our own observations, Dr. Carr's Costa Rican turtle project has apparently not observed Monel tag corrosion.

Sincerely,

GEORGE H. BALAZS
Jr. Marine Biologist

GHB:ec

UNIVERSITY OF HAWAII
Hawaii Institute of Marine Biology
Coconut Island • P. O. Box 1346 • Kaneohe, Hawaii 96744

March 18, 1975

Mr. J. R. Haas, Manager
National Band and Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

Please pardon my delay in answering your most interesting letter of February 14th and note of March 12th concerning deterioration in monel tags used on sea turtles. I was pleased to learn of your awareness for the problem I related, as well as your prior laboratory investigations of possible causes. The important question at this point seems to be one of incidence. Unfortunately, we have no real way of finding out how many tag losses actually occur in the wild. Of course, one can examine for scar tissue or old puncture marks at the tagging site, however, based on my experiences to date, such observations would amount to little more than guess-work. As suggested, the .040" monel would surely last longer due to greater thickness, but presently I do not feel this to be a satisfactory alternative. No reliable information exists on the reproductive life of a green turtle, although 25 to 30 years may not be an unreasonable estimate provided that human predation does not occur on the nesting beach. Considering the amount of labor involved with intensive tagging studies, one would like to have a very high percentage of tags remain intact for that length of time. Several tags which I inspected from wild turtles showed obvious signs of corrosion after only 12 to 18 months, therefore even a doubling of the thickness probably would not remedy the problem in these cases. Additionally, the 15,000 minimum order is prohibitive unless I were to file a joint order with another worker. The long term solution is clearly a more durable material, possibly one such as the Inconel you mentioned. Perhaps smaller quantities could be obtained by emphasizing the research, hence advertising, aspects of the matter. If such an approach has merit, I would be more than happy to write company officials and explain the potential value. Another possibility which you may consider is coating the monel tags with Teflon.

In the meantime, we will have to work with our available tags. I have devoted some thought to the problem and have arrived at several ideas. As you stated, we know that "working" the metal aggravates the problem as does

contact with body tissue. It would therefore seem logical to not combine these two factors, that is, not place the extensively worked end of the tag in contact with body tissue. In a group of 25 lb. turtles being held at our facility, I am testing this idea by tagging in the normal manner and then passing the tag through the piercing site so that the curved bend is located where the locking end normally would be. There can be little doubt that the locking end is more heavily worked, therefore hopefully this manipulation will lessen corrosion. Another contributing factor to corrosion at the locking end, when it is in contact with flesh, is the rough and more abrasive surfaces of the point and associated mechanism. This has an irritating effect that retards healing. As corrosion occurs, the surface may become even more abrasive, causing the continued presence of body fluids. By placing the curved end in contact with flesh, perhaps we can promote healing and create more of a "pierced ear-ring" effect.

During the course of my work with captive sea turtles over the past three years, I have purchased from your company Style 4-1005, sizes 3, 4, 681 and 49. As you know, the method of locking in these tags differs, with size 4 and 49 containing a punched-out bridge under which the point passes after piercing. Sizes 3 and 681 do not have such a bridge but rather the point goes through the slot and bends on the outside. It would seem to me that this latter method is far superior for turtles in that the highly vulnerable, heavily worked bridge is not depended upon. Possibly size 681, or 62 provided it locks in a similar manner, should be tested on full size adult turtles in the wild by using both types on the same animal, a comparison I intend to carry out during the coming nesting season. I can see no reason why size 681 (or 62?) cannot be used on large turtles as tag length would be sufficient.

You may be interested in two tags which I have enclosed (return is not necessary). Size 49 was on a green turtle for less than two months. The animal was contained in a cement tank at Sea Life Park (a large oceanarium here in Hawaii) and out of 20 such tagged turtles, 15 tags had a similar appearance. Possibly atypical environmental conditions (such as electrical current) exist in this tank, but we have thus been unable to identify the problem. The second tag (size 4) was on one of my 25 lb. captive turtles for approximately four months. I believe the same degree of corrosion would also have occurred had this animal been in the wild as the holding area consisted of a one acre tidal pond where no external factors should be involved. Of course, another unknown is the influence of diet.

I would be interested in any comments you may have on the thoughts that have been presented. Also, I would be most appreciative if samples of

the following tags could be sent: Style 4-1005, size 62; Style 4-1242 M, size 16; and Style 4-1242 S, size 28. Again, many thanks for your personal interest in this problem.

Sincerely,

GEORGE H. BALAZS
Jr. Marine Biologist

GHB:ec

Enclosures

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I. BENES
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August 26, 1976

University of Hawaii at Manoa
P.O. Box 1346
Coconut Island, Kaneohe, Hawaii
96744

Attention: George H. Balazs

Gentlemen:

Having overlooked your request for information regarding marking and branding equipment, we are pleased to enclose literature showing the various equipments available.

You will note that these branders are heated by electric, gasoline and bottled gas and can be furnished with either brands having permanent lettering or a slotted holder for interchangeable letters so that the various set-ups can be made for the type of marking intended. We hope that with the delay involved that it has not inconvenienced you greatly and if you feel that this type of equipment will service you properly, we will be glad to hear from you at your convenience.

Yours very truly,

EVERHOT MANUFACTURING CO.

I. Benes
Sales Manager

IB:klc
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UNIVERSITY OF HAWAII AT MANOA
Hawaii Institute of Marine Biology
P.O. Box 1346, Coconut Island
Kaneohe, Hawaii 96744

August 29, 1975

"OUR 73rd YEAR"

Attn: George H. Balazs, Jr. Marine Biologist

Dear Mr. Balazs:

Thanks for your letter copy dated 8/22/75 to Dr. George Hughes in Pietermaritzburg. We have not heard any further word from Dr. Trillmich as of today. We recently completed an order for a few thousand monel tags for Dr. McFarland in Ecuador, and I believe I mentioned previously about the 10,000 monel order we completed for Mr. Marquez in Mexico.

We now have an order for 1,000 monel tags from Mr. Bob Delong, National Marine Fisheries Service, Marine Mammal Division, Building 192, Naval Support Activity, Seattle, Washington 98115, with whom I have spoken over the telephone 2 or 3 times in recent weeks providing him with the details on the inconel tags. Mr. Delong advises that corrosion is a minor problem in his operations but would possibly be interested in the inconel tags for future use, but for their immediate needs will utilize the monel tags.

While having this correspondence at hand, I am sorry that I have not responded earlier to your letter of July 8 containing a copy of a letter to Mr. Talbert in Columbia, S.C., also dated July 8. I have not had any word from Mr. Talbert and I was hoping if he was instrumental in publication of the Loggerhead Newsletter, that this would be an excellent avenue for dissemination of the inconel information.

In your July 8th letter to me you mentioned a subject that has been brought to our attention previously and which I have throughly discussed with the metal suppliers. We have been presented evidence from research agencies to substantiate the contention that monel tag corrosion appears more severely and frequently in tags produced in recent years when compared to tags produced 10, 12, 15 years ago. The metallurgists from the nickle alloy companies are unable to explain this phenomenon. The monel we use

Continued on Page 2

in the production of the tags is of an identical alloy and incorporates identical properties as that used years ago. The metallurgists opinion is quite simply "it's not in the metal --- and must be a varying outside influence that is present today that was not years ago".

We do not have any idea what this "varying outside influence" might be; it seams to have everyone puzzled - we are producing the tags today the same as 15 years ago, the only difference now is with the applicator. Our Pow-R-Cep applicator we believe is being more universally used with the monel tags, whereas several years ago only the conventional single leverage applicator was available. We do not think this would make any difference.

Should you have any further information, kindly keep me posted and be assured of my reciprocation in this direction.

Yours truly,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH/jcw/2

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UNIVERSITY OF HAWAII AT MANOA
HAWAII INSTITUTE OF MARINE BIOLOGY
P.O. BOX 1346, COCONUT ISLAND
KANEOHE, HAWAII 96744

APRIL 2, 1975

"OUR 73RD YEAR"

ATTN: GEORGE H. BALAZS, JR. MARINE BIOLOGIST

DEAR MR. BALAZS:

YOUR LETTER OF MARCH 18TH HAS BEEN RECEIVING OUR ATTENTION FOR THE PAST SEVERAL DAYS. I CONCUR WITH YOUR THOUGHTS REGARDING THE USE OF THE .040" MONEL AND THE DATA THAT WE HAVE ACCUMULATED HERE CONCERNING THE DETERIORATION OF THE MONEL TAGS DOES SUPPORT YOUR CONCLUSIONS THAT THE SIZE 4 AND SIZE 49 TAGS SHOW FASTER AND MORE PRONOUNCED DETERIORATION THAN IS EXPERIENCED ON THE SIZE 3 AND SIZE 681 TAGS AND WE BELIEVE THIS IS DIRECTLY ATTRIBUTABLE TO THE INTENSE DIE WORKING OF THE MATERIAL TO ACCOMPLISH THE BRIDGE CONSTRUCTION IN THE SEALING UNIT, WHEREAS SUCH BRIDGE IS NOT PRESENT IN THE SIZE 3 OR 681 TAGS.

CURRENT COMMITMENTS WILL NOT ALLOW US TO ENTERTAIN THE POSSIBILITY OF PRODUCTION OF THE SIZE 4 TAG WITHOUT THE BRIDGE, HOWEVER, WE DO BELIEVE THAT WE CAN MODIFY SOME EXISTING EQUIPMENT WHICH WE ARE PRESENTLY NOT USING TO PRODUCE THE SIZE 49 TAG WITH THE LOCKING DEVICE SIMILAR TO THAT INCORPORATED INTO THE SIZE 681 TAG. ACTUALLY, PRODUCTION OF THESE TAGS WITHOUT THE BRIDGE IN THE SEALING UNIT IS SUBSTANTIALLY LESS SOPHISTICATED AND IT WOULD BE OUR THOUGHT TO JUSTIFY THE PRODUCTION OF SUCH A TAG BY INCORPORATING IT INTO OUR REGULAR LINE OF EAR TAGS FOR LIVESTOCK. I AM UNABLE AT THE MOMENT TO ADVISE YOU WHEN THESE WOULD BE AVAILABLE BUT I DO BELIEVE IT WOULD BE SOME TIME WITHIN THE NEXT 60 TO 90 DAYS.

I BELIEVE YOUR THOUGHTS AS OUTLINED IN THE SECOND PARAGRAPH OF YOUR LETTER WITH REGARDS TO PLACING THE LESS EXTENSIVELY WORKED PARTS OF THE TAGS IN CONTACT WITH THE BODY TISSUE ARE WELL FOUNDED AND WORTH TRYING AND PERHAPS WITH THIS MANIPULATION OF THE TAG, LESS CORROSION WOULD BE EXPERIENCED AND LONGER TAG LIFE EFFECTED.

I HAVE TELEPHONED THE NICKEL ALLOY PRODUCING COMPANIES SEVERAL TIMES WITHIN THE LAST FEW DAYS AND I'M PLEASED TO REPORT TO YOU THAT SOMETIMES PERSERVERENCE STILL PAYS OFF, IT IS JUST A MATTER OF GETTING TO TALK TO THE RIGHT PERSON AT THE RIGHT TIME CONCERNING THE AVAILABILITY OF INCONEL IN SMALL QUANTITIES AND THE SUITABILITY OF INCONEL FOR THESE TAGS. AS TO AVAILABILITY, I AM INFORMED WE WOULD HAVE TO PAY A PENALTY PRICE-WISE AND DELIVERY-WISE FOR SMALL QUANTITIES. AT THE MOMENT, I DO NOT KNOW WHAT THESE WOULD BE. AS TO SUITABILITY, I AM ADVISED THAT THE INCONEL WILL BE "ABSOLUTELY CORROSIVE-PROOF" AND WILL NOT BE IN THE LEAST AFFECTED BY OUR WORKING AND SHOULD "LAST A LIFETIME". THESE CLAIMS ARE THOSE OF THE NICKEL ALLOY COMPANIES THAT PRODUCE THE INCONEL AND I GUESS I'M A BORN "DOUBTER" BUT THE INFORMATION CAME FROM METALLURGIST ENGINEERS WHO HAVE EXPERTISE IN THIS FIELD AND I EXPLICITLY EXPLAINED TO THEM WHAT WE WOULD DO TO THE METAL AND THESE WERE THEIR ANSWERS.

OF COURSE, WE KNOW FROM EXPERIENCE THAT THE WORKABILITY OF ONE METAL CAN BE QUITE DIFFERENT FROM THE WORKABILITY OF ANOTHER. I'M NOT AT ALL SURE WE CAN USE INCONEL WITH OUR PRESENT EQUIPMENT AND THIS SUBJECT WAS ALSO GONE INTO QUITE THOROUGHLY WITH THE METALLURGISTS AND WE HAVE TRIED TO DRAW SOME CONCLUSIONS TO ANTICIPATED PROBLEMS. BUT, FOR THE MOST PART, ALL OF THIS IS HYPOTHETICAL AND WE REALLY WON'T KNOW UNTIL WE GET INTO THE PRODUCTION. THIS BRINGS US TO THE PROBLEM OF INVESTING SEVERAL HUNDRED OR MAYBE A THOUSAND DOLLARS IN INCONEL AND NOT KNOWING WHETHER WE CAN WORK IT, AS THE METAL COMPANIES WON'T LET US HAVE A SAMPLE FOR OUR TRIAL.

I'LL BE LEARNING MORE OF THE PROBLEMS CONCERNING THE INCONEL WITHIN THE NEXT SEVERAL DAYS AND WILL BE KEEPING YOU POSTED AS TO THE AVAILABILITY, PRICE, ETC. BUT EVEN IF THE INCONEL CAN BE HAD, WE WILL, IN ALL PROBABILITY, PROCEED WITH PLANS TO PRODUCE THE SIZE 49 TAG WITHOUT THE BRIDGE IN THE LOCKING HOUSING.

THE SIZE 62 TAG IS NOT AVAILABLE IN THE MONEL METAL BUT WE ARE SENDING YOU SAMPLES OF THE 1005 SIZE 681 TOGETHER WITH THE STYLE 1242 MONEL IN SIZE 16. THE 1242 MONEL IS NOT AVAILABLE IN SIZE 28. THE SIZE 62 TAG ALSO INCORPORATES THE BRIDGE IN THE LOCKING HOUSING.

I APPRECIATE YOUR LETTER AND YOUR INTERESTING COMMENTS CONCERNING THE NATURE OF YOUR RESEARCH. PLEASE BE ASSURED OF MY COMPLETE COOPERATION IN HELPING TO DO ALL I CAN TO MAKE YOUR RESEARCH PROJECT SUCCESSFUL. THANK YOU.

YOURS TRULY,

NATIONAL BAND AND TAG COMPANY

J. R. HAAS

JRH:LC/2

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

April 26, 1977

Mr. J. R. Haas
National Band and Tag Company
721 York Street
Newport, Kentucky 41072

Dear Mr. Haas:

I want to thank you very much for sending me the copied letter from Huntington Alloys and the laboratory data concerning Inconel 625. This was all most informative, and serves to further confirm our earlier findings. Before saying anymore, I want to tell you that the Inconel tags I have had on my seven captive turtles for over six months now show absolutely no pitting or corrosion of any sort. I am encouraged by these results, as the Monel tags (also size 681) showed noticeable pitting after the same time period under similar conditions. It may be premature, but I think Inconel 625 is the answer to turtle tag problems.

Bill Rainey's plans for the redesigning of your size 49 tag were interesting, but I can't help but wonder what its all for. The basic problem to my present way of thinking, is the composition of the metal and not the design. I'm sure you could change the size 49 locking mechanism; in fact, I suggested it to you two years ago and you thought at the time it could be done without much trouble. But will it solve the corrosion problem of Monel? I doubt it. As I've said before, attack also takes place on the inscription and at other sites in contact with the flesh of the animal.

Another point you will certainly want to consider is that your seal tagging customers apparently require the internal locking mechanism presently found on your size 49 tag. This is to eliminate the possibility of the tag becoming caught on fish nets that seals come into contact with. I discussed this problem briefly last year with Bob Delong of the National Marine Fisheries Service in Washington State. He is one of your customers and perhaps you will want to discuss this point with him.

I feel that the best likely solution to the corrosion problem of turtle tags is to do exactly what we have already done - manufacture Inconel 625 tags in size 681. The tags are perfectly suited for all sizes of turtles (except hatchlings), they have a simple locking mechanism, and the alloy is proving to be resistant

to salt water attack (as Huntington predicted it would be). Personally, I now have enough of these tags to last me for some years, therefore it apparently is no longer a problem for me. I certainly do thank you for this fact.

Have you had any requests for another run of Inconel tags? I would very much like to stay informed on what other researchers around the world are also using Inconel.

I have submitted your name for the permanent mailing list of the Marine Turtle Newsletter (no cost involved). Let us continue to stay in contact on matters of turtle tags.

Sincerely,

GEORGE H. BALAZS
Jr. Marine Biologist

GHB:ec

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University of Hawaii at Manoa
Institute of Marine Biology
P.O. Box 1364 Coconut Island
Kaneohe, Hawaii 96744

March 30, 1977

"OUR 75th YEAR"

Attn: George H. Balazs

Dear Mr. Balazs:

We recently received a copy of the Marine Turtle Newsletter No. 2, January 1977 and found the information contained therein to be most interesting and, hopefully, constructive. We should like to receive subsequent copies of the Newsletter and any other pertinent bulletins which might be issued, could you kindly arrange this for us.

Mr. William E. Rainey's report mentioning the comparison of the Inconel 625 with the Chromel A with regard to corrosion resistance prompted my telephoning Huntington Alloys. A copy of Huntington's answer is enclosed and after reviewing this data, the question in my mind as to the preference for Inconel 625 over Chromel A is completely resolved. I presumed you would be somewhat interested in reviewing this data, please keep in mind that this data is compiled by Independent Research Analysis which are in no way connected with Huntington Alloys.

Meanwhile, we intend to contact Mr. Rainey in regards to his suggestion for redesigning the metal tag. From Mr. Rainey's comments and comments we have received from other agencies, it does appear that a redesign of the locking mechanism would be beneficial on the larger size 49 tag. A locking mechanism similar to that presently incorporated into the size 681 tag has been suggested. Also, perhaps, other modifications in the design of the tag would be desired which could be accomplished at the same time. In the near future, we intend to contact Mr. Rainey concerning this subject, we will also contact you along with a few other agencies. We will keep you advised.

Thank you for your attention.

Sincerely yours,

NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH:lc/1

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Hawaii Institute of Marine Biology
P.O. Box 1346, Coconut Island
Kaneohe, Hawaii, 96744

May 17, 1977

"OUR 75th YEAR"

Attn: George H. Balazs, Jr.Marine Biologist

Dear Mr. Balazs:

I have your letter of April 26th and I want to thank you for placing my name on the permanent Marine Turtle Newsletter mailing list - I have been receiving copies.

I was pleased to learn of your so far satisfactory findings with the Inconel 625 tags. I am inclined to agree with your thoughts that the primary corrosion problem lies with the material itself and not in the tag design.

I do not believe redesigning the size 49 tag will solve the monel corrosion problem, but I do think it would be a step in the direction of lessening the problem. We are aware that the present locking mechanism on the size 49 tag discourages net snagging whereas it is believed that an open locking or clinching mechanism would result in serious net snagging difficulties and for this reason, we plan to retain the availability of the bridged closed house mechanism for those clients who want to utilize it and at the same time, design another tag along the same lines as the size 49 tag incorporating a locking mechanism similar to that presently in the 681 tag. I am presently requesting comments from other agencies with regards to what they would like to have in a redesigned size 49 tag in regards to inside tag measurement, perforation to receive the curl of the point after closing, etc. We have in mind something along the lines illustrated by the enclosed rough sketches, perhaps, you would have some suggestions to offer, they would be welcome. Other pressing problems have yet prevented me from contacting Bill Rainey in this regard.

We have had correspondence from other individuals concerning the use of the Inconel 625 tags but all have wanted the size 49 tag and quantities involved are relatively small making the purchase of the Inconel 625 not practical. Within the past couple of weeks, I have had correspondence and telephone conversations with James I. Richardson, Little Cumberland Island Loggerhead Research, University of Georgia, Institute of Ecology, Athens, Georgia who has been using the size 49 tag in monel and has been experiencing corrosion difficulties. I sent Mr. Richardson samples of the size 681 monel tag for his trial and mentioned that because of the open locking mechanism that corrosion might be less of a problem, but Mr. Richardson was skeptical of whether the size 681 would be satisfactory for his purpose (too small). I will attempt to keep you appraised of any activity that is generated on inquiries that we have for the Inconel 625 tags.

University of Hawaii at Manoa
George Balazs
Kaneohe, Hawaii

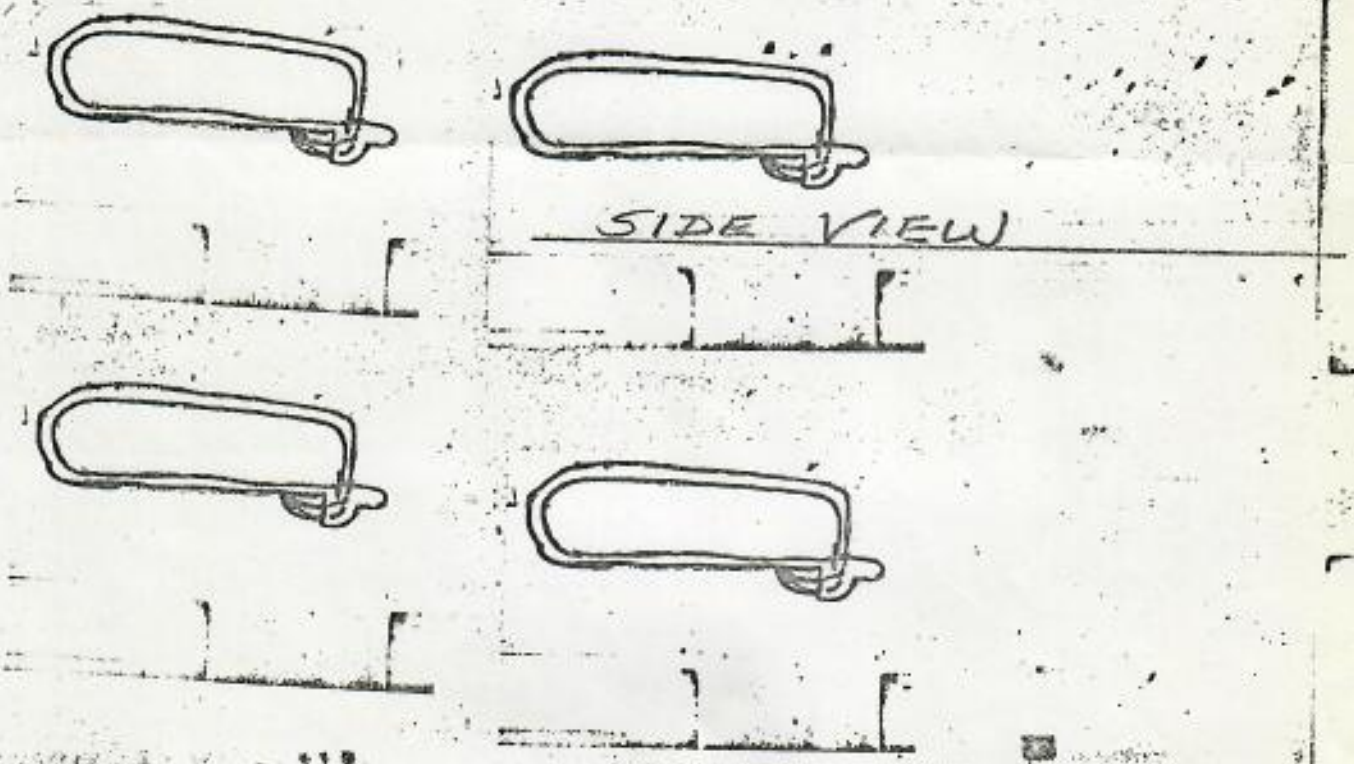
In my last telephone conversation with Huntington Alloys, the comments on the availability of similar quantities of Inconel 625 were not what I would classify as encouraging. They are not at all interested in making another small quantity order for us under "trial" conditions. This is the main problem I foresee, the availability of the material for future production of Inconel tags in either the size 681 or the size 49.

Sincerely yours,

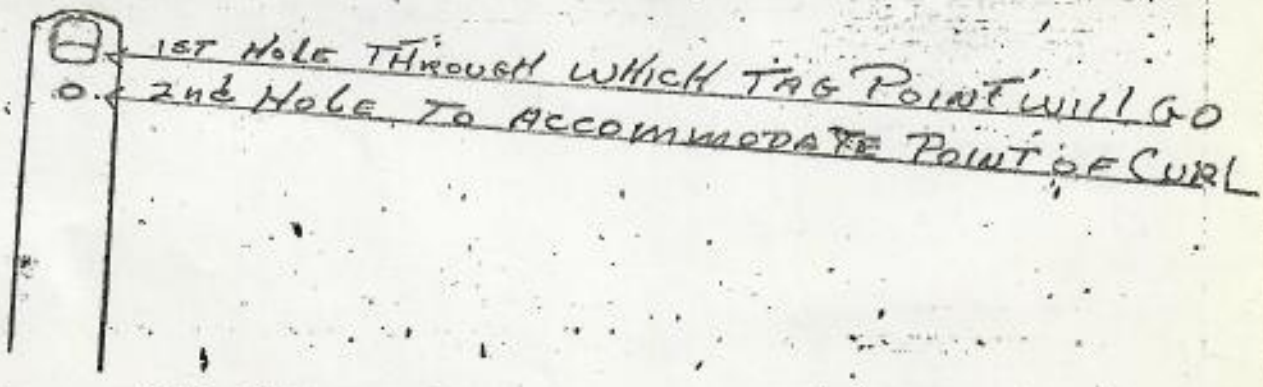
NATIONAL BAND AND TAG COMPANY

J. R. Haas

JRH:lc/2



SIDE VIEW



TOP VIEW

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

March 10, 1980

Northwest Marine Technology, Inc.
231 Broad Street
Summit, New Jersey 07901

Dear Sirs:

I would appreciate receiving information on your internal wire tagging devices that might prove suitable for use on one ounce hatchling sea turtles.

Thank you for your assistance in this matter.

Sincerely,

GEORGE H. BALAZS
Assistant Marine Biologist

GHB:ec

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ATTN: GEORGE H. BALAZS

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51188

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No. 51188

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CLASS	ORDER NO.	INVOICE DATE	SHIPMENT

SHIPMENT REQ. DEST: 7/1/77

VIA: INS 11 PP

ANTICIPATED WEEK ENDING: Sooner if Poss 6/10/77

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3.50/Net	(1)	STAMP SET UP CHARGE STAMPED "WRITE UNIV HAWAII"					
45.40/M	1000	(4-1005) MONEL METAL TAGS - SIZE 1 NUMBERED: 7001 thru 8000					
3.50/Net	(1)	STAMP SET UP CHARGE STAMPED "HAW"					
9.70/EA	1	(4-1005-13) PLIER, SIZE 1					
9.70/EA	1	(4-1005-38) PLIER, SIZE 3					

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ORDER REMINDER

Dear Customer:

We are enclosing a copy of an order that you placed with us about a year ago as a reminder to check your stock of these items to determine if a re-order is needed at this time. If so, just indicate the quantities needed and return the order copy in the enclosed envelope. Or, if you want us to get in touch with you later to remind you to order these items -- indicate such date on the enclosed sheet -- return it -- and we will get in touch with you then.

We want you to know that we do appreciate your business, and will exert every effort to supply your requirements at the lowest possible price while maintaining the very best quality.

Yours truly,

NATIONAL BAND AND TAG COMPANY

Tom V. Haas

Tom V. Haas, Manager

ENC: PC 1656/Env.
TVH:lc/
FORM: 1899 yellow copy
9/29/76

BEST QUALITY -- LOWEST PRICES -- PROMPT SERVICE -- SINCE 1902

from Sea Turtles: A Guide 1977
George Hughes

C. THE LOGGERHEAD TURTLE – *Caretta caretta:*

Dimensions:

40 mm at hatching reaching 100–120 cm with a total mass of 160 kg (350 lbs). Largest recorded in our area 140 kg (305 lbs).

Distribution:

Found throughout the tropical and temperate littoral zones extending as far south as Cape Town in Africa. More common on east coast than west.

Migrations:

Range widely from nesting areas. Record tag returns are from Tongaland nesting beaches with a total distance of 2640 km (1650 miles). One female executed this voyage in 66 days an average daily swim of 40 km (25 miles). Long distance recoveries indicate that the Tongaland beaches draw female loggerheads from over 3000 km of the African coast and from Madagascar.

A newly tagged loggerhead sub adult, note the characteristic general orange brown colour. The monel metal tag is common to all tagging programmes

BIRD BANDING

The Hows and Whys

U.S. DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

This building houses the Bird Banding Laboratory.

Three pintail ducks from North America turned up in widely separated parts of the world. One duck was taken near Cali, Colombia, South America; one in Japan; and the third along the Dart River in England. The South American hunter was told that his duck had come from North Dakota. The Japanese scientists learned their bird had been on a National Wildlife Refuge in New Mexico. The English sportsman found that his pintail, just 21 days before, had been seen in Labrador, some 2,200 miles across the Atlantic. How did these people know their ducks had come from North America?

It really isn't such a mystery as it might seem. On the leg of each duck the hunter had found an aluminum band. The band carried a number and a request that the finder of the band report to the Bird Banding Laboratory, Washington, D.C. Each hunter did exactly that. Records of the wild birds banded in North America are kept in this office. Here it is that the band number and species, age and sex, date of banding, place of banding and name of the bander are recorded. When someone sends in a band he has found, the record can be located quickly, because all this information is stored in a computer.

Banding information is recorded on magnetic tape. The computer can locate records quickly.

Now let's come back to the three banded ducks. Clerks, with the aid of the computer, soon found the three numbers among the 23 million banding records on file in the office. Then they sent each reporter a Certificate of Appreciation telling him the kind of bird he had taken, whether male or female, how old it was, where it had been banded and by whom. Since the banders were also interested in knowing what happened to their pintails, they were told who recovered them, how, when and where they were found, and whether the bird was dead or alive.

history of bird banding

The marking of birds was carried on during the days of the Roman Empire to identify the falcons of the emperor. Modern bird banding really had its beginning with Hans Christian Mortensen, a schoolteacher of Viborg, Denmark. In 1890 he began putting metal bands on the legs of teal, pintails, storks, starlings, and two or three kinds of hawks. These bands had his name and address inscribed on them. As his banded birds began to appear in many places in Europe, other bird students became interested in bird "ringing," as it is called in Europe. In a short time bird banding was "catching on" in America, and more and more people began to band birds in the United States. Deciding they could accomplish more if they worked as a group, in 1909 they formed the American Bird Banding Association. During World War I, however, banding lagged. Biologists in the Bureau of

Wildlife workers banding a Canada goose.

Biological Survey (now the Bureau of Sport Fisheries and Wildlife) were convinced that banding had much to tell us about birds, especially about their migration and life span. So, to continue the banding of birds in America, the Bureau and its counterpart north of the border, the Canadian Wildlife Service, offered to take over the work of the American Bird Banding Association. The offer was soon accepted, and since 1920, banding of migratory birds in the United States and Canada has been under the joint direction of the federal governments of the two countries.

what does banding tell us?

Banding birds has shown us many things about the individual bird as well as about the species or group to which it belongs. We know that many birds live as long as 10 years, and some live even longer. For example, a red-winged blackbird that was banded in New York was shot 14 years later in North Carolina, and a black duck banded on Cape Cod was taken by a hunter 17 years later in Newfoundland. Some Canada geese live to be more than 20 years old. The longest a North American bird has been known to live in the wild is 36 years. The holder of this record was a herring gull, banded off the coast of Maine in 1930 while still in the nest and found dead along the shore of northern Lake Michigan in 1966.

If banded birds are captured, released alive, and recaptured, we can reconstruct the migration routes they were following. Or, when large numbers of bobolinks or blackbirds, robins or redstarts, and mourning doves or mallards are banded, we can form a general picture of the pathways used by these birds between nesting and wintering grounds.

From banding information we have learned that some birds, such as the golden plover, do not return north in the spring over the same route they took south in the fall.

How did we learn that the Arctic tern makes the longest known migration flight of any living species? It was from bands returned from such faraway places as France, Nigeria, Natal and Cape Province, South Africa. It is now known that this bird makes an annual round-trip flight of about 25,000 miles. It nests near the Arctic Circle and winters on the islands near Antarctica.

Many ducklings and goslings are banded each summer on their nesting grounds. Hunters who return the bands they find on these birds during the hunting season are helping to ensure their own hunting in the future. Even though some hunters do not send in their bands, from the bands which are turned in from hunting areas, wildlife biologists can still determine how many waterfowl there will be along the various migration routes during the following autumn. Knowing approximately how many wood ducks, pintails or mallards could possibly be in an area during the hunting season is a good basis for saying how large a bag limit should be established. The game managers want to be sure enough pairs of these birds escape the guns to provide the next season's breeding stock. Excessive shooting this hunting season means less ducks next year.

The Atlantic Golden Plover returns north over a different route than the one it follows south to its wintering grounds.

Banding gave us this picture of the travels of the Arctic Tern.

how birds are banded

Specially designed traps or nets are used to catch the birds for banding. The bird bander must take extreme care in trapping and handling the birds to avoid injuring them. The bander visits his

Like most of our migratory birds, the Indigo Bunting crosses international boundaries between nesting and wintering grounds, and is protected by international treaties.

A close look at a band being placed on the leg of a hawk. The populations of many of our hawks have declined in recent years.

A wildlife biologist removing an Indigo Bunting from a net during a banding operation.

traps or nets hourly so that birds don't suffer from exposure and are not killed by predators. The last trip is made at dusk—birds are never left in a trap overnight. Trapped birds are removed from the traps or nets, identified, examined for age, sex and physical condition, and carefully fitted with aluminum bands and released. Some birds, waterfowl, for example, may be color marked in various ways so they can be recognized individually from a distance. Examples of color markers are plastic neck bands, wing tags, colored leg bands, paints and dyes.

Authorized banders receive bands without charge from the Bird Banding Laboratory, as well as the necessary forms for keeping accurate records. When a band is put on a bird's leg, the bander records the number, the kind of bird, its age and sex and the place and date of banding. Later the bander returns the completed form to the Banding Laboratory, where this information is stored in a computer where it is readily available in case the band is later recovered. Over a million birds are banded every year. Of these, we hear back from over 100,000.

Seventeen different sizes of aluminum bands are used in banding birds. In addition, special bands made of such metals as monel, incoloy, and titanium are sometimes used in special studies or on birds that tend to wear out their bands very rapidly. Very small bands are needed for tiny birds such as warblers, vireos, kinglets and hummingbirds. Large bands are used on swans, geese or eagles. Besides the serial number, each band bears the address: "AVISE BIRD BAND

WRITE WASHINGTON, D.C. USA." Thus, the finder of a band knows where to send it, and the Bird Banding Laboratory has a number to use in locating all the banding information for a particular bird.

who can band birds?

Anyone who is at least 18 years old and knows how to identify all of the common birds in their different seasonal plumages may apply for a banding permit from the Fish and Wildlife Service. The applicant must furnish the names of three well-known bird banders or ornithologists who can vouch for his fitness as a bird bander. Only those persons who are well qualified and have research projects in mind are issued banding permits.

how can we all help?

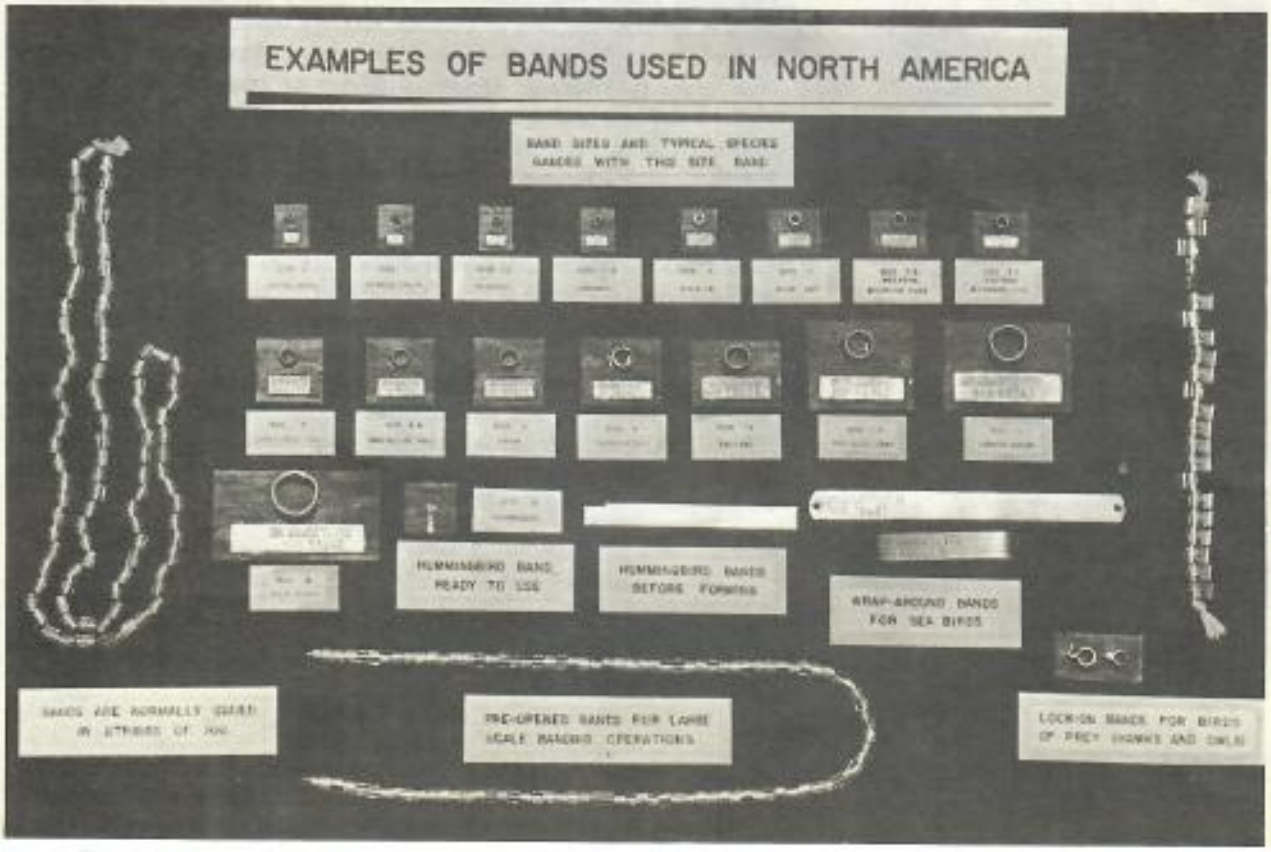
Not everyone can or wants to band birds, but we can all help the work of bird banding by sending in the bands we find. In fact, this important study of birds would fail were it not for the many people who report bands. Banding is only one phase of the work—the bands must be found and returned.

where are we most likely to find bands?

Hunters should always look at the legs of the game birds they shoot, since many of these birds carry bands. Dead birds along our highways and birds washed up at the seashore may have bands on them. Fishermen sometimes catch banded birds in their nets and on their lines. Sometimes banded ducks are found in beaver and muskrat traps.

Keeping accurate records is an important part of every bander's work. Here, a hen wood duck has just been marked with a colored neck streamer so that she can be identified from a distance without having to recapture her.

The 17 different sizes of bands used by American banders.



UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

WASHINGTON • ISSUED 1972

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT 423

FLOY TAG & MANUFACTURING, INC.

4616 UNION BAY PLACE N.E. • SEATTLE, WASHINGTON 98105 • (206) 524-2700

FLOY TAGS GIVE FISH SOMETHING TO LIVE FOR

Russell Amick, President
Paul Lyon, Vice President

NOSTALGIA

In going through an old file, we discovered a customer list of our first year in the fish tag business, 1957. They are listed below:

United States Fish & Wildlife Service Seattle, Washington C.E. Atkinson, Fred Cleaver Richard Hajney	California Dept. of Fish and Game Stanford, California Ed Best
Bureau of Commercial Fisheries Woods Hole, Mass, Sterling Cogswell	Alaska Dept. of Fish and Game Juneau, Alaska Walter Kirkness
Fishery Research Institute University of Washington Seattle, Washington W.F. Thompson, Al Hartt, Mike Dell, Ben Jones, Al Palmer	International Pacific Salmon Fisheries Commission New Westminster, B.C. Loyd Royal
Washington Dept. of Fisheries Seattle, Washington Al Lasater, Lee Alvorson, Ken Thorson, Pete Bergman, Bud Jewell, "Heater" Heyamoto	Pacific Oceanic Fishery Investigations Honolulu, Territory of Hawaii Garth Murphy, Vernon Brock
Oregon Fish Commission Clackamas, Oregon Sigurd Westerheim	U.S. Fish & Wildlife Service Juneau, Alaska N.J. Wilimovsky

The "Lock-On" is the brain child of Margaret Anderson, our Plant Manager. Margaret has the "know how" of all operations and can take telephone calls for quotations, delivery, etc. Should we not be in.

The FT-4 "Lock-On" slips easily into a canula needle which has a very sharp point for penetration. Once inserted, the applicator is withdrawn and the two ends are locked together. We believe many more fish can be tagged per hour than the regular FT-4. Please see attached sample.

The tubing may be any length you desire. Length is determined by the size of the fish and anticipated growth.

LONG TERM RECOVERIES

Mr. Thomas O. Duncan, Chief, South Central Reservoir Investigations, 113 South East Street, Fayetteville, AR 72701 submits the following:

"A white bass was tagged December 30, 1968 and was recaptured 1,535 days or four years and 72 days after tagging. The fish was two years old when tagged. This age was determined in our laboratory using age and growth data they have. Total age of the fish was six years. The tag was covered with periphyton and appeared black. It was stiff but the printing was well retained and readable even though the printing was black on dark blue tubing.

A Largemouth bass was tagged in the spring of 1969 and 17.2" long when tagged. It was recovered March 5, 1973 and had grown to 23 inches.

The American Littoral Society, Sandy Hook, Highlands, NJ 07732 reports a sports fisherman caught a bass bearing the FT-4 spaghetti tag after being at large for six years and eight days. The legend was still legible.

This speaks well for tag longevity with no harm to the fish.

GOODBY TO THE FD-67 TAGGING GUN

Five and a half years ago, the Dennison tagging gun revolutionized fish tagging. It is now obsolete and is replaced with the Mark II tagging gun which is superior to the FD-67:

1. New jam resistant feed automatically loads tags in "firing" position.
2. New easy squeeze action.
3. New super-strong positive rack and pinion drive.
4. No change in cost.
5. Additional no-corroding plastic parts.

Inter-American Tropical Tuna Comm. Scripps Institute of Oceanography La Jolla, California Frank Alvorson, Gordon Broadhead	Bureau of Commercial Fisheries Division of Biological Research U.S. Fish & Wildlife Service Washington, D.C. Dr. A.L. Tester, Chief
International Halibut Commission University of Washington, Seattle Richard Myhre, Bill High	U.S. Fish and Wildlife Service Branch of Anadromous and Inland Fisheries, Washington, D.C. Ralph P. Silliman, Chief
Oregon Fish Commission Astoria, Oregon Ray Morgan, Bob McQueen Jack Van Hyning	Fisheries Research Board of Canada Nanaimo, British Columbia Dr. Keith Ketchen
Washington Department of Game Seattle, Washington Cliff Millenbach	U.S. Fish and Wildlife Service Ann Arbor, Michigan
United States Fishery Laboratory Beaufort, North Carolina	U.S. Fish and Wildlife Service Boothbay Harbor, Maine
Oregon Game Commission Portland, Oregon Dr. John Rayner	

21 pilot customers in 1957 and many thanks to you. Our current customer list is close to 500 and growing.

If any name has been missed, it was not entered on the 1957 list.

May 1, 1973

3. Additional no-corroding plastic parts.

The FD-67 anchor will soon be available with a 1" monofilament. The current FD-67 anchor with 5/8" monofilament will remain a stock item.

New Quotation Time Limit

Due to many factors, quotations are valid for a maximum of 90 days.

WHEN FORMALITY IS DROPPED, UNDERSTANDING SETS IN!

Please send us news on tagging for publication.
May 1, 1973

Sincerely yours,

Paul Lyon

FROM

.....

.....

.....

PLACE 6¢ STAMP HERE

NATIONAL BAND & TAG CO.

721 YORK ST.

NEWPORT, KY. U.S.A. 41072

STONE MANUFACTURING and SUPPLY CO.
Livestock Identification and Show Equipment
1212 Kansas Ave. • Kansas City, Mo. 64127
816-231-4020

TO:

GEORGE BALAZS

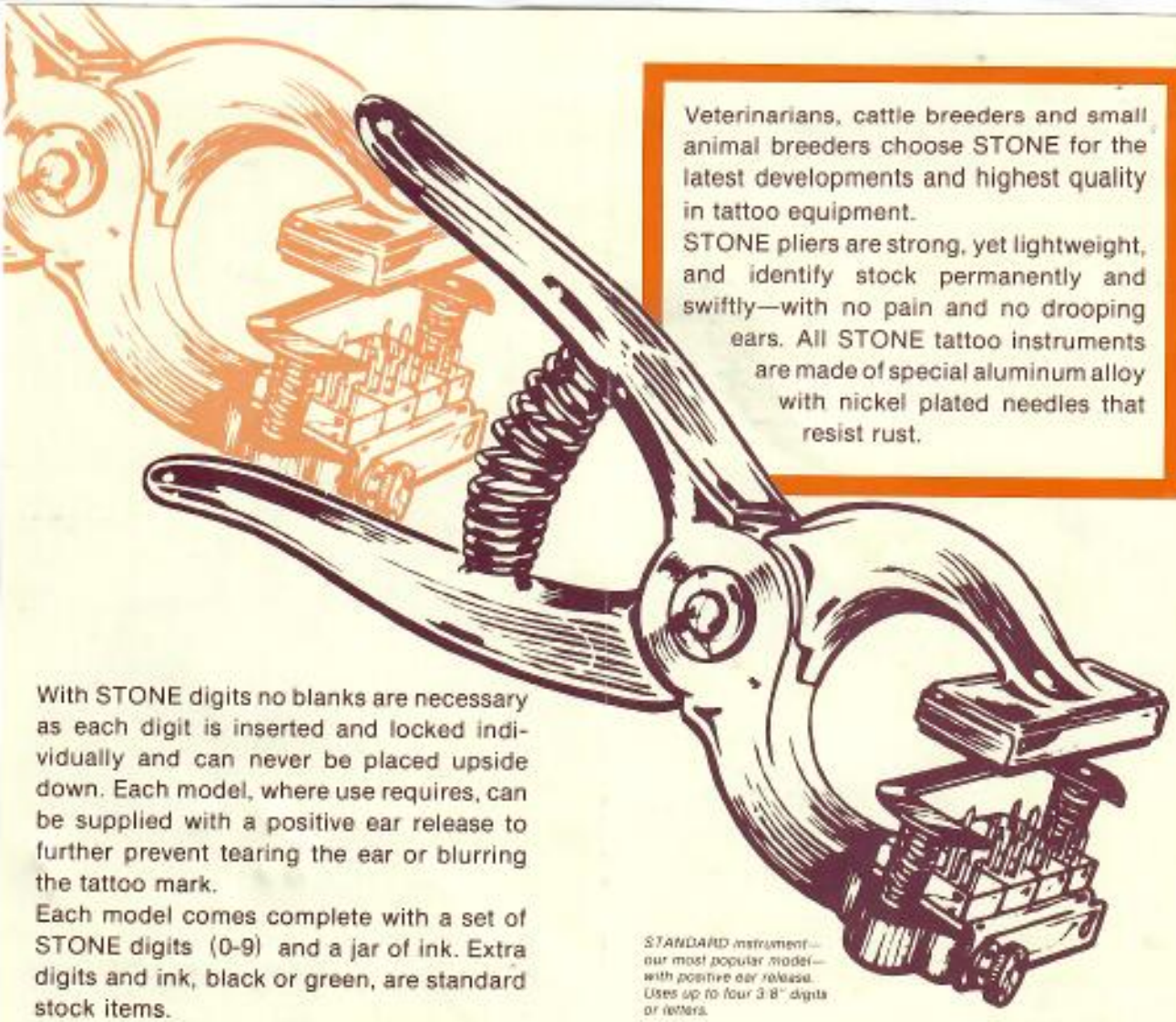
THANK YOU FOR YOUR INQUIRY. WE REFER YOU TO THE FOLLOWING:

HAWII RANCH & FARM SUPPLY
P.O. BOX 1237
KAMUELA, HAWAII 96743

INQUIRY DEPT.
STONE MFG. CO.

Veterinarians, cattle breeders and small animal breeders choose STONE for the latest developments and highest quality in tattoo equipment.

STONE pliers are strong, yet lightweight, and identify stock permanently and swiftly—with no pain and no drooping ears. All STONE tattoo instruments are made of special aluminum alloy with nickel plated needles that resist rust.



STANDARD instrument—our most popular model—with positive ear release. Uses up to four 3/8" digits or letters.

With STONE digits no blanks are necessary as each digit is inserted and locked individually and can never be placed upside down. Each model, where use requires, can be supplied with a positive ear release to further prevent tearing the ear or blurring the tattoo mark.

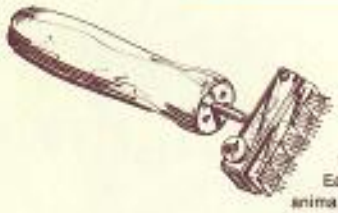
Each model comes complete with a set of STONE digits (0-9) and a jar of ink. Extra digits and ink, black or green, are standard stock items.

STONE products include 148 items in 61 different classifications. Ear notchers, cattle tags, fasteners, branding irons, nose leads, combs, show sticks, brushes, cow magnets, obstetrical equipment, horn weights, hoof clippers.

SMALL ANIMAL TATTOO, with or without positive ear release, designed specifically for poultry, dogs or other small animals. Holds up to five STONE 5/16" digits or letters.

REVOLVING HEAD TATTOO shown with positive ear release. The same precision, high quality as the STANDARD, only equipped with a revolving head. Permits up to four ⅜" digits or letters on each side **for a total of eight.** One side can be used for your registration brand, the other for the animal number.

300 PET TATTOO is a new small instrument with 5" comfortable handles and holds up to four special 300 digits or letters in only a 1 1/4" space. It is the ideal instrument for use with pets or smaller animals.



THE LIP TATTOO instrument is for permanently tattooing the upper lip of horses. Easy to use, causes no harm to the animal. Accommodates up to five 5/16" STONE digits or letters.

SOLD BY:

STONE Tattoo Equipment

For

"Permanent Identification"

For ANIMALS LARGE or SMALL

TATTOO OUTFITS

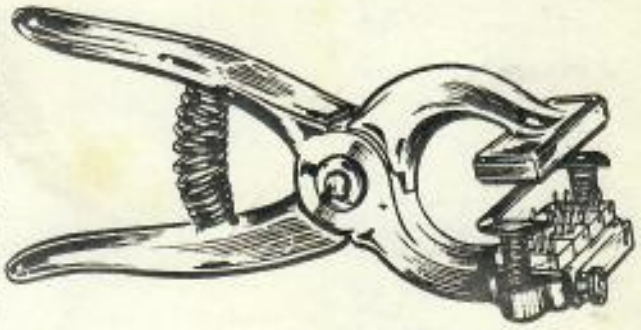
STANDARD WITH POSITIVE EAR RELEASE

The most popular tattoo used by leading Breeders and Associations. Precision made of a special aluminum alloy —very sturdy, yet light weight, making it exceptionally easy to handle. Holds up to four digits with each digit inserted individually from front . . . no blank digits necessary and specially designed so that the digits cannot be placed upside down. The positive ear release prevents the points of the digits from scratching the ear or blurring the tattoo mark.

Complete outfit consists of plier, set of ⅜" digits (0-9) and 2 oz. jar of ink

Extra digits and ink sold separately.

See Price Sheet, Page 3.



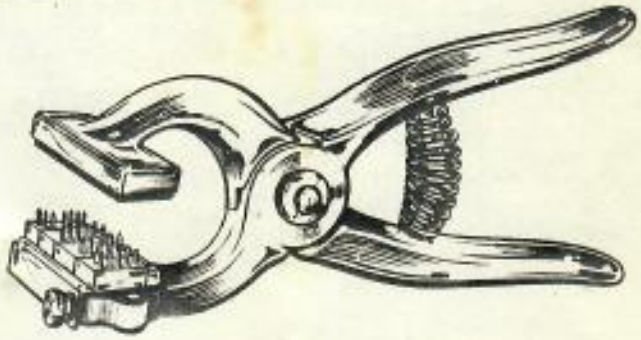
STANDARD

Same as above tattoo—except without ear release.

Complete outfit consists of plier, set of ⅜" digits (0-9) and 2 oz. jar of ink.

Extra digits and ink sold separately.

See Price Sheet, Page 3.



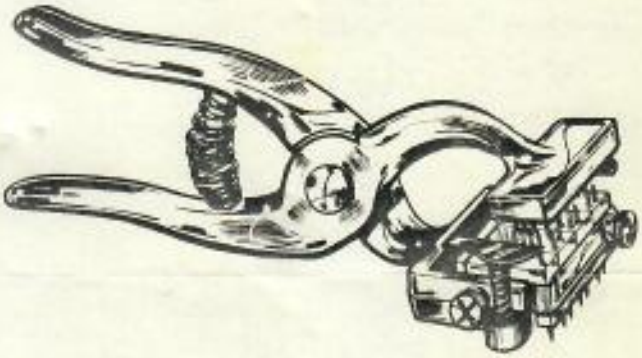
REVOLVING HEAD WITH POSITIVE EAR RELEASE

The same precision, high quality workmanship as the Standard, only this outfit comes equipped with a revolving head, which holds up to four digits on each side, for a total of eight digits. One side can be used for your registration brand, other side for number of animal. Comes equipped with the positive ear release.

Complete outfit consists of plier, set of ⅜" digits (0-9) and 2 oz. jar of ink.

Extra digits and ink sold separately.

See Price Sheet, Page 3.



REVOLVING HEAD

Same as above tattoo—except without ear release.
Complete outfit consists of plier, set of ⅜" digits (0-9) and 2 oz. jar of ink.

Extra digits and ink sold separately.

See Price Sheet, Page 3.

TATTOO STONE OUTFITS

SMALL ANIMAL TATTOO

The same precision, high quality workmanship as the Standard Tattoo. Designed specifically for poultry, dogs, and other small animals. Holds up to five digits with each digit inserted individually from front . . . no blank digits necessary and specially designed so that the digits cannot be placed upside down. The positive ear release prevents the points of the digits from scratching the ear or blurring the tattoo mark.

Complete outfit consists of plier, set of 5/16" digits (0-9) and 2 oz. jar of ink.

Extra digits and ink sold separately.

See Price Sheet, Page 3.

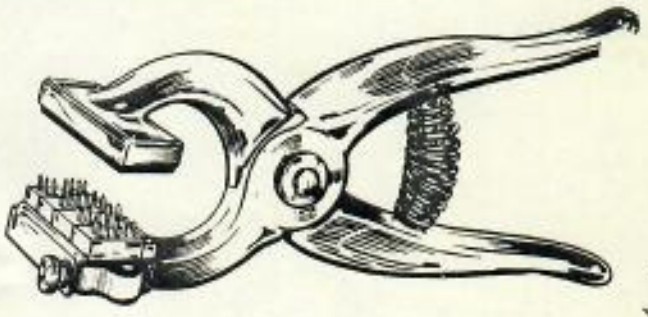
F-100 TATTOO

The same precision, high quality workmanship as the Standard Tattoo. Designed purposely to be interchangeable with certain other competitive tattoo pliers and digits (do not use Stone's Standard 3/8" tattoo digit in this plier). Available with positive ear release.

Complete outfit consists of plier, set of F-100 digits (0-9) and 2 oz. jar of ink.

Extra digits and ink sold separately.

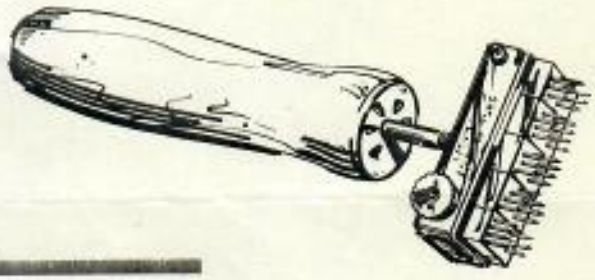
See Price Sheet, Page 3.



THE LIP TATTOO

This instrument is ideal for permanently tattooing the upper lip of horses. Easy to use, causes no harm to the animal. Accommodates up to five 5/16" STONE digits or letters.

See Price Sheet, Page 3



300 PET TATTOO

This is a new small instrument with 5" comfortable handles and holds up to four special #300 digits or letters in only a 1¼" space. It is the ideal instrument for use with pets or smaller animals.

Complete outfit consists of plier, set of #300 digits (0-9) and a 2 oz. jar of ink.

Extra digits or letters and ink sold separately.

See Price Sheet, Page 3

TATTOO STONE OUTFITS

STANDARD TATTOO DIGIT

This digit referred to as 3/8" digit is for use in Stone's Standard and Revolving Head Tattoo Pliers. All needles nickel plated. Precision made for uniform penetration. Available in numbers and letters.

See Price Sheet, Page 3.

SMALL ANIMAL TATTOO DIGIT

This digit referred to as 5/16" digit is for use with Stone's Small Animal Tattoo Plier or Lip Tattoo Gun. All needles nickel plated. Precision made for uniform penetration. Availdole in numbers and letters.

See Price Sheet, Page 3.

#300 PET TATTOO DIGIT

This digit referred to as #300 Pet Tattoo digit is for use in STONE'S Pet Tattoo plier. All needles nickel plated. Precision made for uniform penetration. Available in numbers and letters.

See Price Sheet, Page 3.

TATTOO INK

An indelible black ink of heavy, creamy consistency. Extensively used by leading breeders throughout the country. Available in 2 ounce or 4 ounce size jars.

See Price Sheet, Page 3.

ROLL-ON INK

Tattoo ink – "roll-on" applicator. Available in 2 ounce size. Green and Black.

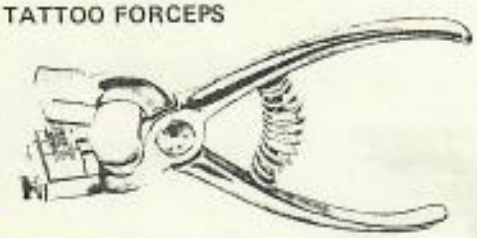
See Price Sheet, Page 3.

GREEN TATTOO PASTE

Available in one size only—metal tube approximately 2 ounce.

See Price Sheet, Page 3.

TATTOO FORCEPS



6321–Large tattoo forceps 14.50

Cast aluminum alloy reinforced at all points of stress; strong spiral spring. Holds one to four 3/8" letters or numerals.

FIGURES AND LETTERS
tempered steel needles

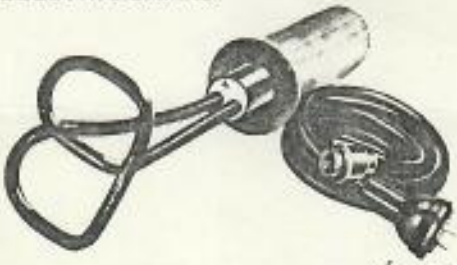
6333–Set of ten figures, 0 to 9 6.65
6345–Single letters .95
6348–Single figures .95

SPECIAL TATTOO CHARACTER

ea 1.70
10-99 @ 1.65
6320–Special tattoo character 100 or more @ 1.60

U. S. official tattoo digit, V within a shield for identifying cattle vaccinated for brucellosis. Uses two spaces in #6321 tattoo forceps.

ELECTRIC BRAND

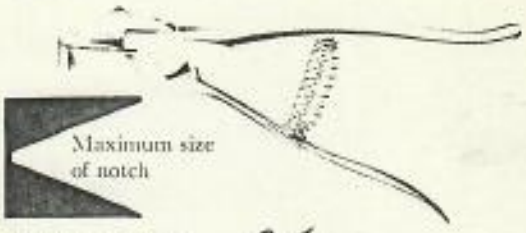


40.00
7110 –Electric "B" branding iron
46.20
7111M–Electric brand, other single letters

"90-second-hot" tubular heating element. 3-1/2" letter "B" meets B.A.I. requirement. 6' cord. 110-115 volts AC or DC.

*Shipped direct from the factory.

EAR NOTCHING PUNCH



6306–Ear notcher 9.50

Solid end punch. High-grade tool steel cutting plate leaves a clean, even notch.

ALL-WEATHER MARKING CRAYON HOLDER

8171–Crayon holder 5.00

Aluminum holder features a sliding plunger that allows use down to end of stick. Protects against breakage and smearing during use.

WAX MARKING CRAYON

12 or more
8174–Orange crayon ea .55 ea .50
8172–Red Crayon .55 .50

4" long, 1" diameter; in cardboard tube. Orange or red.

TATTOO INK

ea .88
6330–Tattoo ink 12 or more ea .85

Creamy consistency; in 4 oz. dauber bottle.

Jensen-Salsbery Laboratories Division of Burroughs Wellcome Co., 520 W. 21st St., Kansas City, Mo. 64108
tel. 816-471-4080

Jen-Sal

Veterinary Biologicals • Pharmaceuticals • Surgical Supplies

Wellcome

March 12, 1980

Mr. George H. Balazs
Assistant Marine Biologist
Hawaii Institute of Marine Biology
P. O. Box 1346
Coconut Island
Kaneohe, Hi. 96744

Dear Mr. Balazs:

The tattoo materials illustrated on the attached copy of our catalog page are primarily intended for identification of cattle. Usually, the ear is cleaned with alcohol and when dry, the tattoo ink is applied to the area to be tattooed. Letters or figures of choice are inserted into the forceps and then applied to the ear. Thereafter, the tattoo ink is rubbed into the small holes made by the tempered steel needles and the job is completed.

The figures and letters are 3/8" high and the forceps will hold a maximum combination of four.

Sincerely,

Mark H. King

Mark H. King
Instrument and Surgical Supply Manager

MHK:fl:09912

Enclosure

BIBLIOGRAPHY

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Massachusetts Audubon Society, Drumlin Farm, South Lincoln, Mass.

PENGUIN FLIPPER-BANDS USED BY THE USARP* BIRD-BANDING PROGRAM 1958-60.

By W. J. L. SLADEN and R. L. PENNEY

Flipper-bands were designed for Adelie, *Pygoscelis adeliae*, and Gentoo, *P. papua*, Penguins in 1948 (color bands) and 1949 (aluminum) (Sladen, 1952: 543) and have since been used extensively on other species, with varying success, by British, French and Australian Antarctic expeditions. These bands have several advantages over bands placed around the tarsus (Richdale, 1951), or around the feathered tibia, but they require very careful fitting. Some of the problems of this technique have been discussed by Gwynn (1955), Austin (1957), and Sladen & Tickell (1958).

The bands described here were designed for the USARP Bird-banding Program**, and are being used by U. S. and New Zealand biologists in studies now being conducted in the Antarctic on population dynamics, behavior, orientation, navigation and physiology of penguins.

Both of us travelled on *U.S.S. Staten Island* during the summer season of Operation Deep Freeze IV, 1958-9. Penney left the ship in February to winter-over at Wilkes Station (66° 15′ S., 110° 31′ E.), and reports here on the success of the 1958 Adelie flipper-band design.

For Emperor Penguins *(Aptenodytes forsteri)*

As the size of the flipper varies more in Emperor Penguins than in Adelies, bands must be used on Emperor flippers with much care, and fitted exactly. More trials are needed before they are used in large numbers.

In the two designs described, the reference number lies on the outer face of the flipper, so that it can be read without handling the bird. Most of the address is hidden in the axilla.

Footnote:— *=United States Antarctic Research Program

Footnote:— **This program started in December 1958, is in collaboration with the U. S. Fish & Wildlife Service and supported by the National Science Foundation (N.S.F. G6327 & G9990).

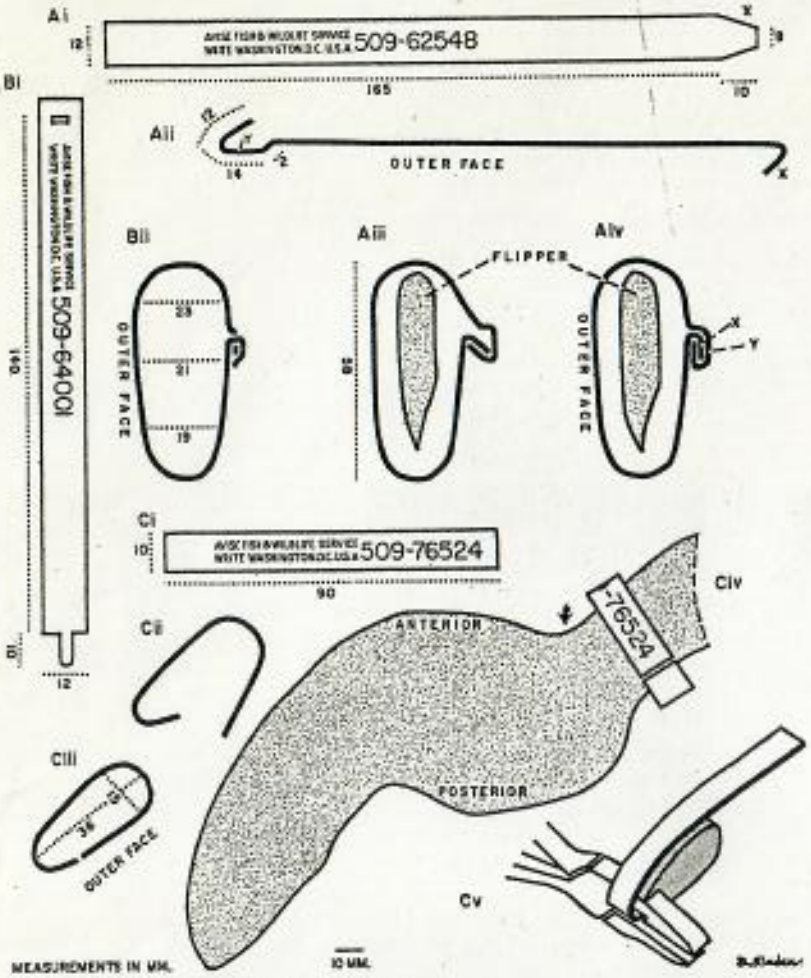

Figure 1. *USARP Penguin-flipper bands*
A 1958 design for Emperor Penguin. (i) first shaping. (ii) second shaping. (iii) shaped around flipper. (iv) final position.
B 1959 design for Emperor Penguin. (i) strip as supplied. (ii) final position around flipper.
C 1958 & 1959 designs for Adelie & Chinstrap Penguins. (i) the strip supplied in 1958, cut to correct length. (ii) the pre-shaped band supplied in 1959. (iii-iv) final position around flipper. Comment on the arrow is in text. (v) pliers for shaping strips. Shows strip partly shaped.

A. *1958 design* (see figure)

Metal: 3SH12 Aluminum, gauge 0.050 inch. Made in the field from strips 25 cms. long and 12 mm. wide.

This design was based on a clip-type previously used for Adelie Penguins (Sladen 1958; Sladen & Tickell 1958,7). One end, "X", of the strip is trimmed on either side (see Ai) so that

when the clip is finally squeezed together (Aiii & iv) with the pliers, the edge marked "Y" is crimped over into the spaces left by the trimming. "X" is thus enclosed from the sides and is prevented from slipping sideways.

This design was developed at a newly-discovered Emperor rookery off Coulman Island (73° 21′ S., 170° 40′ E.), Victoria Land, to which we were transported by the *Staten Island* helicopter. 51 adults and 49 chicks were banded here. After some experience, we found that the enormous adults were not difficult to band, though the process was slow, and padded trousers were needed. The penguin was caught by the neck and, while still standing, its head and neck were thrust firmly between the knees of the holder, with the bird's back away from him. A second person then placed the band on the flipper. Some birds retaliated by pounding the holder's shins with their flippers; others, especially the young, remained quiet, making it possible for one person to do the banding himself.

B. *1959 design* (see figure)

Metal: 3SH14 Aluminum, 0.050 inch gauge, 12 mm. wide.

The 1958 design was changed because the clip is too complicated for general use and apparently can be forced apart by ice (see Sladen & Tickell, 1958, 12). The simple device of tongue and slot of the 1959 design is adequately described in the figure. It is being used during the 1959-60 season.

For Adelie and Chinstrap Penguins *(Pygoscelis adeliae* and *P. antarctica)*

C. *1958 and 1959 designs* (see figure)

Metal: 52SH12 Aluminum (1958 design) and 5052H32 Aluminum (1959 design), and both 0.064 inch gauge and 10 mm. wide.

Improvements on old designs suggested previously (Sladen & Tickell, 1958, 12) were considered in developing these bands. Making them of tough metals (the 1959 band is slightly tougher), enables them to be of the butt-end type, that is, without over-lap or locking device. They are therefore very simple to use. When the band is in place, the five-figure reference number can be read through binoculars from a distance of 60 feet.

The 1959 band is pre-shaped in the factory; the 1958 one is distributed as a strip (Ci) to be shaped in the field. Penney made a pair of pliers for the shaping, on one jaw of which is welded a piece of iron filed into a mold for the band. The end of the strip carrying the address is gripped by the whole width of the jaw, and the strip bent around the mold (see Cv), and adusted so that the ends meet squarely. Shaping takes about 7 seconds. Before the band is closed on the flipper, it is important to try to pull the band off distally to see if it will restrict the movement of the joint, or come off. 4% of the bands of the 1958 and 1959 designs will do this and must be replaced by smaller ones. Opening and closing of the band more than once weakens it, so must be avoided.

Four Chinstrap Penguins, which take the same size of band as the Adelies, were banded on Sabrina Islet (66° 55′ S., 163° 20′ E.), Balleny Islands, on 27 January, 1959. This species was a new discovery for this part of the Antarctic (Sladen, in press).

Nearly 1700 Adelies were banded from the *Staten Island* and at Wilkes Station during the 1958-9 season. At Wilkes, 459 of them were adult birds, and of these, 266 (58%) were found at the same rookeries during the next breeding season. No injuries were seen. A 58% recapture of banded adult Adelies may not be high when one expects breeders that are well established to return to the same or nearby nest-sites (Sladen, 1958: 70). But banding at Wilkes began at the end of the season, and the breeding status of the adults could not be determined. However, 74 were feeding chicks and 55 of these were recaptured (74%). 87 others were occupying nest-sites and 67 of these were recaptured (77%). Between banding and recapture, the birds had molted and spent a winter at sea. So, with allowances for some deaths from usual causes, and some scattering of unestablished birds to the numerous other rookeries nearby, these may be very good rates of survival. Four of the 266 Adelies recaptured at Wilkes had partly-opened bands, but we believe the tougher metal of the 1959 band will stop this. As with other flipper-bands, there is slight wearing of the feathers along a few mm. of the anterior border of the flipper (at the point marked by the arrow in Civ), but this does not harm the bird. It can be almost eliminated by grinding down the square edge of the band at this part, and by reducing the interior length of the band from 36 mm. (see Ciii) at 34 mm.

We are grateful to A. Duvall, U. S. Fish & Wildlife Service and C. Biehl, Gey Band and Tag Co., for valuable advice for the USARP Bird-Banding Program; to Brenda Sladen for the illustration; to O. L. Austin, Jr., for comments on the text; and to R. Goldsmith, G. Caughley, B. Reid, J. Roberts, J. Premsic and men of *U.S.S. Staten Island* for field assistance.

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SOUTHEASTERN BREEDING RANGE OF THE BROWN-HEADED COWBIRD

BY JOHN S. WEBB AND DAVID KENNETH WETHERBEE

Records have accumulated in recent years which attest the belief that the Brown-headed Cowbird *(Molothrus ater)* is extending its breeding range southward and eastward in the Gulf and Atlantic coastal plain area. An adult male cowbird was taken from a net set beside Lake Alice, Gainesville, Florida, on July 7, 1958. A female cowbird in heavily streaked juvenal plumage was taken from the same set on July 28, while three other cowbirds, females or juveniles of undetermined sex, were seen nearby. The female was preserved and given to the Florida State Museum (Accession Number 3670). Dissection showed an ovary which measured 3 mm. long.

The presence of these juveniles in Florida at this early date is believed to constitute evidence that cowbirds breed farther southeast than the fifth edition of the A. O. U. Check-list indicates. Burleigh apparently suspected a southeastern breeding population, for he commented on the difficulty of reconciling the numerous early-summer sight records of immature birds with the relatively late southward migration of the northern breeding population (Georgia Birds, p. 600, 1958). Howell listed such early-summer sight records made by Stoddard July 14, 1930 at Pensacola and July 29, 1927 in Wakulla County (Florida Bird Life, p. 435, 1932). Similar records were made by Craighill in June of 1936, 1937 and 1938 in Dare County on the North Carolina coast (Grey and Murray, *Auk*, **58**: 102, 1941). Still others are on file in the Bird Distribution Office of the Fish and Wildlife Service, including Florida records for July 23, 1950 at Jacksonville, by W. Y. Gary and for July 31, 1926 in Pasco County by A. B. Cannon.

Cowbirds ordinarily have been considered winter visitors in the southeast coastal plain. McClanahan listed the species as an irregular winter resident from November 13 to March in the Gainesville area *(Proc. Fla. Acad. Sci.*, **1**: 101, 1936) and Sprunt cited the cowbird as "an irregular visitant in all parts of the State from midsummer to April but with no record of breeding" (Florida Bird Life, p. 446, 1954). Howell considered the bird an "irregular winter resident" in Alabama, though occasional in summer (Birds of Alabama, p. 205, 1928). In coastal South Carolina the cowbird was designated as "common only in the winter months of January and February" but was "present from June 25 to March 19" (Sprunt and Chamberlain, South Carolina Bird Life, p. 506, 1949). Brimley reviewed scores of migration records from 1885 to 1941 at Raleigh, North Carolina, and tabulated the species as a winter visitor from early September through April (Pearson, Brimley and Brimley, Birds of North Carolina, p. 404, 1942).

The known and suspected southeastern breeding range of the cowbird (as of June, 1959) is plotted in Figure. 1. Evidence for recent extension of breeding range is annotated below. Records cited are grouped by numbered areas which conform with the map numbers

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Dear George,

Obviously Archie cant help us out on this order for inconel tags so can you tell me exactly how many you can afford to buy. What about splitting the 5000 order between us and taking 2500 each ? If thats alright with you then we can go ahead and order. Please let me know by return of post.

Hope this letter finds you well.

Yours sincerely,

George.

for: DIRECTOR

GRH/jc

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Dear George,

INCONEL TAGS

Following an enquiry to National Band I'm informed that some INCONEL is going to be available and that they are dealing with you re: orders but can't quote a price.

Before I can make a firm order I have got to know how much as we run a tight budget here.

Please keep me informed of developments and especially prices. Do you want us to order through you if it is possible for us to buy?

Hope all goes well with you.

Yours sincerely,

George.

for: DIRECTOR.

GRH/mh

LABORATOIRE des REPTILES et AMPHIBIENS
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336-00-21

JACQUES FRETEY

Paris, le 8 avril 1981

à George H. BALAZS
University of Hawaii at Manoa

Cher Collègue,

En réponse à votre lettre du 28 février.

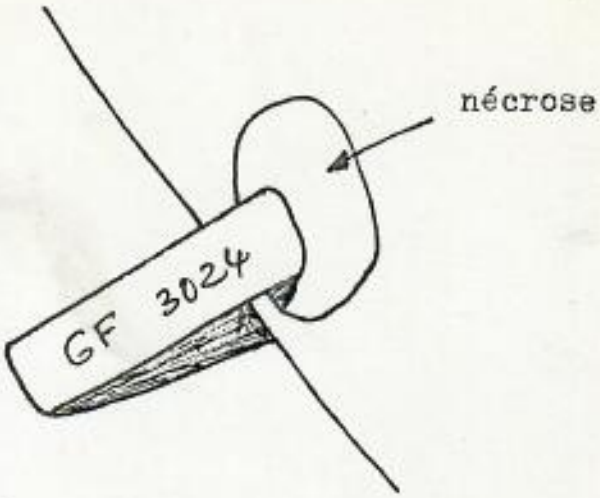
J'utilise pour les femelles Dermochelys coriacea les grandes marques (tags) dont Vous avez ci-joint un exemplaire. Ces marques se mettent directement à la patte de la tortue avec une pince spéciale comme pour les marques métalliques du modèle habituel.

Pour Chelonia mydas et autres petites espèces dont la peau des pattes est plus dure, on peut utiliser le modèle plus petit (voir exemplaire échantillon n° 021) avec un message sur la deuxième face comme les grandes marques. Pour poser cette marque chez Chelonia, il faut faire au préalable un petit trou avec emporte-pièce fourni par le fabricant.

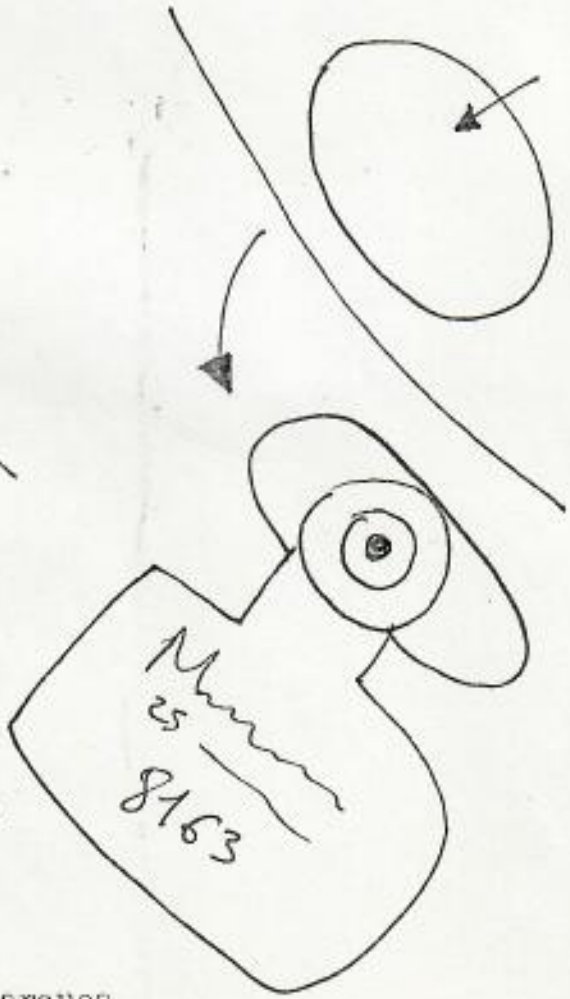
Le fabricant est: CHEVILLOT identification
119, rue Vieille du Temple
75003 Paris FRANCE

Le modèle de grande marque s'appelle: AXAFLEX C.4 jaune
prix à l'unité: 1,72 franc
prix de la pince automatique: 195 francs

Il me semble que ces marques de matière plastique blesse moins les tortues et sont mieux supportées physiologiquement. Elles se voient mieux que les marques métalliques la nuit et le numéro peut se lire plus rapidement. Mais peut-être sont-elles perdues plus facilement aussi par le fait que les tissus de la patte peuvent se nécroser et libérer l'étiquette.



avec les marques métalliques; si le trou dans la patte s'agrandit, la marque peut tenir.



avec les marques plastiques; si le trou s'agrandit, la marque peut partir. C'est l'inconvénient de cette marque.

Si Vous voulez essayer ces marques AXAFLEX, dites-le moi je m'en occuperai avec le fabricant CHEVILLOT. Il faut faire un poinçon (environ 500 francs) pour le nom du laboratoire. Cordialement.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

11/16/83

To : George

Larry

From:

Don't understand the premise regarding boric acid and sound absorption and the subsequent conclusion — but, this is the first reference I've read stating flatly the Pacific is more acidic than the Atlantic. If so, has bearing on tag loss (corrosion) problem out your way

Mayke

TRANSMITTAL FORM CD-82A (10-67)
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JOHN TIERNEY. 1983. THE INISIBLE FORCE.
SCIENCE 4(9):74. NOVEMBER

(continued from page 71)

The classic view of the ocean, the one used by acoustics engineers for listening to subs, was of a relatively stable mass of water—turbulent at the surface, of course, and crisscrossed by great currents like the Gulf Stream, but generally constant and predictable, especially in deep waters. Then, when researchers tracked floats set loose in the north Atlantic, they discovered currents spinning out in rings from the Gulf Stream. By the early 1970s it was clear from satellite observations that all the oceans were swirling mixtures of these circular currents called eddies. Sometimes warm water flowed around a core of cold water, sometimes vice versa; the patterns changed incessantly and inexplicably. New underwater sensors revealed more surprises: currents in the deep. Sensors nearly two miles deep in the Atlantic would float southeast for three weeks, then southwest for a month. Some of the sensors would move 50 feet per hour, others 500.

"No matter where oceanographers looked in the 1970s, they found eddies," said Robert Stevenson, a Navy oceanographer stationed at Scripps. "There was an absolute revolution in oceanographic research. This had a huge impact on underwater acoustics, because acoustics was based on the concept that the ocean is horizontally laminated—and the oceanographers were saying, 'Sorry, friends, this isn't so.' Then a lot of sea stories came in, with skippers saying, 'Hey, that explains why I was going along with my sonar and I had a contact and then I didn't.'"

The problem, as the skippers realized, is that the changing water temperatures in an eddy would make any sound waves that tangled with it bend crazily. When a sound is made underwater, the vibrations cause adjacent water molecules to alternately press together and spring apart. These molecules in turn bump the next molecules, and they bump against the next, and the sound is transmitted through the water. Water molecules are more closely packed than air molecules, so it takes less time for each molecule to bump the next, and sound travels five times faster. Raising the pressure or the temperature of the water increases the speed of sound, which has important consequences in the ocean. Sound waves in water bend in the direction of lower temperature or pressure, where they travel slowest. Think of a row of soldiers marching abreast at an angle across a road and into a muddy field: Each soldier is slowed as he enters the mud, but the rest march at their original pace. The effect is to swing the row around to face the field.

All of which produces strange effects even in a neatly layered textbook ocean. About 3,000 feet below the surface, for instance, lies a narrow duct toward which sound waves above and below are bent because of changes in temperature and pressure (see pages 72-73). A sound focused along this Deep Sound Channel, as it's called, sometimes travels halfway around the world, as scientists discovered in 1960 when a depth charge set off in an experiment off Australia was heard in Bermuda. A sub's noises in the channel can also travel great distances—in a textbook ocean.

But in the real ocean those eddies can disrupt the Deep Sound Channel by raising the bottom cold water a thousand feet above normal. The sounds from a sub in the cold core of an eddy can be bent away from the adjacent warm water—and anyone listening there. Sound waves also are scattered by undersea mountains or sea floor deposits. The speed of sound can change hourly, especially in surface waters. Shipboard sonar operators talk about the "afternoon effect," whereby a sub that they heard in the morning becomes inaudible because its noise is bent away from the surface water newly warmed by the sun. Sound waves are also distorted when they bounce off plankton and gas-filled bladders of fish that make up the "deep scattering layer"; this layer typically lies at least 600 feet below the surface at night, then drops during the day.

Even the highly variable chemistry of ocean waters plays a role. In the 1960s oceanographers were mystified because in some waters low-frequency sounds were one-tenth as strong as predicted. Tests in Lake Superior, the Red Sea, and Lake Tanganyika suggested that sound waves were breaking apart and then recombining the boric acid ions in the water. The process soaked up acoustic energy, weakening the sound. It turned out that this sound absorption is related to the acidity of the water, which explains why the more acidic Pacific absorbs sound less than the Atlantic—again, on average. There are always those local variations.

"What we've found," said Stevenson, "is that the ocean is variable at every parameter—temperature, pressure, salinity, you name it." In classical antisubmarine warfare, protecting a ship from a marauding submarine, this variability doesn't matter quite so much: The waters around the ship can be monitored carefully for changes. But a ballistic missile submarine makes for a whole new problem.

Shhh . . .

Since 1960, when the first Polaris went on duty, American missile-carrying submarines have gone on more than 2,000 patrols. According to the Navy, the Soviet Union has never tracked a single one.

Sometime in the last 23 years other submarines or ships *must* have happened to hear one of these Polaris, Poseidon, or Trident subs, but the Navy insists that no one has set out to follow one and succeeded. The Soviets dispute this claim, and so do some Americans. After all, a sub might have been tracked without its skipper's knowledge. But most experts I talked to tend to believe the Navy. These subs don't have to give themselves away by approaching an enemy ship or port. During their two-month patrols, they can meander at leisure and still strike anytime. The first Polaris could hit a Soviet target from 1,400 miles away. Now the Trident can strike from 4,000 miles. When the new 6,000-mile missiles are put on the Trident about 1990, it will be able to hide in more than 40 million square miles of ocean and still fire on Moscow.

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George H.Balazs, Wldlf.Biologist
National Marine Fisheries Service
Honolulu Laboratory
PO Box 3830
Honolulu, Hawaii 96812

December 4, 1984

"OUR 82nd YEAR"

Dear Dr. Balazs:

Receipt is acknowledged of your November 30, 1984 letter requesting information on a size 49 tag which you found on a sea turtle in Mexico recently. You mention there is a Spanish inscription on one side of the tag. Could you advise exactly how this reads as we do not recognize the BUR. COMM. FISH SAN DIEGO 6 stamping which you mention is on one side of the tag.

We await your further word.

Sincerely,

NATIONAL BAND AND TAG COMPANY

Linda Collins

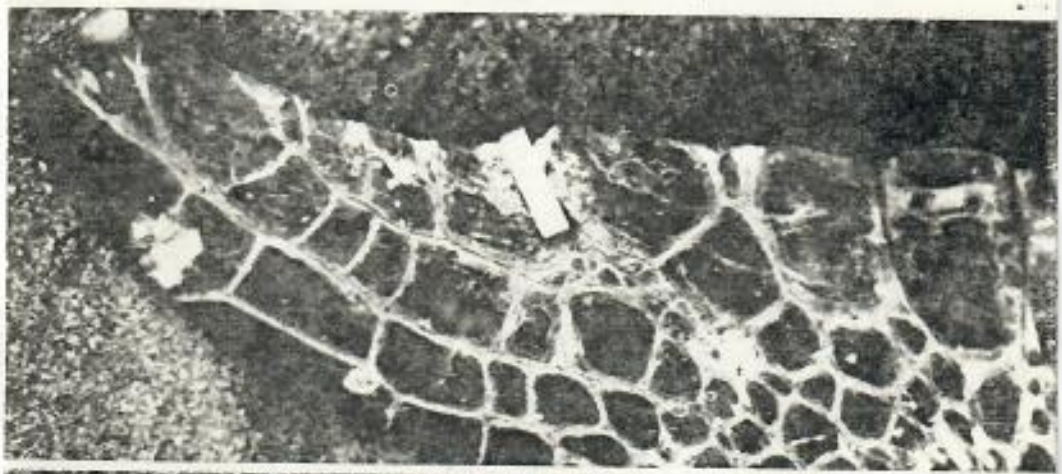
Linda Collins

lc/1

TURTLE RESEARCH AREA

PLEASE ASSIST BY NOT USING LIGHTS
KEEP NEAR HIGHWATER MARK
KEEP BEHIND NESTING TURTLES.

AUSTRALIAN NATIONAL UNIVERSITY.



Reef, pending which the green turtle should be placed on the list of protected animals. However, no research was carried out on the green turtle until, in 1964, I visited Heron Island at the southern end of the Great Barrier Reef and initiated a study of the population ecology of Queensland green and loggerhead sea turtles.

All the adult female turtles nesting on Heron Island are tagged, after laying their eggs, by means of a monel metal tag (invented by Tom Harrisson) fixed to the trailing edge of the left front flipper (see opposite); some on nearby islands were also tagged. On Heron Island information is kept on all nesting turtles throughout a 15-week period each summer, including clutch size and incubation success, and we have had recaptures from as far away as Papua-New Guinea and New Caledonia. For three years we operated a 50,000-egg capacity hatchery (opposite) and marked large numbers of hatchling turtles for growth studies. The research, now in its fifth year and still in progress, is an excellent example of conservation work in practice. Every summer thousands of people visit the island, watch our work and learn of our aims.

In February 1968 as a result of preliminary data collected in the first four years, I requested the Government to extend protection to all sea turtles, and if possible extend the legislation to the whole State. This recommendation was supported by the Great Barrier Reef Committee and other interested bodies, including the Wildlife Preservation Society of Queensland. The result was the Order in Council already quoted.

Properly exploited, sea turtles and/or their eggs could be a valuable continuing source of protein; unfortunately, exploitation is frequently extremely short-sighted. Europeans usually take turtles on the beaches at the start of the breeding season before the female turtle has even laid her eggs. As green turtles nest about every three years, a three-years' crop of up to about 1000 eggs is wasted. Furthermore the male turtles remain an untapped resource whilst the females are greatly overfished. Schemes like Tom Harrisson's in Sarawak, which utilise only the eggs, are much better. However, these may suffer from not enough eggs being protected and allowed to hatch. At least 10 per cent of the eggs laid should be protected from predators, and the hatchlings liberated in deep water over the edge of the reef. Many reptile eggs are very susceptible to movement even when freshly laid, and collecting and moving them to an adjacent hatchery, even using great care, results in a lower percentage hatch. It is, of course, much more practical to move eggs to a central hatchery than to construct enclosures around individual nests. However, if the eggs are moved in order to protect them, then the proportion protected should be increased to a minimum of 15 per cent, the remainder being available for human consumption.

The new legislation in Queensland alters the conservation problems of many sea turtles, but the leathery turtle, unless an important rookery is found in Queensland or elsewhere in northern Australia, has the least certain future of the world's sea turtles. Every effort must be made to increase substantially the percentage of the leathery turtle's eggs being protected in Malaya and to try again to start a hatchery scheme in Ceylon.

TAG FILE

PLASTIC TAGS ON LEATHERBACK SEA TURTLES, DERMOCHELYS CORIACEA

Abstract. Tagging of the Sandy Point, St. Croix, population of nesting leatherback sea turtles began in 1981; saturation tagging was initiated in 1982. Tags were placed along the trailing edge of the fore flippers, ca 20 cm from the body. All nesting females were double- or triple-tagged. Twenty-eight remigrations involving 20 individual turtles were documented between 1981-1985.

Size-19 monel tags (National Band and Tag, USA) were found to abrade the carapace within 9 - 10 days of application. In an attempt to alleviate this problem, monel tags were placed "up-side-down", i.e., with the number facing downward and the abrading cinch-tab facing upward. This method was successful in minimizing carapace damage, did not complicate tag application, and did not affect the survivability of the tag.

Size-2 Riese tags ("Flexible Jumbo"; Dalton Ltd., England) were applied in conjunction with the up-side-down monel tags in hopes that the plastic tags would show acceptible survivability while at the same time eliminating carapace damage.

Riese tags effected no carapace damage but showed dismal recovery rates. In an analysis of tag loss following one, two, and three years of absence, 23 out of 26 (88.5%) Riese tags on returning turtles had been lost. Turtles returning after one year displayed 100% Riese tag loss; turtles returning after two years, 86.4% loss; turtles returning after three years, 100% loss. In addition, the fore flippers showed a remarkable degree of regeneration, and only rarely did a hole, notch, or callosity remain to attest to the tag loss.

In contrast, after up to four years of absence, five out of 31 (16.1%) monel tags on returning turtles had been lost. Turtles returning after two years of absence displayed 15.8% monel tag loss; turtles returning after three years, 33.3% loss; turtles returning after four years, no loss.

Intensive tagging efforts with localized populations, such as occur on Sandy Point (St. Croix) and Culebra (Puerto Rico) National Wildlife Refuges, provide excellent arenas in which to assess the effects of tagging, as well as the comparative survivability of tag type and placement, because turtles returning both intra- and inter-seasonally are closely monitored.

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Athens, Georgia 30602

6th Annual Sea Turtle Workshop, Waverly, Georgia. 19 - 21 March, 1986.

April 18, 1986 F/SWC2:GHB

Mr. John Forehan
STOCKBRANDS Co. Pty. Ltd.
P. O. Box 80
Mt. Hawthorn
Western Australia 6016

Dear Mr. Forehan:

I am writing to let you know that the titanium sea turtle tags we purchased from you last year have a malfunction to the locking mechanism. When applied, the piercing tip of the tag fails to align and pass back through the round hole. We have tested both of the applicators we ordered, as well as tags from several different number lots among the 500. All show this same malfunction.

We consider the tags to be still usable, since the tip does bend somewhat back over to the face of the tag. Nevertheless, it does not function in the manner intended. We would be interested to learn if this problem has been reported to you before. Also, we would like to know if there is anything we can do to the tags and/or applicators to correct the problem.

Your consultation on this matter will be greatly appreciated. I have enclosed three locked tags for your inspection.

Sincerely,

George H. Balazs
Zoologist

cc: Col Limpus
Larry Ogren
Karen Bjorndal
Jack Woody
Nat Frazer

cc: Balazs ✓
HL

Incoloy DS has good oxidation-resistance and strength at high temperatures, and resists green rot attack. A wrought alloy, it is applied to furnace and petroleum-cracking tubes. The composition is 40 nickel, 20 chromium, 8 cobalt, 5 tungsten, 1 niobium (columbium) per cent, the balance iron. The alloy has higher ductility, impact resistance and resistance to stress corrosion cracking. Its uses include reformer furnace tubes, and other applications where metallurgical stability, resistance to oxidation and carburization, and other properties are required.

Incoloy 825 has good resistance to hot acid and oxidizing conditions.

Inconel Alloys An important range of nickel-chromium alloys containing in the wrought form 76 nickel, 16 chromium, 8 iron, per cent, and in the cast form 72 nickel, 16 chromium, 8 iron, 2 silicon, per cent. The alloys are used wherever good strength and considerable resistance to corrosion and oxidation at high temperatures are required. They are not, however, suitable for sulphidizing atmospheres at temperatures in excess of 820 deg. C. (1500 deg. F.). Density is 8.51 g/cu. cm. (0.307 lb/cu. in.). The principal difference between this alloy and Monel Metal (q.v.), is its corrosion resistance and the absence of copper from its composition. It is slightly less dense than Monel Metal, and besides having much strength, is readily hot- and cold-worked. It does not age, nor is it affected by stress corrosion. Tables XVI and XVII give the useful mechanical properties of the alloy. Values intermediate between these can be obtained for special purposes. As measured by impact properties the alloy is tough and has good fatigue resistance, so that it is widely used for making spiral springs designed to withstand the usual weakening effects of high temperatures, up to 400 deg. C. (750 deg. F.). Table XVIII shows the corrosion resistance of Inconel.

There are numerous specific applications of the alloy, e.g. the protective sheathing of electrical heating elements, vacuum drying trays for chemicals, tanks, electric hot-plates, sterilizing cylinders, spherical food pans, steam valve trim, nitriding boxes, varnish kettles, stills employed in food manufacture, desulphurizing equipment in making viscose rayon, etc. It can be readily machined with high speed steel tools. Welding, soldering and brazing are all possible, but in welding, care is taken to avoid fine cracks. Forging presents no difficulties as long as the temperature is kept below 1260 deg. C. (2300 deg. F.). Creep strength is good up to 1100 deg. C. (2000 deg. F.).

Casting temperature range is 1540-1600 deg. C. (2800-2900 deg. F.).

The Inconel alloy can be used as a cladding for steel. It is then often referred to as Inconel 600.

Inconel 713LC Alloy A superalloy of the Inconel group, containing typically 0.06 carbon, 12 chromium, 1.5 cobalt, 4.5 molybdenum, 0.6 titanium, 6 aluminium, 0.3 iron, with 2 columbium (niobium) + tantalum. It is a cast superalloy.

Inconel 718 Alloy is a nickel-chromium heat-resisting superalloy designed for ordnance use, and is particularly suitable for mortar tubes, rocket tubes, thrust chamber jackets, fuel ducts, injector plates, turbine wheels and shafts, bolts, propellers of hydrofoil ships, turbine and compressor bearing seals, etc. It has a tensile strength of about 51.5 tons/sq. in., yield strength 67 tons/sq. in., elongation 18 per cent, so that it is moderately ductile, but has high

TABLE XVI

Condition	Tensile Strength Tons per sq. in.	Yield Strength 0.2 per cent permanent set. Tons per sq. in.	Elongation per cent. in 2 in.	Brinell No.	Izod ft.lb.
Annealed sheet, strip, tubing, cold-drawn rod	35-42	11-18	50-30	130-170	120 (rod)
Annealed cold-drawn wire ...	36-47	"	"	—	—
Hot-rolled or forged bars ...	36-42	"	"	130-170	120
Hard-rolled sheet, strip, tubing	56-76	40-62.5 (sheet and tube)	15-2	220-250	—
Spring wire, cold-drawn ...	74-83	—	10-2	—	—
Cast	30-32	18-20	15-10	150-170	—

TABLE XVII

Condition	Compressional		Tensional				Brinell Hardness No.
	Yield Strength 0.2 per cent. permanent set t.s.i.	Yield Strength 0.01 per cent. permanent set t.s.i.	Tensile Strength t.s.i.	Yield Strength 0.2 per cent permanent set t.s.i.	Yield Strength 0.01 per cent. permanent set t.s.i.	Elongation in 2 in. per cent.	
Hot rolled	19	14	41	21	17	42	159
Cold-drawn	47	40	54	50	44	19	210
Cold-drawn annealed	13	10	42	15	15	42	136

TABLE XVIII CORROSION RESISTANCE OF INCONEL

Corroding Agent	*Degree of Resistance*
Normal atmospheres ...	Complete.
Sulphurous atmospheres	Satisfactory.
Water	Complete.
Sea water	High, to moving water. Subject to pitting in still water.
Neutral and alkaline salts	Complete for most salts.
Refrigerating brines ...	Relatively free from pitting, but liable to slight local attack.
Oxidising acid salts ...	Unaffected except by high concentrations of ferric chloride, cupric chloride or mercuric chloride, in solution.
Oxidising alkaline salts ...	Unaffected by hydrogen peroxide solutions. Should not be exposed to over 5 gm. of available chloride per litre, in hypochlorite solutions.
Mineral acids	Fair to sulphuric and hydrochloric acids; superior to most other alloys towards attack by hydrogen sulphide. Do not use for concentrated or hot dilute hydrochloric acid solutions. Completely resistant to *very* dilute sulphuric acid solutions.
Oxidising acids	Highly resistant. Not resistant to solutions containing appreciable proportions of sulphur-dioxide.
Organic acids	Practically complete towards food acids. Fair to hot, concentrated organic acid solutions. Highly resistant to stearic and oleic acids.
Alkalis	Practically complete, except for very highly concentrated caustic alkali solution.
Wet and dry gases ...	Not resistant to wet chlorine, bromine or sulphur-dioxide atmosphere. Completely resistant to attack by hot steam and withstands oxidation up to 1,100 deg. C. Withstands the attack of reducing sulphur atmospheres up to about 540 deg. C. (max.), and oxidising sulphur atmospheres up to about 815 deg. C. (max.). Resists attack by "nitriding" gases.

toughness and fatigue strength. It is liable to work-harden when machined, but resists salt water corrosion and fatigue.

Inconel X-750 Alloy is a superalloy of the series, containing typically 0.04 carbon, 15 chromium, 2.5 titanium, 0.9 aluminium, 7 iron, 1 columbium (niobium), per cent, the balance nickel. It is a wrought alloy.

Indilitans Alloy An iron-nickel alloy having a low coefficient of thermal expansion, and of American origin. Its basic composition is 36 nickel, with a balance of iron. Early forms of this alloy contained 0.4 manganese and 0.1 carbon. The low expansion coefficient is its important advantage, but in addition it has high corrosion-resistance, strength and shock resistance. The value of the alloy is higher in propertion to its freedom from impurities, unless these are balanced by modification of the basic propertions. The expansivity is influenced by heat-treatment and cold-working, maximum values being obtained at about 600 deg. C. (1100 deg. F.). Another name for this alloy is Nilvar (q.v.).

Inhibited Admiralty Brass Alloy An alloy of 71 copper, 28 zinc, 1 tin, per cent, commonly known as Admiralty Brass (q.v.).

IN-100 Alloy A nickel-base alloy for heat-resistance, containing typically 0.15 carbon, 10.5 chromium, 14 cobalt, 3.0 molybdenum, 4.8 titanium, 5.4 aluminium, per cent, the balance nickel. It is a cast superalloy. See Nickel Alloys and Superalloys. 1.0 per cent vanadium + boron and 0.06 zirconium are included.

IN-102 Alloy A wrought nickel-base alloy containing nominally 15 chromium, 2.9 niobium, 2.9 molybdenum, 3 tungsten, 7 iron, 0.06 carbon, 0.5 aluminium, 0.5 titanium, 0.005 boron, 0.03 zirconium, 0.02 magnesium, per cent, the balance nickel. It has good strength, ductility, and corrosion-resistance, with a high degree of structural stability. It is designed for long-time service at about 700 deg. C. (1300 deg. F.). Density 8.57 g/cu. cm. (0.309 lb/cu. in.).

INOR-8 Alloy An American projected alloy containing 71.6 nickel, 16.58 molybdenum, 6.81 chromium, 4.10 iron, 0.49 cobalt, 0.32 manganese, 0.21 silicon, 0.05 carbon, 0.034 magnesium, 0.03 titanium, 0.01 aluminium, 0.003 boron, and traces of sulphur and phosphorus, per cent. It is designed for heat resistance under conditions of nuclear service.

IN 732 X Alloy An alloy of new type, containing nominally 30 nickel, 2.8 chromium, per cent, the balance copper, and of American origin. It is designed for corrosion-resistance in marine environments. Yield strength is over 22 tons/sq. in. The alloy has unique hardening properties, as well as high strength. Impact resistance is more than 150 ft. lb. Charpy, so that it is extremely tough.

Interurban No. 27 Alloy An American hard babbitt alloy, equivalent to Genuine Babbitt Alloy (q.v.).

Invar Low Expansion Alloy Identical with Nilvar (q.v.), and contains 36 per cent nickel. See also Indilitans Alloy. A form of cast iron containing 34-36 per cent nickel is known. It is used for surveyors' tapes, clock pendulums and other parts needing invariable length with temperature.

Iridiosmine Alloy See Osmiridium Alloy.

Iridium Alloys:

Iridium-Rhodium Alloy Used for temperature measurement, as is:

Iridium-Tungsten Alloy.

Ironier's Bronze Alloy A little-known alloy consisting of equal parts of copper and tin, with the addition of about 2.0 per cent mercury.

Iron-Nickel Alloys Magnetically soft alloys for good overall properties, high permeability and low losses. They are used for audio transformers, coils, relays, and many other parts. Typical examples are Hipernik and Permalloy alloys (q.v.).

Iron-Nickel-Copper-Molybdenum Alloys Alloys of British origin designed for high permeability and of low-field magnetic type. They contain nominally 77 nickel, 14 iron, 5 copper, 4 molybdenum, per cent, and are produced by powder metallurgy.

Isoperm Alloy A nickel-iron alloy, whose main advantage is an exceptionally low hysteresis value, employed particularly for cable loading-coil cores.

Jacoby's Alloy An alloy for bearings containing typically 80 tin, 10 antimony, 5 copper, per cent, and possessing anti-frictional properties. It has a white tint.

J.A.E. Alloy A British-made nickel-copper alloy containing basically 70

nickel, 30 copper, per cent, designed for electrical use in compensating shunts, etc. Density is 0.322 lb/cu. in., specific gravity 8.94, melting range 1300-1350 deg. C.(2370-2460 deg. F.). Tensile strength 28 tons/sq. in., elongation 52 per cent, Brinell hardness 110. It has a high temperature coefficient of magnetic permeability.

Japanese Blue Gold A copper alloy for ornamental and decorative use designed as a substitute for costlier metals. Basically it contains 90-99 copper, 10-1 gold, per cent.

Japanese Brass Alloy A type of brass containing about 55 copper, 45 zinc, per cent.

Jewellery Bronze Alloy A copper alloy containing 87.5 copper, 12.5 zinc, used in the jewellery trade and also in architecture. It is also a base for gold plate. Density is 8.78 g/cu. cm. (0.317 lb/cu. in.). Tensile strength ranges from 17-33 tons/sq. in., approx., yield strength 4.5-28 tons/sq. in., elongation 47-4 per cent in 2 in., Rockwell hardness F55-68, B47-82. The range covers the various tempers in which the alloy is supplied. The alloy can be worked and joined in the same manner as Gilding Metal (q.v.).

Johnson Bronze Alloys American proprietary alloys of tin-antimony-copper type, containing basically 91 tin, 4.5 antimony, 4.5 copper (soft babbitt alloy) or 89 tin, 7.5 antimony, 3.5 copper (hard babbitt alloy). They are used for both bronze-backed and die-cast bearings. They largely correspond to Genuine Sovereign Babbitt Alloy (q.v.) and Genuine Babbitt Alloy (q.v.). Some of the hard babbitt alloys of this type contain 1 per cent graphite, and are used for oil-impregnated bearings.

Journal Brass Alloy A copper-lead-bronze alloy containing typically 70 copper, 5.5 tin, 24.5 lead, per cent, largely used for journal bearings on railways as a babbitt metal. It has a comparatively high load-carrying capacity.

Kanthal Alloy An iron-chromium-aluminium electrical resistance alloy used because of its remarkable electrical and oxidation resistance at temperatures exceeding those at which nickel-chromium alloys can be safely used. It is therefore primarily applied to furnaces and electrical heating units, both household and industrial. The basic composition is 67 iron, 25 chromium, 5 aluminium, 3 cobalt, per cent. These proportions of chromium, aluminium and cobalt can be varied to give three qualities operating successfully at the respective temperatures of 1150, 1300, and 1340 deg. C. (2100, 2370 and 2450 deg. F.). They give in the heat-treated condition tensile strengths at 20 deg. C. (70 deg. F.) of about 49 tons/sq. in., and reduction of area 64 per cent. Strength is quickly lost at temperatures above 1100 deg. C. (2000 deg. F.), so that in use they must be supported.

Karakane Alloy A copper-tin-iron-zinc alloy containing typically 10 copper, 10 tin, 0.5 iron, 1.5 zinc, parts. It is used for the casting of bells.

Kennametals An American range of hard carbide metals. See Tungsten Carbide.

Kennertium W 2 Alloy An American heavy tungsten alloy, said to be 62 per cent heavier than lead by volume, and designed for radioactive shielding, balancing and rotational inertia. It has an ultimate tensile strength of 45 tons/sq. in., yield strength 38 tons/sq. in., elongation 3-5 per cent. Density is 0.67

lb/cu. in. It possesses high strength, rigidity, easy fabricability, machinability and ability to be soft soldered or brazed. Typical applications are to pressure bombs, capsules, shutter devices for oil well exploration, radioactive containers, counterweights for ailerons and variable pitch propellers, governors and centrifugal clutches.

Key Alloy A copper-tin-lead-zinc alloy employed in the production of certain types of keys. Essentially a bronze, it contains basically 80 copper, 10 tin, 5 lead, 2 zinc, per cent.

Kienmayer's Amalgam A mercury-containing alloy designed to minimize friction in mechanical appliances. It contains one part zinc, one part tin, two parts mercury.

Kingston's Alloy A tin-copper bearing alloy having anti-frictional properties, and containing 88 tin, 6 copper, 6 mercury, per cent. It is a white metal used for bearings.

Kirksite Alloys Zinc-base stamping alloys for dies containing about 4 per cent aluminium, and broadly similar to the zinc-base die-casting alloys (q.v.). They are mainly employed for the critical parts of dies subject to wear or extreme pressures, and are mostly used in conjunction with a rubber punch in hydraulic presses. Having a low melting point (380 deg. C.-715 deg. F.), however, lead alloy punches can also be cast straight from the zinc die or even made from the alloy itself. As sand-cast the alloys have about 16-17 tons/sq. in., tensile strength, compressive strength of 27-33 tons/sq. in., elongation of 3 per cent in 2 in., and Brinell hardness of 80-107. They are applied mostly to the intermediate range of uses between mass-production and hand-tooling, when tooling with metals of iron base would be too costly.

K Monel Alloy A nickel-copper alloy containing basically 66 nickel, 29 copper, 3 aluminium, designed for use where high strength and corrosion resistance is required in such parts as pump rods, springs, shafts, valve stems, and non-magnetic parts of aircraft. It can be produced in large cross-sections. In sulphidizing atmospheres it is not used at temperatures above 310 deg. C. (600 deg. F.). Density is 8.47 g/cu. cm. (0.306 lb/cu. in.). The tensile strength range is 67 tons/sq. in., yield strength 49 tons/sq. in.

The alloy has good resistance to dilute mineral acids, salt water and steam, but does not withstand oxidizing acids. Elongation ranges from 45-15 according to the condition and form of the material. Brinell hardness similarly ranges from 140-320. These values correspond to cold-drawn rod and bar, annealed, annealed and age-hardened, as drawn, and as-drawn age-hardened. Different values are obtained on hot-rolled and forged material in the same form, and different again on cold-drawn wire and strip.

Essentially this alloy is a modified Monel Metal (q.v.), the difference being the addition of aluminium. It will respond to normal heat-treatment. Specially important is the ability of the alloy to be heat-treated *after* mechanical working, so that a strength as high as that of some alloy steels is obtainable by heat-treating a hard-drawn or hard-rolled section. This with the advantage of high corrosion resistance makes the alloy highly suitable for specific purposes. The material is non-magnetic at room temperature, and for this reason is used for stressed parts in locations close to compasses and similar instruments, but must be carefully cleaned or the superficial oxide

will render it slightly magnetic.
Casting temperature is 1450 - 1510 deg C.
all types of forming processes can be used, and the usual methods of joining employed.

Monimax Alloy An American magnetically soft alloy containing 43 per cent nickel, 3 molybdenum, the balance iron. It is designed for above average resistivity, high permeability and high frequency coils. Permeability is 2,000-35,000, and resistivity, 80 microhm-cm.

M.I.A. Alloy A magnesium wrought alloy of American type containing basically 1.2 manganese, 0.09 calcium, per cent, the balance magnesium, designed for wrought products having reasonable mechanical properties together with extremely good weldability, combined with resistance to corrosion and ability to be hot-worked. Density is 1.76 g/cu. cm. (0.064 lb/cu. in.). It has a tensile strength of about 15.5-16 tons/sq. in., yield strength 8-10 tons/sq. in., elongation 17-7 per cent in 2 in., Brinell hardness 42-54. It can be heat-treated and joined by the usual processes, but resistance welding is widely used.

Monotype Die-Casting Alloy A type-metal alloy capable of being mechanically die-cast and used in the printing industry. It has a rapid cooling rate so that hard alloys can be used having a high melting range. It has excellent casting properties, wear-resistance and resistance to pressure. The composition range is 64-78 lead, 7-12 tin, 15-24 antimony, per cent, Brinell hardness is 24-33. A typical monotype alloy contains 76 lead, 8 tin, 16 antimony, per cent, and has a contraction rate of 2.0 per cent.

Monel Metal Alloys A range of nickel-copper alloys used for applications demanding high strength and corrosion-resistance. Extensive use is made of them, particularly in the chemical, marine, power, electrical, oil refinery, textile, pulp and paper, industries, while they are also used considerably for domestic and architectural purposes. They are resistant to many forms of corrosion, such as that by marine atmospheres and sea water, dilute sulphuric acid and strong alkaline solutions. Density is 8.84 g/cu. cm. (0.319 lb/cu. in.). See Tables XXII and XXIII.

Monel Alloy 400 is a general-purpose corrosion-resistant alloy of this type.

Monel Alloy K500 can be heat-treated and has increased strength.

The alloys have a white tint, and their mechanical properties are tensile strength 41 tons/sq. in., cold-drawn, 35 tons/sq. in., annealed; respective yield strengths being about 26 and 10, and elongation 27 and 44 per cent in 2 in., while Brinell hardness is 199 and 123. The casting temperature range is 1480-1560 deg. C. (2700-2850 deg. F.). The alloys can be soldered, brazed and welded by the normal processes. A typical composition is 65-70 nickel, 26-30 copper, up to 3.0 iron, up to 1.5 manganese, up to 0.25 silicon, up to 0.25 carbon, per cent. The metal is magnetic and tough, but is not susceptible to heat-treatment. Its strength is greater than that of low carbon steel by about 10-15 per cent. Special types of Monel Metal are used for specific purposes. See H Monel, K Monel, R Monel, S Monel, etc.

Montegal Alloy An aluminium-magnesium alloy having a typical composition of 0.95 magnesium, 0.8 silicon, per cent, the balance aluminium, designed for parts requiring hardness above the average. It is susceptible to heat-treatment, and has a tensile strength of 21-22 tons/sq. in.

More Jones Alloys A series of American proprietary bearing alloys. *More Jones Crescent Alloy* is a high-tin, lead-base alloy containing typically (a) 10

TABLE XXII

Property	Hot-rolled. Tons per sq. in.	Cold-drawn. 1in. diameter. Tons per sq. in.
Tensile strength	27–28	40–42
Yield Point	12–16	33–36
Limit of proportionality	9–13	20–22

(Henry Wiggin and Co., Ltd.)

TABLE XXIII

Temperature Deg. C.	Ultimate Tensile Strength, Tons per sq. in.	Limiting Creep Stress. Tons per sq. in.	Limit of Proportionality. Tons per sq. in.
Room	37	–	15
100	35	–	14
200	33	–	13
300	34	–	12
400	32	22	10
500	28	10	6
600	20	2	–
700	14	1	–

(Henry Wiggin and Co., Ltd.)

Effect of Temperature on the Mechanical Properties of Monel Metal

or 20 tin, 12.5 or (b) 15 antimony, 63.5 or 75 lead, and 0.2 or 1.5 copper, per cent. It has a tensile strength of about 6.5 tons/sq. in., at room temperature and about 3.25 tons/sq. in., at 100 deg. C. (212 deg. F.). Brinell hardness corresponding ranges from 21-22, and 10-11.

More Jones Improved Alloy is a low-tin, lead-base bearing alloy containing 5 tin, 9-15 antimony, 80-86 lead, and not more than 0.5 copper, per cent. Softer and weaker than the high-tin bearing alloys, it has largely similar properties.

More Jones Hoo Hoo Alloy is a soft babbitt alloy containing basically 91 tin, 4.5 antimony, 4.5 copper, per cent, with modifications if required. It has a tensile strength of about 5.5 tons/sq. in., yield strength 9.8 tons/sq. in., Brinell hardness 17, all at 20 deg. C. (70 deg. F.) temperature. It is used for both bronze-backed and die-cast bearings.

More Jones Nickel Alloy is a hard babbitt bearing alloy containing basically 89 tin, 7.5 antimony, 3.5 copper, used for shaft and connecting rod bearings where higher pressures are encountered, and also for die-casting. Tensile strength at 26.7 deg. C. (80 deg. F.) is about 5 tons/sq. in., elongation 11.5 per cent, Brinell hardness 25.5.

magnesium, 0.2 nickel, per cent, the balance being silver. They are like fine silver in being resistant to corrosion and stain, and are designed for use where a combination of high electrical and thermal conductivities is required together with a hardness uninfluenced by the temperatures of soldering and brazing or by high working temperatures. Characteristic applications include brazed electrical contacts retaining hardness; high-heat-conductive spring clips for miniature vacuum tubes; instrument and relay springs that have to be highly conductive of electricity or to work at high surrounding temperatures; and electrical parts that have to be severely formed and afterwards hardened. They have rates of creep of about 1/10th that of silver, and creep causes them to show virtually no elongation when they fracture.

The higher magnesium alloy (0.28 per cent) has a tensile strength of about 29-31 tons/sq. in., yield strength 24-26 tons/sq. in., elongation 5-15 per cent, Rockwell 30T hardness 63-68. The corresponding values for the lower magnesium alloy (0.22 per cent) are 27-29, 20-22, 13-21 and 58-63.

In the annealed state the alloys are soft, easily formed, and somewhat harder than fine silver.

Silver Soldering Alloys See Silver Alloys and Silver-Brazing Alloys.

Silver Amalgam A solution of silver and mercury containing about 26 per cent silver, but one type known as *Arquerite* has about 86 per cent silver. It is an uncommon mineral, found in nature either dispersed in mercury or in deposits of silver.

Silverite Alloy See Nickel Silver.

Silveroid Alloy An industrially used nickel-copper-tin-zinc-lead alloy in varying compositions employed for decorative purposes and also for the same industrial purposes as Nickel Silver (q.v.).

Simanal Alloy An American proprietary alloy containing typically 86.75 silver, 8.8 manganese, 4.45 aluminium, per cent, designed for permanent magnets, the silver being a replacement for the copper used in other magnet alloys. It is somewhat costly, but is workable and machinable, which not many highly-alloyed magnets are, and it also has a high coercive force so that it can stand up to highly demagnetizing effects. It is therefore suitable for heavy a.c. field work, or as the moving element in instruments for measuring magnet strength. It has a low residual flux or remanence of $B_{rem.}$ 550, so that it needs a considerably larger area than most other magnets to develop the same flux. It is often used in thin disc form magnetized across its thickness. It is thus suitable for compass needles magnetized across the width rather than the length, and pointing therefore east and west.

Simgal Alloy A British aluminium-base alloy of low strength, but when heat-treated, giving a proof stress of about 12 tons/sq. in., and tensile strength of 14 tons/sq. in. It is specially designed for intricate extruded parts, anodizes well, and is used in this process and for other purposes involving dyeing.

Sincomax Alloys A British range of permanent magnets produced by powder metallurgy and then sintered and employed for measuring instruments.

Singer's Amalgam A blend of tin and zinc in mercury, consisting of 3.5-6 mercury, 2 zinc, 1 tin, parts, and designed for use in frictional apparatus.

Sinimax Alloy An American magnetically soft alloy containing 43 nickel, 3 silicon, per cent, the balance iron. It is designed for above-average resistivity,

high permeability, and high frequency coils. Permeability is 3,000-35,000, resistivity 90 microhm-cm. A special application is to radar pulse transformers. Coercive force is 0.06 oersteds, specific gravity 7.70 g/cu. cm.

Slidex Alloys British nickel-silver alloys for making metallic slide fasteners, and containing 10, 12 and 18 per cent nickel. See Nickel-Silver Alloys.

S Metal Alloy An American heavy-duty lead-base babbitt alloy containing typically 82.5 lead, 15 antimony, 1 tin, 1 arsenic, 0.5 copper, per cent. It is inexpensive and readily obtained, and has a resistance to fatigue equivalent to that of the tin-base babbitt alloys. It also retains its mechanical properties well at elevated temperatures, and is usually bonded to steel strip for bearings. It has a tensile strength of about 4.5 tons/sq. in., to 1.75 tons/sq. in., over the temperature range 25-150 deg. C. (80-300 deg. F.), with elongation 1.2-15.5 and Brinell hardness 20.8-9.8.

Smith No. 10 Alloy An iron-chromium-aluminium American resistance alloy containing typically 55 iron, 37.5 chromium, 7.5 aluminium, per cent. It has excellent electrical and oxidation resistance so that it can be safely employed at temperatures for which nickel-chromium alloys would be unsuitable. It can be hot-worked, but in the cold state lacks ductility so that fabrication becomes difficult. Its resistance is superior to that of most other resistance alloys, but like them it lacks strength at elevated temperatures and is liable to grain-enlargement and attack by refractories. Its specific resistance is 1,000 ohms/cir. mil. ft. (170 microhm-cm.). It has a range of serviceable temperature corresponding to that of Kanthal Alloy (q.v.).

S Monel Alloy A cast nickel-copper alloy containing basically 63 nickel, 30 copper, 4 silicon, per cent, designed for high strength, pressure-tight, corrosion-resistant, non-galling and sliding parts made as castings, such as valve seats and other moving elements. Its density is 8.36 g/cu. cm. (0.302 lb/sq. in.). It has a tensile strength ranging from 49-65 tons/sq. in., yield strength 36-51 tons/sq. in., elongation 4-1, Brinell hardness 275-350, in the sand-cast condition.

S.590 Alloy A cobalt-chromium-nickel-base alloy of wrought heat-resisting type, produced in the United States. It contains 0.4 carbon, 1.2 manganese, 0.4 silicon, 20 cobalt, 20 chromium, 20 nickel, 4 molybdenum, 4 tungsten, 4 niobium (columbium), per cent, the balance iron. It is used for wheels and buckets for gas turbines working at up to 810 deg. C. (1500 deg. F.). Tensile strength at 24 deg. C. is about 59 tons/sq. in., and yield strength about 23.5 tons/sq. in. At 540 deg. C. (1000 deg. F.) these values are about 56 tons/sq. in., and 31 tons/sq. in. The alloy can also be employed for forgings at temperatures up to 540 deg. C. (1000 deg. F.).

S.816 Alloy An American wrought heat-resistant alloy containing 0.4 carbon, 1.2 manganese, 0.4 silicon, 20 chromium, 20 nickel, 4 molybdenum, 4 tungsten, 4 niobium (columbium), 4 iron, the balance being cobalt. It is used for the same purposes as S.590 Alloy (q.v.) and has similar mechanical properties although the rupture strength at 870 deg. C. (1600 deg. F.) is somewhat higher than for certain other alloys of this type. Casting temperature range is 1450-1540 deg. C. (2650-2800 deg. F.). It can be soft soldered, silver soldered and brazed.

Sodium Amalgam A solution of metallic sodium in mercury, of varying

R-Monel a type of Monel alloy (q.v.) containing a somewhat higher sulphur percentage (0.25–0.06%) than ordinary nickel-copper alloys (0.01%) of this type to render it more machinable.

HUNTINGTON ALLOYS

HUNTINGTON ALLOYS, INC., HUNTINGTON, WEST VIRGINIA 25720

J. GADBUT
TECHNICAL SERVICE AND
SPECIFICATIONS MANAGER

TS-32477-D4
March 24, 1977

MAR 31 1977

Mr. J. R. Haas
National Band and Tag Company
721 York Street
Newport, KY 41072

Dear Mr. Haas:

As we discussed by telephone possibly the best way to quench the criticism leveled at the Hawaii Institute would be to show actual sea water corrosion data on INCONEL alloy 625 versus Chromel A. In essence Chromel A is 20 Cr - 80 Ni while INCONEL alloy 625 is 21.5 Cr - 61 Ni - 9 Mo - 3.6 Cb. For alloy materials in sea water, crevice corrosion or pitting is the most damaging form of attack. Molybdenum is specifically added to alloys for sea water service to prevent pitting. Note that Chromel A has none and is very prone to crevice attack in sea water.

I have enclosed published information showing pitting and crevice data as well as general corrosion rates. In particular note the discussion which I have underlined on the last page concerning the insufficiency of 80 Ni - 20 Cr in sea water. I hope this is helpful to you and if I can be of further assistance, please let me know.

Very truly yours,

David L. Graver

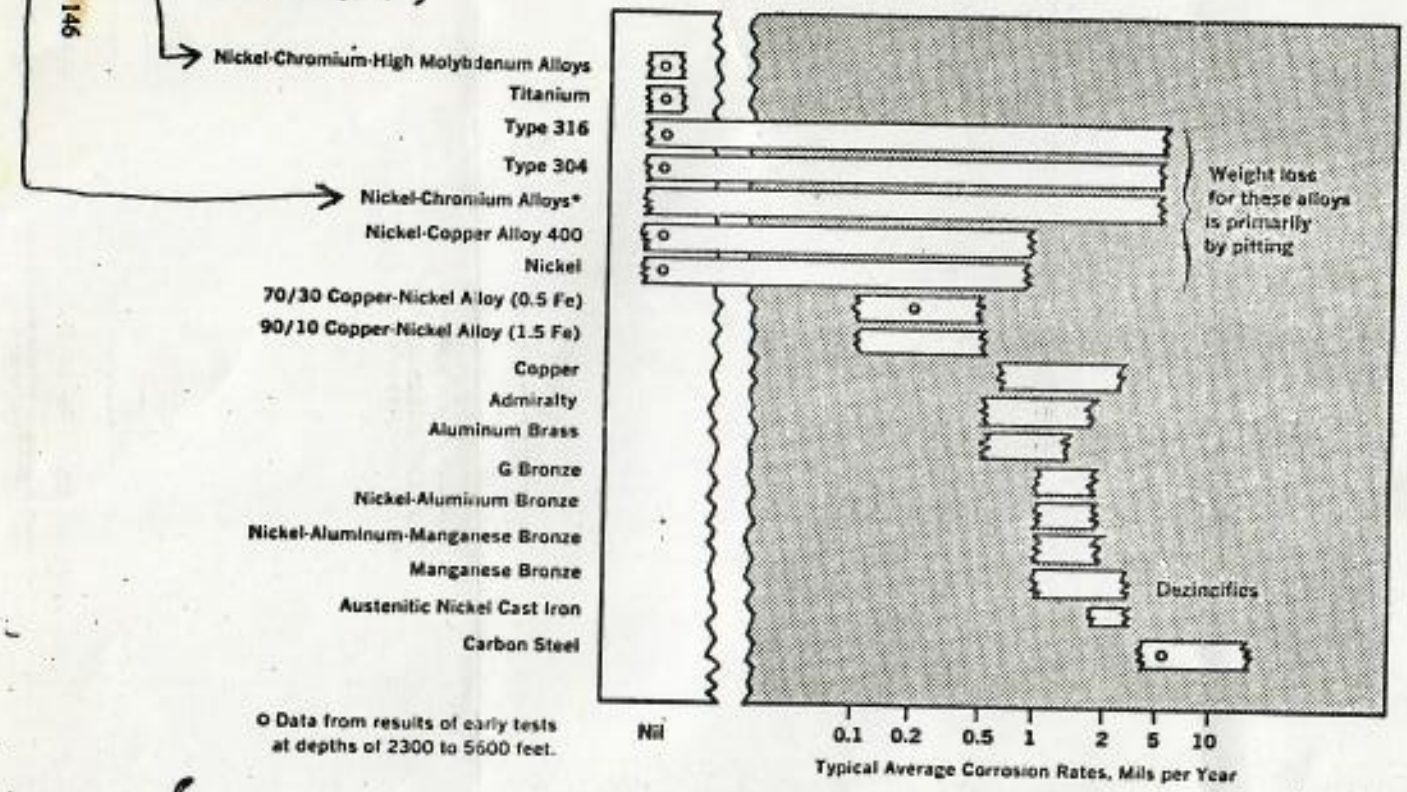
David L. Graver
Chief Corrosion Engineer

DLG/ds
Enclosures

From "Marine Corrosion – Causes and Prevention"

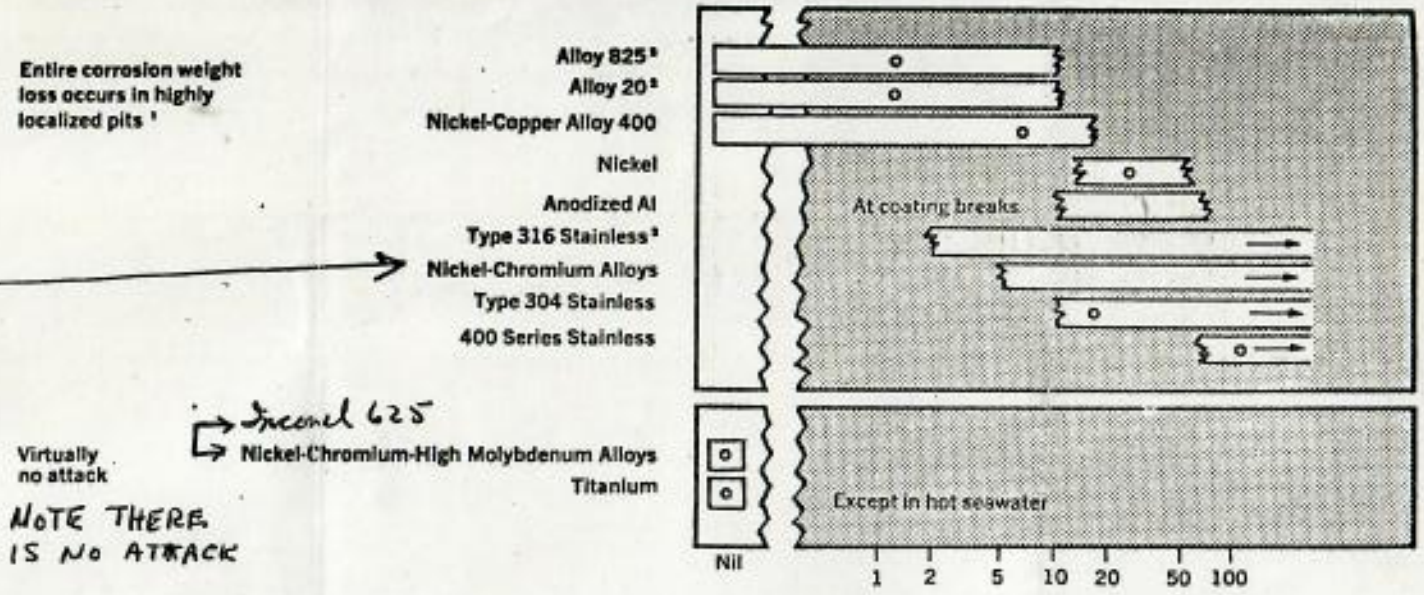
This would represent Chromel A, Nichrome V or Inconel alloy 600
These exhibit serious pitting. They do not exhibit general uniform corrosion. therfor representations as general wastage are misleading

Inconel 625
(no attack)



NOTE (* Nickel-chromium alloys designate a family of nickel base alloys with substantial chromium contents with or without other alloying elements all of which, except those with high molybdenum contents, have related seawater corrosion characteristics.)

Figure 4-47. Rates of general wastage of metals in quiet sea water.



NOTE THERE IS NO ATTACK

o Data from results of early tests at depths of 2300 to 5600 feet.

(1) As velocity increases above 3 fps pitting decreases. When continuously exposed to 5 ft. per sec. and higher velocities these metals, except Type 400 series, tend to remain passive without any pitting over the full surface in the absence of crevices.

(2) These grades have an advantage over Type 304 stainless steel and related grades in that there is a substantial reduction in the number of pits, i.e., probability of pitting even though the depth of such pits as do occur is not greatly reduced.

Figure 4-48. Rates of pitting of metals in quiet sea water.

149

This represents Chronel A, Nechrome V or Inconel 600
Note the serious pitting that they exhibit, anywhere from .005"/year to in excess of .1"/year in quiet sea water

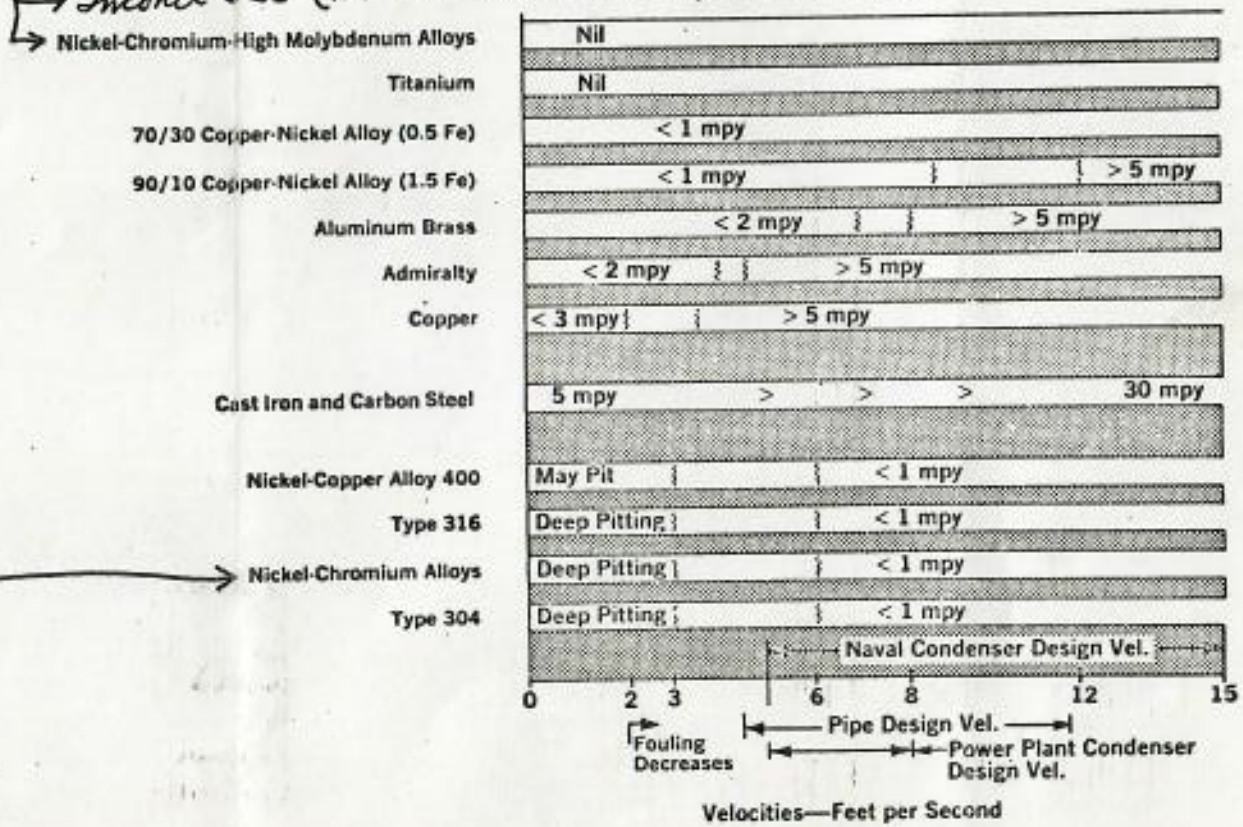
From "Marine Corrosion – Causes and Prevention"

(2)

From "Marine Corrosion – Causes and Prevention"

This represents Chromel A, Nichrome V and Inconel 600. Note that they exhibit deep pitting in flowing sea water at the lower velocities

Inconel 625 (no attack in flowing sea water)



150

Figure 4-49. Rates of attack of metals by sea water moving at moderate velocities.

(3)

intensity of crevice corrosion of types 304 and 316 stainless steel were demonstrated also in studies by Vreeland and Bedford[4] of prevention of crevice corrosion by cathodic protection. With the control specimens of the type 304 alloy exposed for 1 year, 82% of the crevices were affected; with the 316 alloy, 64% of the crevices were affected. The maximum depth of crevice corrosion of the 304 alloy was perforation of specimens 0.063 in. thick. The maximum depth with the 316 alloy was 0.033 in.

Another technique for studying both the probability and intensity of crevice corrosion, employed at the F.L.L. Laboratory, makes use of the setup illustrated in Figures 5-7 and 5-8. The appearance of crevice corrosion within the crevices on a stainless steel is shown in Figure 5-9. With a high copper alloy the attack occurs just outside the crevices (Figure 5-10). A practical example with a copper alloy appears in Figure 1-7.

As noted previously, crevice corrosion of stainless steels involves not only the intensity of attack but its probability as well. This is illustrated by results of test with the setup shown in Figures 5-7 and 5-8, as covered by Figure 5-11 comparing two grades of cast stainless steel. The CF 8M grade was superior to the CA 15 grade with respect to both the probability and intensity of crevice corrosion. Here, again, the practical advantage was greater with respect to intensity than with respect to probability.

Note { The probability factor for crevice corrosion of the straight chromium grades of stainless steel containing from 12 to 18% chromium is about 100%. The probability factor decreases with the more highly alloyed compositions of the stainless steel type that contain high percentages of nickel supplemented by molybdenum and copper, known by the trade names Incoloy 825 and Carpenter 20. Probability of

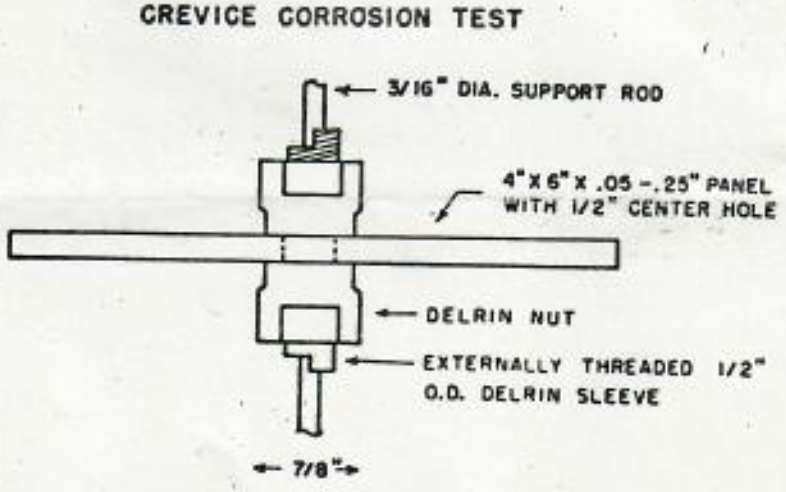


Figure 5-7. Crevice corrosion test specimen assembly.

From "Marine Corrosion - Causes and Prevention"

Right at the top of the list. The number designations on the tags should stay intact

TABLE 5.2 ORDER OF RESISTANCE OF ALLOYS TO CREVICE CORROSION IN SEAWATER

Inconel 625	Most resistant	Incoloy 825
Hastelloy C 276		Carpenter 20
Titanium		
Al 6 ×		Type 317 stainless steel
IN 748		Type 316 stainless steel
MP 35 N		Type 26 chromium/molybdenum
		Incoloy 800
70–30 copper nickel		Type 310 stainless steel
90–10 copper nickel		Inconel 600
Tin bronzes		Type 304 stainless steel
Aluminum bronzes		Type 347 stainless steel
Yellow brass		Type 321 stainless steel
Aluminum brass		Type 301 stainless steel
Red brass		Precipitation hardened stainless steel
Silicon bronze		Type 303 stainless steel
Copper		Type 430 stainless steel
		Type 440 stainless steel
Monel nickel copper alloys		Type 430 F stainless steel
Austenitic cast irons		Type 410 stainless steel
Cast irons		Type 416 stainless steel
Carbon and low alloy steels		

This is where Chromel A fits in the listing. It will be seriously attacked in the crevice.

crevice corrosion becomes zero with titanium and the nickel chromium alloys containing high percentages of molybdenum, represented by Inconel 625, Hastelloy C 276, AL6X, MP 35N, and IN 748. A listing of alloys in order of resistance to crevice corrosion in seawater appears in Table 5-2.

PREVENTION

In the tests designed to find a reliable caulking compound to prevent crevice corrosion of stainless steels, none of the petroleum base greases with or without additions of inhibitors turned out to be useful. Lanolin by itself was not effective, but did prevent crevice attack when mixed with zinc oxide. Most of the greases not only failed to prevent crevice corrosion but permitted this to occur in the crevices formed by patches of the greases applied to the stainless steel surfaces. Incidentally, petroleum jelly patches and smears remained free from fouling by marine organisms.

In another series of experiments[5] it was found to be possible to prevent crevice corrosion of stainless steels by the application of cathodic protection currents. The current density required, based on the total area of the test specimen, was found to

From "Marine Corrosion - Causes and Prevention"

(6)

NOTE

38

Incoloy 800, as shown in Table 36, does well in deep-ocean environments. This excellent behavior is unexpected and is not consistent with its composition, since it is closely related to the pit-susceptible austenitic-grade stainless steels.

TABLE 36. DEEP-OCEAN BEHAVIOR OF Ni-Cr-Fe, Ni-Cr, AND Ni-Cr-Mo ALLOYS(43)

Alloy	Exposure Time, days	Depth, feet	Corrosion Rate, mpy		Crevice Corrosion, mils		Notes on Attack
			Water	Mud	Water	Mud	
Inconel 600	123-1,064	2,340-6,780	<0.1-0.5	<0.1-0.3	4-51	3-10	Mostly local crevice, some pitting
Inconel X750	123-1,064	2,340-6,780	<0.1-0.4	<0.1	0-47	0-9	Crevice attack in water and mud
Inconel 718	402	2,370	<0.1	<0.1	0	4	Slight crevice in mud zone
Incoloy 800	123-1,064	2,340-6,780	<0.1	<0.1	0	1-6	Trace of crevice in mud zone; most samples OK
Incoloy 825	123-1,064	2,340-6,780	<0.1	<0.1	0-22	0-8	Most samples OK
Inconel 625	402	2,370	<0.1	<0.1	None	None	
Hastelloy C	123-1,064	2,340-6,780	<0.1	<0.1	None	None	

Like Chromel A

NOTE

Under immersed conditions, Incoloy 825 may be locally attacked in quiet seawater under fouling and at crevices. However, its resistance to pitting and crevice attack is much greater than that of the austenitic-grade stainless steels. The rate of attack after 3 years was 0.018 mpy for the totally immersed condition, as well as in the half-tide and the splash zones. In these particular exposures, local attack did not develop in the well-aerated splash zone, nor under the totally immersed condition. In the latter condition, pitting may eventually take place, unless the surface is continuously provided with well-aerated seawater. (See Table 35 for shallow-water results for Incoloy 825.) In hot seawater, this alloy is resistant to stress-corrosion cracking and thus finds application in seawater heat-exchanger service.

Hastelloy C and Inconel 625 are the best known of the nickel-chromium-molybdenum alloys. Under immersed conditions, their corrosion resistance is equaled only by that of titanium materials.

An example of the resistance of Inconel 625 in shallow seawater environments is given in Table 37. No corrosion of any significance was observed in any of these aggressive environments after exposures of up to 3 years. Circular welds on material annealed at 1800 F prior to welding also showed no significant attack after 1 year of exposure.

TABLE 37. DESCRIPTION OF SEAWATER CORROSION TESTS ON INCONEL 625 IN WHICH NEGLIGIBLE ATTACK WAS OBSERVED(a)

(1) Tests with 0.25 inch-diameter 7 x 19 wire rope at Wrightsville Beach, North Carolina, in ambient seawater.

Exposures: (a) trough at 2 fps, (b) water line, (c) tidal zone, and (d) partial mud burial.

(2) Tests with 4 x 12 panels with plain crevice (1.25-inch fiber washer), and welded configurations (2-inch-diameter circular weld ground flush).

Exposures: (a) quiet seawater and (b) trough at 2 fps.

(a) Data provided by The International Nickel Company, New York, N. Y. (1968).

Hastelloy C has been tested in a great variety of seawater environments and found extremely resistant. A few selected examples are presented in Table 38. Note that Hastelloy C will withstand high velocity, elevated temperatures, stagnant

TABLE 38. CORROSION OF HASTELLOY C IN SEAWATER ENVIRONMENTS(a)

Type of Test	Site	Seawater Conditions				Duration	Corrosion(b), mpy	Notes
		Temp, F	pH	Velocity, fps	Oxygen, ppm			
Spool	Curacao	82	6.6	(Pump suction)	3.5	3 yr	0.4	No pitting
Spool	–	325	–	0.5	–	3.3 yr	<0.1	
Coupon	Wrightsville Beach, N.C.	51	8.0±	128	Sat'd	30 days	0.2	
Sandblasted plate	Ditto	Ambient	8.0±	Low	Sat'd	10 yr	0.016	No pitting or crevice attack
Sheet tensile rotating in autoclave	Navy Laboratory at Annapolis, Md.	350	–	10	–	1080 hr	(Weight gain)	
Navy erosion test	Wrightsville Beach, N.C.	86	8.0±	20	Sat'd	60 days	0.63	

(a) Taken from literature supplied by The International Nickel Company and Union Carbide Corporation.
(b) Weight losses were so small that cleaning and weighing errors may be the major factor, especially for plate samples.

From "The corrosion of Metals in Marine Environments"

(7)

A comparison of a few other well-known metals with Monel-400 is shown in Figure 40. From the standpoint of weight-loss penetration, Monel-400 corrodes at about the same order of magnitude as zinc. The 6061 aluminum alloy shows much less attack, but experiences deeper pits in the same exposure.(40) Cupronickel and aluminum bronze are found superior to Monel-400 in respect to both pitting and weight-loss penetration. Corrosion rates in quiet seawater for Monel and stainless steel are compared in Table 35. Note that the pits on the Monel alloys are broader and less deep. Monel was less susceptible to crevice attack than were the stainless steels.

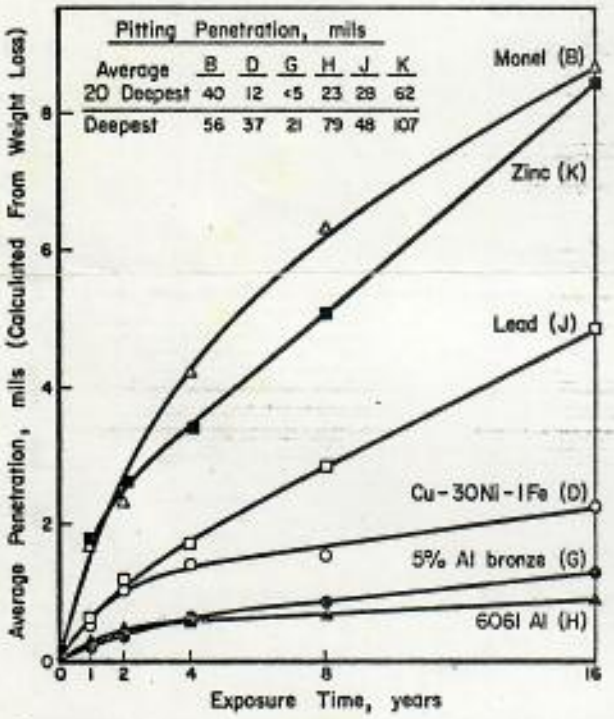


FIGURE 40. COMPARISON OF VARIOUS METALS AFTER 16 YEARS' IMMERSION IN LOW-VELOCITY PACIFIC SEAWATER OFF THE PANAMA CANAL(40)

Used with permission of National Association of Corrosion Engineers

As shown in Figure 41, the weight-loss penetration of Monel-400 in deep-ocean environments, is typically about 1 mpy or less. However, Monel-400 is subject to severe pitting attack in the deep ocean, as illustrated in Figure 42. Under these conditions, the weight-loss penetration typically ranged from 0.3 to 1.1 mpy and crevice attack ranged from negligible to complete perforation or 125 mils.(43)

To control the tendency for pitting in quiet seawater, it would be desirable to provide cathodic protection, as by galvanically coupling a Monel item to a large steel surface. As with nickel, if impressed current is used, it may be necessary to polarize just to the pitting potential, since the general corrosion is not excessive.

Monel-400 and Monel-K500 are used mainly in high-velocity applications in the immersed condition. These applications include such items as pump impellers and small propellers.

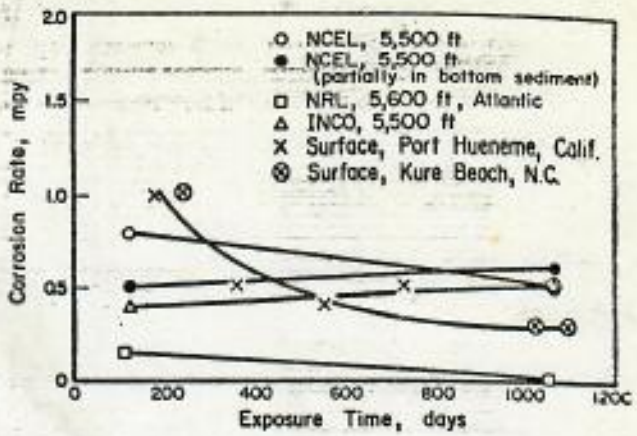


FIGURE 41. CORROSION OF MONEL-400 ALLOY IMMERSED IN SEAWATER AT SHALLOW AND DEEP OCEAN SITES(1)

NOTE.

Nickel-Chromium-Molybdenum. Before discussing the individual alloys for which information is available, one can cite some general effects of alloy composition on the corrosion behavior of nickel-chromium-molybdenum alloys. Nickel, itself, is prone to pitting. When chromium is added to nickel, as represented by the 80Ni-20Cr composition (Nichrome) or by Inconel 600, the passive film is strengthened greatly but not sufficiently to prevent crevice and pitting attack in seawater. Thus, the nickel-chrome and nickel-chrome-iron compositions can be used in seawater only where the velocity will be such as to maintain the passive film or if cathodic protection is used. In general, these alloys are much more resistant to local attack than nickel; local breakdown may take years to develop under some conditions.

When molybdenum is added to nickel, the tendency to local attack is virtually eliminated, as is the case with Hastelloy B (which contains 28 percent molybdenum and 5 percent iron). When the nickel is modified with suitable amounts of both chromium and molybdenum, the extremely good resistance of such alloys as Hastelloy C, Inconel 625, etc., is obtained. Thus, each of these additions contributes to the improvement of the corrosion behavior of the nickel-base composition.

→ Like Chromel A

Inconel 600 and X750 alloys will remain passive in flowing, well-aerated seawater, but will be attacked at crevices. Pitting also occurs. Both these alloys do well with cathodic protection in quiet seawater and both are resistant to chloride-ion stress-corrosion cracking. Deep-ocean crevice-attack results for Inconel 600 are presented in Figure 43. It is to be noted that the crevice attack has led to perforation in one case.

Inconel 718 is much more resistant to crevice attack, no doubt because of the 3 percent molybdenum addition. It is a good alloy for erosion corrosion and strength. Recent applications in the marine field include hydrofoils, bolts, and propellers.

From "The Corrosion of Metals in Marine Environments"

Jorgensen steel - 841-9281

Aluminum Products Mono - 955-3367
A Division of
JVCommun Inc.
669 Sheridan St.

ITT Harper
A Division of
International Telephone and Telegraph Corporation
8200 Lehigh Avenue
Morton Grove, Illinois 60053
(312) 966-6000

October 31, 1975

Reprints - Inconel 625

Mr. George H. Balazs
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P. O. Box 1346
Coconut Island
Kaneohe, Hawaii 96744

Dear Sir:

We fabricate nickel copper into various metal products. The alloy Monel is a registered trade mark that is manufactured by a single company. This company is the Huntington Alloy Division of International Nickel Company. Corrosion data, as well as answers to specific questions, can be obtained from the International Nickel Company who has done extensive work at their Kure Beach facility in North Carolina. The address of the International Nickel Company is given below.

Also attached is a breakdown of the chemical analysis of the various grades of Monel, most of which have excellent corrosion resistance in the applications you have specified. The alloy you are probably using is the nickel copper 400.

The information submitted should be of assistance to you in solving your problem.

Very truly yours,

ITT HARPER

George Vacek

George Vacek
Director, Quality Control

GV/sl
Encl.

International Nickel Company
67 Wall Street
New York, New York 10005

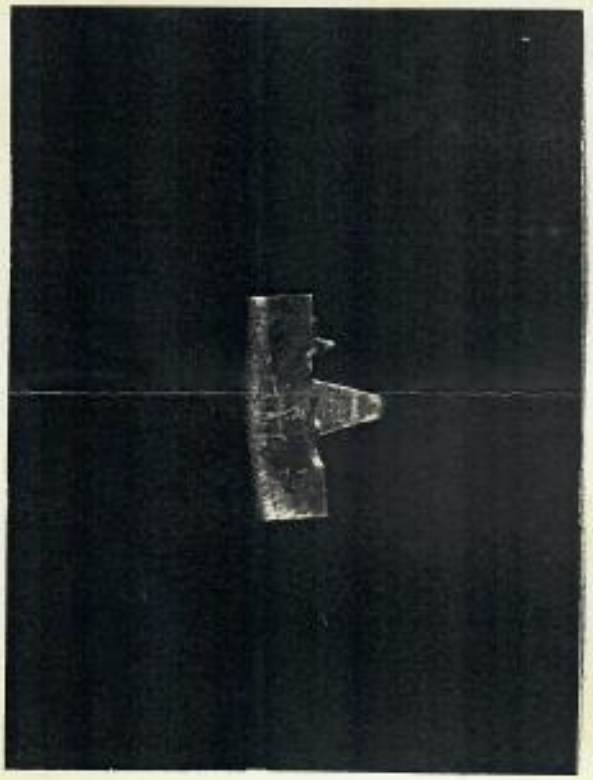
cost of strip - Inconel strip
Size 49 - 3/8" x 1mm ~ 7/32 - 1/16
" 681 - 5/16" x 1/32 (< 1mm)

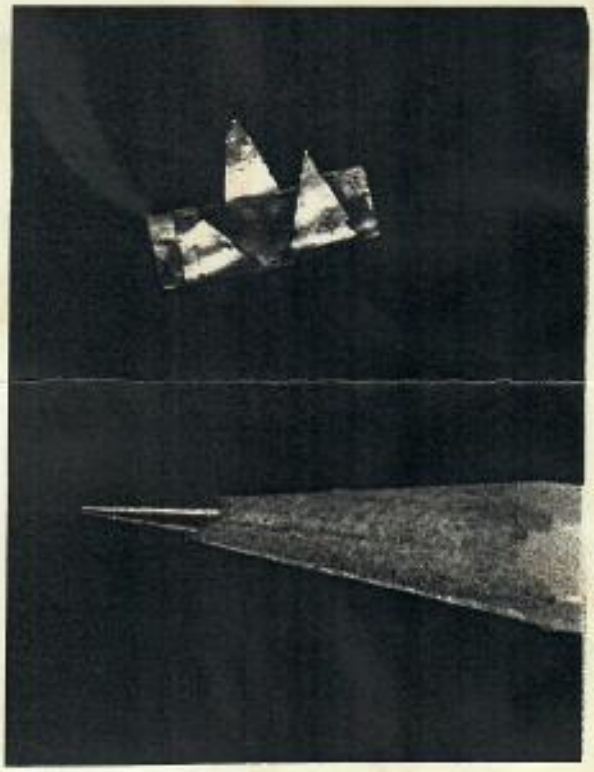
ALLOYS

NEW DESIGNATION	PREVIOUS DESIGNATION	Nominal Chemical Composition, %								
		Ni	C	Mn	Fe	S	Si	Cu	Cr	Others
MONEL Nickel-Copper Alloys										
MONEL alloy 400	MONEL alloy	66.0	0.12	0.90	1.35	0.005	0.15	31.5	—	—
MONEL alloy 401	MONEL "401" alloy	44.5	0.03	1.70	0.20	0.005	0.01	53.0	—	Co 0.50
MONEL alloy 402	MONEL "402" alloy	58.0	0.12	0.90	1.20	0.005	0.10	40.0	—	—
MONEL alloy 403	MONEL "403" alloy	57.5	0.12	1.80	0.50	0.005	0.25	40.0	—	—
MONEL alloy 404	New Product	55.0	0.06	0.01	0.05	0.005	0.02	44.0	—	Al 0.02
MONEL alloy R-405	"R" MONEL alloy	66.0	0.18	0.90	1.35	0.050	0.15	31.5	—	—
MONEL alloy 406	LC MONEL alloy	84.0	0.12	0.90	1.35	0.005	0.15	13.0	—	—
MONEL alloy 410	MONEL alloy castings	66.0	0.20	0.80	1.00	0.008	1.60	30.5	—	—
MONEL alloy 411	MONEL alloy castings, welding grade	62.0	0.20	0.80	1.50	0.008	1.60	32.5	—	Cb 1.30
MONEL alloy K-500	"K" MONEL alloy	65.0	0.15	0.60	1.00	0.005	0.15	29.5	—	Ti 0.50 Al 2.80
MONEL alloy 501	"KR" MONEL alloy	65.0	0.23	0.60	1.00	0.005	0.15	29.5	—	Ti 0.50 Al 2.80
MONEL alloy 505	"S" MONEL alloy castings	64.0	0.08	0.80	2.00	0.008	4.00	29.0	—	—
MONEL alloy 506	"H" MONEL alloy castings	64.0	0.10	0.80	1.50	0.008	3.20	30.0	—	—
MONEL alloy 507	"RH" MONEL alloy castings	64.0	0.55	0.80	1.50	0.008	2.70	30.5	—	—
INCONEL Nickel-Chromium Alloys										
INCONEL alloy 600	INCONEL alloy	76.0	0.04	0.20	7.20	0.007	0.20	0.10	15.8	—
INCONEL alloy 604	INCONEL "600" alloy	74.0	0.04	0.20	7.20	0.007	0.20	0.10	15.8	Cb 2.00
INCONEL alloy 610	INCONEL alloy castings	71.0	0.20	0.90	9.00	0.008	2.00	0.50	15.5	Cb 1.00
INCONEL alloy 611	INCONEL alloy castings, welding grade	70.5	0.20	0.90	9.00	0.008	1.60	0.50	15.5	Cb 2.00
INCONEL alloy 700	INCONEL "700" alloy	46.0	0.12	0.10	0.70	0.008	0.30	0.05	15.0	Ti 2.20 Co 28.5 Al 3.00 Mo 3.75
INCONEL alloy 702	INCONEL "702" alloy	79.5	0.04	0.05	0.35	0.007	0.20	0.10	15.6	Ti 0.70 Al 3.40
INCONEL alloy 705	"S" INCONEL alloy castings	69.5	0.30	0.90	8.00	0.008	5.50	0.50	15.5	—
INCONEL alloy 713	INCONEL "713 C" alloy	74.0	0.12	0.10	1.00	0.008	0.30	—	11.5	Cb 2.00 Mo 4.50 Al 6.00 Ti 0.50
INCONEL alloy 718	INCONEL "718" alloy	52.5	0.04	0.20	18.0	0.007	0.20	0.10	19.0	Ti 0.80 Al 0.60 Mo 3.00 Cb 5.20
INCONEL alloy 721	INCONEL "M" alloy	71.0	0.04	2.25	7.20	0.007	0.12	0.10	16.0	Ti 3.00
INCONEL alloy 722	INCONEL "W" alloy	75.0	0.04	0.55	6.50	0.007	0.20	0.05	15.0	Ti 2.40 Al 0.60
INCONEL alloy X-750	INCONEL "X" alloy	73.0	0.04	0.70	6.75	0.007	0.30	0.05	15.0	Ti 2.50 Al 0.80 Cb 0.85
INCONEL alloy 751	INCONEL "X 550" alloy	72.5	0.04	0.70	6.75	0.007	0.30	0.05	15.0	Ti 2.50 Al 1.20 Cb 1.00

~6/87

UNIDENTIFIED TAG





The photographs above show a cylindrical 3-pronged clip found fastened to the edge of the left front fin of a young loggerhead taken in the open sea just north of S. Jorge, The Azores. The tag was sent in by Helen Martins of the University of the Azores. Ms. Martins is a collaborator in the international tagging program of the Caribbean Conservation Corporation, and has provided extremely important data on the seasonal abundance and size range of young loggerheads presumably derived from America in Azores waters. The present recovery could be important evidence of this, but, strangely, there is no inscription of any kind on the tag. If any reader should be able to suggest the possible origin of the tag we would be extremely glad to get the suggestion.

Dr. Archie F. Carr
Center for Sea Turtle Research
Department of Zoology
University of Florida
Gainesville, Florida 32611, USA
Telephone: (904) 392-1250

University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

June 25, 1981

Mr. L.A. Yerkovich
Senior Technical Coordinator
Huntington Alloys, Inc.
Huntington, West Virginia 25720

Dear Mr. Yerkovich:

Thank you very much for your letter of June 2nd that arrived in Honolulu while I was out in the field tagging turtles at French Frigate Shoals. I was pleased to learn of your willingness to examine some of my Inconel tags that have been attached to turtles. The tags that I have enclosed are as follows:

	Tag No.	Description
1.	2270	Recovered after 4 years, 1 month attached to an adult turtle at French Frigate Shoals
2.	2060	Recovered after 4 years, 9 months attached to an adult turtle maintained in captivity at Sea Life Park, a commercial display facility.
3.	2146	Recovered after 1 year, 4 months attached to an immature turtle off the Island of Hawaii
4.	2083	Recovered after 1 year attached to an immature turtle at Kure Atoll
5.	2164	Recovered after 1 year attached to an immature turtle at Midway Islands
5.	2493	New from National Band and Tag Company manufactured in 1976
7.	5217	New from National Band and Tag Company manufactured in late 1980

I do not know the exact thickness of the tags when manufactured, but the papers I have from National Band and Tag Company suggest .030-.035".

In late 1980 National Band and Tag provided me with a second special order of Inconel alloy 625 tags. Tag number 5217 (enclosed) is from this shipment. I was interested to see that these more recently produced tags

are dull and do not have the silver-surface shine that is present in my first order of 1976. There are also dark spots present on some of the tags. Can you offer any explanations for this change in appearance?

All of the "used"tags that I am sending to you were recovered with varying amounts of fouling organisms (primarily calcareous algae) growing on the surface and in the stamped letters and numbers. I have cleaned most of this material away using a soft brush.

Please feel free to cut or analyze these tags in any way that you feel is necessary. It is not essential that they be returned in their present condition.

I appreciate your continuing interest in this matter, which is of critical importance to our research of Hawaiian sea turtles.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:lb.

HUNTINGTON ALLOYS
An INCO company

K-4
August 5, 1981

Mr. George H. Balazs
University of Hawaii at Manoa
P. O. Box 1346
Coconut Island
Kaneohe, Hawaii 96744

Dear Mr. Balazs:

This responds to your letter of June 25, 1981 requesting that we examine samples of INCONEL alloy 625 supplied to you by National Band and Tag Co. We are very much encouraged and pleased by the performance of the tags after almost 5 years of service and fully expect that the alloy will perform as well for the better part of the life span of sea turtles.

The strip supplied to National Band and Tag was not processed by Huntington Alloys, Inc. It was, however, processed by converters from product supplied to them by Huntington. In light of this intermediate processing by converters, I can only speculate as to the reason for the difference in surface appearance of the most recent tags and those tags purchased in 1976. My guess is that the appearance is related to the quality of the furnace atmosphere during the bright annealing cycle; the darker tags being exposed to high traces of oxidizing gases in the annealing cycle.

While the differences in surface appearance may have prompted you to question that both lots of tags were produced in INCONEL alloy 625, chemical analyses of the samples you supplied verified that they are, in fact, INCONEL alloy 625. You can, therefore, expect the same excellent resistance to seawater attack in spite of the appearance variation.

As to the matter of the dull spots present on some of the tags; these appear to be superficial surface defects probably resulting from dust or dirt particles being rolled into the surface in the final rolling pass of the strip. Aside from the cosmetic affect that is created, these spots will not interfere with the corrosion resistance of the tags. You can use them confident that identification markings over the years will be just as legible as you have already observed.

Very truly yours,

L. A. Yerkovich

L. A. Yerkovich
Senior Technical Coordinator

LAY/kbz

August 18, 1981

Mr. L. A. Yerkovich
Senior Technical Coordinator
Huntington Alloys, Inc.
Huntington, West Virginia 25720

Dear Mr. Yerkovich:

I was indeed pleased to receive your letter of August 5th concerning the performance of INCONEL alloy 625 tags on Hawaiian sea turtles. Your service in evaluating this matter is greatly appreciated.

If it wouldn't be of any additional difficulty, I wonder if you can provide me with comparative data on the corrosion rates experienced by each of the several recovered tags that I sent to you? The variables for these tags include length of time in wild, as well as island-area where the turtle resided. By examining this information together, I may be able to formulate some ideas as to the factors responsible for increased corrosion (possibly diet of turtles, age of the turtles, seawater temperature, coastal pollution, etc.). In any event, it would be very helpful to have these corrosion data for possible use in one of my future publications (with proper credit to you and Huntington Alloys).

Again, thank you for your continuing help.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:md

HUNTINGTON ALLOYS
An INCO company

K-2
September 1, 1981

Mr. George H. Balazs
University of Hawaii at Manoa
P. O. Box 1346
Coconut Island
Kaneohe, Hawaii 96744

Dear Mr. Balazs:

This responds to your letter of August 18 in which you requested comparative data on corrosion rates of sea turtle tags which you had recovered after as much as 4 years' - 9 months' of service.

There is no possible way to make the determination unless the actual surface areas and exact weights of the individual tags were known before they were placed in service. In any event, we have recorded the following information on the chance that you may have made those measurements before putting the tags in service.

Tag. No.	Wgt. - Gms.	Thickness - In.	
		Edge	Center
2060	3.0245	0.027	0.031
2083	3.0435	0.027	0.030
2146	2.9924	0.026	0.030
2164	2.9657	0.026	0.029
2270	3.0533	0.027	0.030
2493	--	0.027	0.030

Tag No. 2493 was a new tag which was sectioned to supply sample for chemical analysis. Since the total tag was not available, weight determination was not possible.

In the environment where turtles reside, sea water temperature, salinity, oxygen content, level of pollutants, diets of turtles and their discharges, in all likelihood, will not reduce the corrosion resistance of INCONEL alloy 625. Typically, I would expect that the rate will remain reasonably constant and something of the order of 0.0001 in./year. Your identification numbers, I am confident, will be retained and legible for decades.

Very truly yours,

L A. Yerkovich

L. A. Yerkovich
Senior Technical Coordinator

LAY/kbz

December 18, 1984 F/SWC2

Mr. John Forehan
Stockbrands Co. Pty. Ltd.
P. O. Box 80
Mt. Hawthorn
Western Australia 6016

Dear Mr. Forehan:

Our experimental titanium hatchling tags were applied to green sea turtles under both captive and field conditions over the past 5 months. We experienced a very high rate of breakage and misapplication due to erratic bending of the metal. An assortment of these tags has been enclosed for your evaluation. Please note that the dark coloration is due to a black marking pen that was used to reduce sheen. In a small trial that I personally conducted on hatchlings at a local oceanarium, 50% of the tags failed to work properly when applied, and most were the result of breakage. The fracture often occurred along one of the stamped numbers or letters.

We are aware that titanium is a very hard metal, so perhaps it is unrealistic to expect a tag this thin to bend after it has been stressed from stamping. We look forward to your professional appraisal of this problem. Can it be resolved? Should we consider production with a different corrosion-resistant metal such as Inconel?

Best regards for the New Year.

Sincerely,

George H. Balazs
Wildlife Biologist

GHB:ey
cc: Balazs
HL

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

January 18, 1985 F/SWC2:GHB

Mr. John Forehan
Stockbrands Co. Pty. Ltd.
P. O. Box 80
Mt. Hawthorn
Western Australia 6016

Dear John,

Thank you for your letter of January 4th concerning the breakage problems we experienced with the titanium hatchling tags. As we discussed at an earlier date, there is quite a bit of difference between the style and size of the lettering and numbers stamped on the inside of the tag versus the outside of the tag. The inside inscription is smaller, but more clearly stamped and much easier to read. Would it be possible to have this style used on the outside and eliminate the inside stamping? If this could be accomplished, the breakage problem might be reduced or eliminated.

On a separate subject, may we please have a price quotation per 1,000 of your titanium tags which measure approximately 35 mm by 8 mm in the locked position. In addition, to place an order we would need to know the cost of the applicator pliers and an estimate for air postage.

Sincerely,

George H. Balazs
Wildlife Biologist

check inside stamping

STOCKBRANDS CO. PTY. LTD

53 Edward Street, Osborne Park, W.A. Telephone 444 4877 All correspondence to P.O. BOX 80, MT. HAWTHORN, WESTERN AUSTRALIA 6016

January 4 1985.

National Marine Fisheries Service,
Southwest Fisheries Centre,
Honolulu Laboratory,
P.O. Box 3830,
Honolulu , HAWAII 96812.

Dear George,

We regret the problems you have experienced with the hatchling tags.

The metal is, as you say, very hard and compounds the problem of the break or notch line formed when stamping.

There are just too many letters and numbers on the tag for us to be able to space them either side of the bend areas; and that is the only real solution. We can try stamping the numbers less deeply, however then there is the problem of legibility.

Depending on the life you require from these tags, inconel or even stainless should be quite suitable, or an alternative may be, to use a streamer tag in addition to carry some of the legend.

George, you will need to rethink this system and perhaps we need to design a new type of tag. Some of the glues these days are pretty good, in fact we used to make a titanium tag that was glued on scallop shells.

Give it some thought. We will always be pleased to work with you.

Kind regards and all the best for the New Year.

Yours faithfully,

JOHN FOREHAN.

ORDER FOLLOW-UP

Manufacturers Of Identification Tags For:
Agri[illegible] — Horticulture — Biological and Scientific Research — Rabies Control and Animal Licensing — Electric and Industrial Uses

Bill

NATIONAL BAND AND TAG CO.

Phone: Area (606) 261-2035
721 YORK ST., P.O. BOX 430
NEWPORT, KY. 41072-0430 U.S.A.

CLASS	DATE ENTERED	N.B.&T. ORDER NO.
425	09/28/84	79663

REFER TO THESE NUMBERS WHEN YOU INQUIRE

THIS IS A COPY OF AN ORDER PLACED APPROXIMATELY ONE YEAR AGO. IT IS SENT AS A REMINDER TO SEE IF A REORDER IS NEEDED.

(FOR SHIPMENT IF OTHER THAN ADDRESSEE)

NATL. MARINE FISH SERVICE

PO BOX 3830
HONOLULU HI 96812

94855 MARYLYNNE GODFREY

**** THIS IS NOT AN INVOICE - DO NOT PAY ****

CUSTOMER PURCHASE NO. — IF YOU NEED TO RE-ORDER PLACED LAST YEAR DO YOU NEED TO RE-ORDER AT THIS TIME?

QUANTITY ORDERED	DESCRIPTION	UNIT PRICE
	09/28/84: BAND & STAMPING CHG. CONFIRMED	
2,997	1005-1 FISH & SMALL ANIMAL TAG, SZ. 1 01800930MO	
	NUMBERING AND STAMPING: C001 THRU C999 D001 THRU D999 E001 THRU E999	
	ALL BANDS - STAMPED: NMFS	
	SAMPLE ATT. FOR REF.	
3	SETUP CHARGE	
	FACTORY: KEEP PRODUCTION TIME	

HONOLULU LABORATORY

Aug 27 10 30 AM '85
NATL MARINE FISHERIES SERVICE

Aug 30 9 25 AM '85

CUSTOMERS ORDER NO.	CUSTOMERS ORDER DATE	SHIP VIA	DELIVERY REQUESTED	ANTICIPATED SHIPMENT WEEK OF	TERMS	
84JJA00529	09/12/84	INS 19 PP	10/12/84	10/12/84		FOB NEWPORT NET 30 DAYS

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ORDER REMINDER

Dear Customer:

We are enclosing a copy of an order that you placed with us about this time a year ago as a reminder to check your stock of these items to determine if a re-order is needed at this time. If so, just indicate the quantities needed and return the order copy in the enclosed envelope. Or, if you want us to get in touch with you later to remind you to order these items -- indicate such date on the enclosed sheet and return it to us, and we will get in touch with you then.

We want you to know that we do appreciate your business, and will exert every effort to supply your requirements at the lowest possible price while maintaining the very best quality.

Sincerely,

NATIONAL BAND AND TAG COMPANY

Linda Collins

Linda Collins

LC/1

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Science Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396
(808)943-1221 • Fax: (808)943-1290

June 20, 1994 F/SWC2:ghb

Mr. Bob Pitman
National Marine Fisheries Service
Southwest Fisheries Science Center
P.O. Box 271
La Jolla, CA 92038

Dear Bob:

Your letter of 4/30/94 requesting my comments on your short manuscript was delayed for some reason and didn't arrive here until the end of May. Perhaps you were out to sea when you wrote it. Nevertheless, I've just now found the time to read and consider what you've said. I presume you're having me serve as an "internal reviewer" to fulfill SWFSC publication requirements. I'm happy to offer my opinions in that capacity.

A brief historical perspective on the Inconel tag may first be helpful. National Band and Tag Co. (NBT) started manufacturing Inconel 625 alloy tags in late 1977. This came about as the direct result of my working with CEO Fred Haas to achieve a truly corrosion-resistant tag for sea turtles. The "scientific standard" for sea turtle tags up until that point was Monel 400 alloy, available in both NBT's size 49 (large) and size 681 (medium) self-piercing, self-locking tags. However, as some researchers were painfully aware, Monel 400 alloy tags literally corroded to pieces in a few years when attached to sea turtles at certain geographical locations.

One of the most severe places for corrosion was the Hawaiian Islands. Inconel 625 alloy was suggested by metallurgists as the solution. Following pilot production (to the great credit of Fred Haas), and evaluation on Hawaiian turtles in the intensely corrosive environment of Sea Life Park, Inconel tags were added to NBT's line of products. The company continues to be the sole worldwide manufacturer of this product. However, due to technical difficulties associated with cutting and stamping the alloy strip, NBT only offers Inconel in the size 681 tag. Researchers that feel a compelling need for the larger size tag continue to use Monel 400, or have turned to the pure titanium product of Stockbrands Ltd. in Australia.

I've placed numerous orders for Inconel tags over the past 16 years and can tell you that the shiny nature of the tag can vary somewhat from batch to batch. In one case I recall, the tags were so dull that I wondered if some other alloy besides 625 had been mistakenly used. I contacted Fred Haas and he explained that the Inconel strip obtained from the suppliers does in fact

vary in appearance, depending on slight but uncontrollable differences in the production process. This characteristic is completely beyond NBT's control.

The points made in your short paper are certainly worth discussion. But it seems to me that if a "problem" of any sort exists, beyond an occasional case, we would have heard some word of it by now from all the past tagging done of both immatures and adults. Adults regularly undertake reproductive migrations back and forth through pelagic waters. And, of course, olive ridleys of just about all sizes live out there on a near-permanent basis. The more we learn about loggerheads, the more likely such a life style may also occur for this species. The Monel tags widely used in the past, and still being applied by some workers, also have a shiny surface. But perhaps not always with the polished appearance of some of the Inconel tags.

Here in Hawaii many of our Inconel tags on turtles become fouled with algae or other growth that covers the metallic surface (see enclosed xerox of photo). Does this fouling also happen to tags on pelagic-phase turtles? I would imagine it does to some extent, depending upon the environment of the particular oceanic region. But I have no idea how long such fouling might take. Fouling, in fact, has been a recognized problem in some areas, where too much growth attaches to the tag and causes it to shed from excessive drag. Interestingly, fouling problems seen in some areas are more prevalent on Inconel, plastic, and titanium tags than on Monel tags. The reason for this is that, when Monel tags corrode, they release copper and nickel ions toxic to fouling growth. A built-in "anti-fouling bottom paint", so to speak. The other tags mentioned simply don't corrode, so no toxins are released.

I agree with you that, if available, and all factors are equal, it would intuitively seem better to use dull or blackened tags rather than shiny ones. But I would not endorse nor presently agree with your suggestion to blowtorch the Inconel tags cherry red then plunge them into water to achieve a blackened appearance. In my view, Fred Haas has a valid concern about tag alignment that needs to be evaluated with sufficient numbers (i.e., hundreds of tags). More important, I would be very concerned about possible effects to the alloy itself that might somehow render it less resistant to corrosion. However, posing this latter question to a competent metallurgist should help to provide an answer. I'll look up the name of the person that originally suggested the use of Inconel and try to contact him for an opinion. Perhaps you can do the same using another independent source, and we can compare notes.

Your manuscript mentions that you considered spray painting the Fish and Wildlife Service's Inconel tags before applying them to pelagic turtles. However, as you said in your letter, tags that I supplied the SWFSC several years ago had already been sprayed gray. I coated the tags with an epoxy-based spray paint prior to sending them to the Center. To the best of my memory, I did this to address concerns that you (or Sally Beavers) voiced to me about the shiny appearance of a metal tag newly applied to small pelagic turtle. My logic at that time was to eliminate or reduce the metallic appearance during the early post-tagging period, perhaps until natural fouling occurred to permanently accomplish this objective. Painting was simply an intuitive and harmless action as an attempt to address a suggested potential problem. Naturally the paint was not expected to stay on for an extended time (beyond a few weeks). Until careful background research is conducted to examine all ramifications, blowtorching the tags should be considered a possibly harmful action to address a suggested potential problem. Having lived through the grief of seeing tags corrode and fall off, I try to be very conservative on all tag use and tagging techniques.

I've made some other comments directly on your manuscript, which is being returned with this letter. I would be interested to know why you didn't first spray paint the Fish and Wildlife Service tags before applying them, if you sensed a problem. Also, have you ever seen a predator dart after a turtle upon release? What is the relative size of the chrome lures you use to catch billfish and sharks in comparison to the Inconel tag which measures 8 x 28 mm? And lastly, what is the return address on the Fish and Wildlife Service tags you are using, and where is the tagging information presently being submitted?

Many thanks for contacting me. I'll get back to you after I've been able to contact the metallurgist.

Sincerely,

George H. Balazs
Zoologist and Leader,
Marine Turtle Research Program

George Balazs
Southwest Fisheries Science Center
Honolulu Laboratory
2570 Dole St.
Honolulu, Hawaii 96822

30 April 1994

Dear George;

I am enclosing a short note I would appreciate your comments on. It concerns problems associated with shiney sea turtle tags. I know this is something you have given some thought to because when I was using the turtle tags you sent us a few years ago I noticed they were all spray-painted black; it took me awhile to figure out why, but now I know. I was considering sending this to the Marine Turtle Newsletter if this issue hasn't been aired before. Any comments you have would be much appreciated. I am particularly interested to know how your spray paint holds up.

Cheers,

Robert L. Pitman
Southwest Fisheries Science Center
P.O. Box 271
La Jolla, CA 92038

Potential Problems

Comments by GHB 6/20/94

Problems with Shiny Metal Turtle Tags - R.L. Pitman
or Concern for Shiny ...!

During a research cruise I participated in last year in the Gulf of California, Mexico, I had the opportunity to catch and tag sea turtles at sea while the ship was involved in other operations. I caught a total of 29 turtles (22 olive ridleys and 7 loggerheads); all except 2 ridleys (which were too small to tag) were tagged and released. The tags I used were the standard USFWS inconel tags. Most of the turtles were captured from an inflatable launch, they were processed in the launch and released, in most cases, within 10 minutes.

Several times after I released the turtles in the relatively clear oceanic waters, I watched them as the swam almost straight down and out of sight. When the sun was out, I could clearly see bright flashes from the shiny silver tags as the turtles swam out of sight. On at least three turtles, I continued to see the tags flashing even after the turtles themselves were well out of sight. This tag flash undoubtedly causes prolems for turtles by attracting predators: they flash much the same way that chrome lures do that we use in the tropics to catch large tunas, billfish and sharks. The flash is very similar to the flash a wounded fish makes when it is trying to swim. We caught and released several dinner plate-sized olive ridleys during the trip and I couldn't help but have an uneasy feeling about the additional burden we had saddled these turtles with.

In an effort to reduce the shininess of the tags, I considered spray-painting them, but that seemed to be only a shortterm measure in the corrosive marine environment. At the suggestion of the chief engineer onboard, we put individual tags in a vice, heated them with a blowtorch until they were red hot, then dropped them into a can of water. The tags turned a permanent dull black as a result fo this treatment, seemingly perfect for our purposes but probably too labor intensive an effort for any tagging program that puts out 100s or 1000s of tags.

I wrote a letter to National Band and Tag Company inquiring about the possibility of obtaining tags with a dull dark finish and was told in a letter by a Mr. Fred E. Haas that the company had looked into the matter but that because they manufacture such a small number of turtle tags it was not worth the trouble for them to acquire such a small quantity of raw material. In reply to another question I had about the effects of heating and cooling the tags, Mr. Haas replied "Heating the tags to a red hot color and letting them cool at room temperature may anneal the steel or possibly distort the alignment of the the tag preventing it from sealing properly. However, if the process works for you, I would say it is causing no appreciable change and would continue the process." My experience was that there was no appreciable difference in the shape or quality of the heated tags.

I bring this issue up because tag loss is a problem for all turtle taggers, and I think few people have had the opportunity

Lots of people have. Everyone that does in-water tagging.

SWFS cruise? If not, who?

potentially not "Undoubtedly unless you have da into as fro

size?

The reade will then ask "Why did you continu to ta the

Who do you know?

Unclear RE waste of?

But you cooled you in water

Did you th apply same to turtles

Proof? First hand observation?

to see what their tags look like on their turtles at sea. My guess is that some tag loss and possibly some turtle mortality can be attributed to the shininess of the tags. Predators would undoubtedly be attracted to the shine; they could bite the tag off, maybe take a limb off, or possibly even kill the turtle, especially in the case of smaller (e.g., headstarted) individuals. Finding a way to reduce the reflectivity of turtle tags is, I believe, worth consideration for people who tag turtles.

good. justified. Better than "Undoubtedly"

STOCKBRANDS CO PTY LTD

PROUD TO BE AUSTRALIAN

FAX TRANSMISSION

DATE	MARCH 4, 1997
TO	NATIONAL MARINE FISHERIES SERVICES
ATTENTION	GEORGE BALAZS
FAX NO	0015 1 808 943 1290
FROM	JOHN FOREHAN
FAX NO	61 9 444 0619
NO OF PAGES	ONE

****

Dear George,

The width dimensions is 6mm.

Hope this answers your query.

Best regards,

JOHN FOREHAN

4N

53 EDWARD STREET
OSBORNE PARK
W.A. 6017
A.C.N. 008 715 044

ALL CORRESPONDENCE TO:
P.O. BOX 80
MT. HAWTHORN
WESTERN AUSTRALIA 6016

TELEPHONE: 444 5519
FACSIMILE: 444 0619

EXPERIMENTAL MARKING OF SEA TURTLES BY TISSUE MODIFICATION

L.P. Hendrickson and J.R. Hendrickson

In the Summer of 1980, we worked with three species of sea turtles (Chelonia mydas, Caretta caretta, and Lepidochelys kempi) at four locations (Miami, Grand Cayman Island, Galveston and Honolulu), to explore the feasibility of marking them with "living tags." Our goal was to develop a technique, practicable under field conditions, for marking large numbers of hatchlings with minimal disruption of nest-to-sea progression, disadvantage and unnatural influence, but with life-long, growing markings, recognizable whatever the age or size of the adult animal. To this end, we treated about 680 animals, exclusive of controls, with tissue grafts and a chemical melanin-suppressant.

At Miami (on C. caretta) and at Grand Cayman (on C. mydas) we tested monobenzylether of hydroquinone as the melanin-suppressant with little long-term success. At all four locations (all three species) we tried four variations of autografting procedures, some of which have given very encouraging results. Disks of tissue cut with a Keyes dermal punch and transplanted to sites prepared with the same instrument grew well, as did pieces of tissue gouged out by cutting obliquely with a dermal punch, then moved to sites prepared in like manner. Disks of plastral tissue inserted into pockets cut under the keratinous layer of carapace scutes were less successful. Small cylinders cut all the way through the marginal plates of the posterolateral carapace and replaced in reversed position gave the least satisfactory results. In all cases, waterproof surgical cement was used to seal off the operated site and hold the grafts in place. Although we tried to observe reasonable cleanliness and, in the treatment of two groups, applied a germicidal ointment over the completed, sealed graft,

aseptic procedures were not followed. Handling time for the procedures was less than three minutes per turtle. Survival of the experimental animals equalled or exceeded the rates of survival in untreated control groups.

The last inspection of all surviving experimental animals took place between 10 and 11 months post-operative. The animals were then released at sea with the exception of small groups kept in Miami, Grand Cayman and Honolulu for continued observation. At the time, nearly a year after grafting, the disk and gouge treatments showed more than 90% graft success in some cases of plastral tissue transplanted to the carapace. The success rate was lower with carapace tissue moved to the plastron. Now, 2.5 years after grafting, the remaining experimental animals in captivity still show conspicuous grafts on their carapaces, as did one Kemp's ridley headstarted at Galveston, recaptured after 289 days in the wild (about 19 months post-operative), and photographed before being released again. Most of the long-term captives have already achieved sizes comparable with wild turtles of considerably greater age, as estimated from what is presently known of growth rates in nature.

On the basis of the results described, further work is planned to refine the grafting procedures. In addition, the first major field test is being considered -- cohort marking of approximately 10,000 hatchlings. We invite discussion of the technique and solicit recommendations regarding site, species and protocols for the proposed major field test. We also invite discussion of the best way to establish suitable control of this marking system to avoid confusing replication of markings and to ensure maximum information retrieval.

Discussion
Lou Ehrhart, leader

Wibbels:
Can you make a tool (for skin transplants) to automate the process and increase speed and efficiency?

J. Henrickson:
We consulted several surgeons, but we were unable to come up with anything. The handling time is under two min/person. We can teach people to do this in about two hours.

L. Hendrickson:
An automated procedure would give precision of cut, but all the turtle shells may not have the same depth.

Witham:
The irregularity of the shape and growth may cause confusion later.

J. Hendrickson:
Until you understand tissue growth, you can't predict certain patterns.

Witham:
This is an inherent problem.

J. Hendrickson:
We now want to study the allometry of growth.

Carr:
Does this deserve mass attention? I think it does as long as you can prove you can work out the allometry problems.

J. Hendrickson:
Some of our transfers are good and some are bad. The question is, can we stretch it further? If Cayman Turtle Farm grows them twice as fast, are we seeing development now that we would normally see in the future?

Wibbels:
We got a recapture with a living mark nine months after marking. The carapace mark was good, but the plastron graft was not as good.

L. Hendrickson:
We think that plastron marks may not stay on as well because of rubbing on the cement bottom, etc. We may want to just mark on the dorsal surface, but this may present coding limitations.

Rabalais:
Can you go to the head for marking?

J. Hendrickson:
It didn't work on the head or flippers, but we didn't try very many.

Carr:
If you do a large release at a site, then coding wouldn't matter. You would just want to see if you got the tag back.

Klima:
You need a coding system or you will have confusion.

Carr:
If the coding won't work, you can at least do a large mark and release.

Harris:
If you use this instead of flipper tags, the public won't know about it.

Carr:
Flipper tags work well in the Carribean, but the living tag is good for finding out if the turtles return.

J. Hendrickson:
We are not proposing an overlap between the flipper tag and the living tag. The tags are testing for different things.

Carr:
But people will see it that way.

J. Hendrickson:
If we're ever going to get a life history table, this is the way to do it.

Owens:
The question is where to do a large study? Tortuguero is not good because there are too many places for the turtles to go. Ascension, Surinam, or Padre Island would be better, since the chances for ambiguity in interpreting tag returns would be minimal.

Western Gulf of Mexico Sea Turtle Workshop Proceedings

DAVID OWENS et al.
Department of Biology, Texas A&M University
College Station, Texas 77843

Sea Grant College Program
Texas A&M University
College Station, Texas 77843

TA[illegible]J-SG-84-105
R/F-15; NA83AA-D-00061
October 1983
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WESTERN GULF OF MEXICO SEA TURTLE WORKSHOP

PROCEEDINGS

JANUARY 13-14, 1983

Organized and Edited
by

David Owens
Diana Crowell
Gayle Dienberg
Mark Grassman
Sheilah McCain
Yuki Morris
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Department of Biology
Texas A&M University
College Station, Texas 77843-3258

October 1983

TAMU-SG-84-105

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National Oceanic and Atmospheric Administration

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FAX TRANSMISSION

DATE : MAY 18, 1994

TO : U.S DEPT OF COMMERCE
NAT. OCEANIC & ATMOSPHERIC ADMIN.
HAWAII

ATTENTION : GEORGE H BALAZS

FAX NO : 0015 1 808 943 1290

FROM : KATHIE THORNTON

FAX NO : 61 9 444 0619

NO OF PAGES : ONE

****

Dear Mr Balazs,

Thank you for your inquiry regarding size and cost of our titanium turtle tags.

We only manufacture two sizes as you can see by the drawings below.

Small tag	A$2.10 each
Applicator to suit	A$40.00 each
Legend Stamp	A$390.00 each
Large tag	A$2.45 each
Applicator to suit	A$60.00 each
Legend stamp	S$330.00 each

The legend stamp is needed if you would like to have a return address stamped on your tags.

Air freight would depend of quantities ordered.

Delivery approximately 6 weeks from receipt of order.

We do hope that we can be of assistance to you in the near future.

If you have any further queries please do not hesitate to contact me on the above fax number.

Yours faithfully,

KATHIE THORNTON

Inconel Tags Placed on Green Turtles in Union Creek, Great Inagua, Bahamas

by Karen Bjorndal and Alan Bolten

Each pair represents one turtle

4551-4552	3 June 1985
4553-4554	3 June 1985
4555-4556	3 June 1985
4557-4558	4 June 1985
4559-4560	4 June 1985
4561-4562	4 June 1985
4563-4564	4 June 1985
4565-4566	4 June 1985
4567-4568	4 June 1985
4569-4570	4 June 1985
4571-4572	5 June 1985
4573-4574	5 June 1985
4575-4576	5 June 1985
4577-4578	5 June 1985
4579-4581	5 June 1985
4580	destroyed
4582-4583	5 June 1985
4584-4585	5 June 1985
4586-4587	5 June 1985
4588-4589	5 June 1985
4590-4591	5 June 1985
4592-4593	6 June 1985
4594-4595	7 June 1985
4596-4597	7 June 1985
4598-4599	7 June 1985
4600	destroyed

Spanish Cay, Bahamas 110165 - letter 9-9-89 w/BP107, BP108

Keoki,

Enclosed as promised is the original 1992 Bikar SPREP document. They are separated, so upon copying you'll have to collate. The pages are numbered.

When submitting it to SPREP (also to you and Danny) I thought I'd do something fancy by sending a document with colored pictures. As such, Kinko separated the report into two groups…one for color, the other black & white.

Since it's been a while since I last read this thing, I glanced through it and by chance came upon page 37 (color) which indicated the return address on the tags to be:

RETURN SPC/SPREP
BPD5 NOUMEA CEDEX
NEW CALEDONIA

The tags did come from SPREP! They were sent to you and that's why we had to rendezvous in your parking lot. You gave me two appropriate applicators painted in white. I clearly remembered talking to Nana about the seemingly odd return address, but it concerned New Caledonia and not HIMB as I mistakenly told you.

Now kicking myself in the ass, I thought if I could make such a mistake as above…could it be possible I also erred in the numbering? I again retrieved the raw data book, and indeed the entries were sequential and consistent. No letter prefixes. However after carefully examining figures 23 (p37) & 41 (p61), it was obvious the tags were considerably larger than those used on Molokai in the early 1980's. Now really piqued, I looked for and found the toolbox we used to store the applicators, tags, books, pens, etc. while working on Bikar. The unused tags and applicators were left on Majuro with Nena, but nestled among the measuring tapes, pens, pencils, sharpeners, and other paraphernalia was a bent and discarded Bikar tag! Lo & behold prefix R…albeit faint and separated from the main body of numbers! It appears we completely disregard the prefix in recording our data and in our report. I guess you'll have to clean up this mess for me. Upon duplicating and further dissemination of this report, kindly notate the missing prefix R where appropriate.

As my catechism teacher often preached….mea culpa, mea maxima culpa!

Bill

Date: Tue, 12 Nov 1996 08:22:58 -0600
From: Michael Coyne <coynem@tamug.tamu.edu>
To: "George H. Balazs" <gbalazs@honlab.nmfs.hawaii.edu>
Subject: Re: Kemp's ridley

TAG File

[The following text is in the "iso-8859-1" character set]
[Your display is set for the "US-ASCII" character set]
[Some characters may be displayed incorrectly]

George,

sorry, no one has yet replied to me on my ridley question, but I did a little investigation (i.e. someone from our lab went to the Lk planning meeting in).

The orginal plan, I believe was to tag 10,000 hatchling, but I think they only tagged 3,384 (Ý) because of equipment problems. Apparently they are using the wire magnetic tags that don't relay any info except presence. As I understand it they put all of the tags in the left fore flipper to denote year but also plan to do the same next year (1997) becasue so few were implanted. Then move to the other flipper in 1998. Using the same flipper for next year seems a mistake to me, providing fertile breeding ground for uncertaintly in answering the question of "how long is the pelagic stage?" Good thing I'm not in charge:)

Hope this helps,

Michael

PS - Total Production was:

Nests -	2,080
Eggs -	191,974
Hatchlings -	119,196
Survival Rate -	62%

>Michael- If you get an answer, especially about the tagging of
>hatchlings, I would appreciate your email-forwarding a copy to me. I'd
>be interested to know the tagging methodology. Size 1 NBT tags? Or?
>

HUNTINGTON ALLOYS
An INCO company

July 22, 1980
DW-2

Mr. George H. Balazs
Fishery Biologist
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center
P.O. Box 3830
Honolulu, Hawaii 96812

Dear Mr. Balazs:

In response to your letter request of July 14th, the following is a list of producers of INCONEL alloy 625 strip.

1. Arnold Engineering
   Railroad Avenue and West Street
   Marengo, IL 60152

2. Plessey Precision Metals
   3301 Melford Avenue
   Los Angeles, CA 90063

3. Somers Thin Strip
   Piedmont Street
   Waterbury, CT 06720

4. Techalloy Company, Inc.
   Rahns, PA 19426

5. Teledyne Rodney Metals
   New Bedford, MA 02742

6. Thinsheet Metals Company
   275 Railroad Hill Street
   Waterbury, CT 06708

7. Ulbrich Stainless Steels
   57 Dodge Avenue
   North Haven, CT 06473

If I can assist you further, please let me hear from you.

Very truly yours,
L. A. Yerkovich
L. A. Yerkovich
Senior Technical Coordinator

LAY:dfw

QUOTATION

Date 8/29/80 No. R08290B

Thank you for your inquiry. Our quotation is as follows:

ARNOLD
THE ARNOLD ENGINEERING COMPANY
Subsidiary, Magnetics & Electronics, Inc.

300 West Street
Marengo, Illinois 60152
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Chicago (312) 263-6300
Cable Address ARENGCO
Telex 25-7448 / TWX 910-642-2790

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE (142)
P. O. BOX 3830
HONOLULU, HAWAII 96812

ATTN: GEORGE H. BALAZS, FISHERY BIOLOGIST

Your Inquiry: F/SWC2:GHB
AUGUST 22, 1980

Customer Drawing Or Part Number	Our Part Number And/Or Description	Quantity	Price	Delivery After Receipt Of Order
	INCONEL 625 STRIP, AMS 5599 .033" X .3125" X COIL	50 LBS	$28.37/LB	3 WEEKS

Comments: SUBJECT TO PRIOR SALE

5 TO 10 LB COILS

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2. *Any order submitted pursuant to this quotation will be subject to acceptance by the seller at its general office at Marengo, Illinois and will be subject to the terms and conditions on reverse hereof.*
3. *Prices quoted are valid for 30 days unless otherwise indicated.*

THE ARNOLD ENGINEERING COMPANY

By B. R. Van Rensselaer
B. R. VAN RENSSELAER dmk

Please refer to our quotation no. on correspondence.

(815) 568-2471

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An Allegheny Ludlum Industries Company

CUSTOMER COPY

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August 15, 1980

National Marine Fisheries Service
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Attention: George H. Balazs,
Fishery Biologist

Subject: F/SWC2:GHB

Dear Mr. Balazs:

In reply to your inquiry of August 1, 1980, we are enclosing literature which will show our products and capabilities.

We do not warehouse items, however, we do set up and produce each order individually. We will be pleased to offer a quotation to your specific requirement.

Very truly yours,

ARNOLD, ROLLING DIVISION

B. R. Van Rensselaer
Customer Service Supervisor
Rolling Mill Products

BRVR/dmk

Encl: (1) Rolling Mill Literature

ARNOLD

Subsidiary

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TECHNICAL BULLETIN

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.000089 to .00039	4"	Upon application
.0004 to .00099	14"	Yes
.001 to .015*	16"	Yes

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9" to under 12-1/2"	± .010
12-1/2" and over	± .015

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NICKEL IRON ALLOYS

Moly Permalloy — (79 Ni, 4 Mo)
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4750 — (49 Ni)

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Alloy 42 — (42 Ni)
Arnoseal — (28Cr 17 Co)
Ni Span C — (42 Ni, 5 Cr 2.5 Ti)

MAGNETIC & COBALT ALLOYS (10% or Higher)

Vicalloy — (51 Co) Hard Magnetic
Vanadium Perm — (48 Co 2V) Soft Magnetic
Remendur — (48 Co)
Arnavar — (43 Co) Spring Type Non Magnetic

COPPER & COPPER BASE ALLOYS

CDA 101 OFHC Copper
CDA 110 Electrolytic Copper
CDA 230 Red Brass
CDA 240 Rich Low Brass
CDA 260 Cartridge Brass
CDA 510 Phos. Bronze
Beryllium Copper Alloy 25
Alloy 720 (60 Cu, 20 Ni, 20 Mn)

STRAIN GAUGE ALLOYS

Balco
Manganin
Constantan
Karma
Evanohm

Normally produced from customer's material.

BASE METALS

Ingot Iron
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Aluminum 2024
Aluminum 3003
Aluminum 5052
Aluminum 6061
Titanium ASTM B265 Grade 1
Titanium ASTM B265 Grade 2
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Type 316
Type 316L
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17-7 PH
Type 347
AM 350
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Type 420
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Alloy 455

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Inconel 625
Inconel 718
Inconel X750
Incoloy 800 (32 Ni, 21 CR)
Incoloy 825 (42 Ni, 21 CR)
Haynes 25 (50 Co)
Hastelloy X
Hastelloy S
Multimet (21 Cr, 20 Ni, 20 Co)

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Hastelloy C276
Alloy 20
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Available Metals and Alloys

Metals and Alloys	Manufacturing Specifications	Gauge Ranges	Minimum Width .035" Maximum Width	Standard Gauge Tolerance
Nickel Iron Alloys				
Moly Permalloy-79 Ni, 4 Mo	Customer Specification	.0001"-.014"	16½"	5%
Mu Metal-78 Ni	ASTM A341-49	.0001"-.014"	16½"	5%
4750-49 Ni	Customer Specification	.0001"-014"	16½"	5%
Controlled Expansion Alloys				
Alloy 42-42 Ni	Customer Specification	.0001"-.010"	16½"	5%
Arnoseal™ 28 Cr, 17 Co	Customer Specification	.00025"-.015"	16½"	5%
Ni Span C*-42 Ni, 5 Cr, 2.5 Ti	Customer Specification	.0001"-.020"	16½"	5%
Magnetic and Cobalt Alloys				
Vicalloy	Customer Specification	.0005"-.020"	16"	10%
Vanadium Permendur	Customer Specification	.002"-.035"	15"	10%
Remendur	Customer Specification	.001"-.015"	15"	10%
Arnavar™	Customer Specification	.0001"-.015"	15"	10%
Copper Base Alloys				
Beryllium Copper Alloy 25	AMS 4530D ASTM B-194 QQC 533 Cond. A	.0001"-.012"	14"	5%
Strain Gauge Alloys—Conversion Of Customers Material Only				
Balco	Customer Specification	.0001"-.005"	4"	10%
Manganin	Customer Specification	.0001"-.005"	4"	10%
Constantan	Customer Specification	.0001"-.005"	4"	10%
Karma	Customer Specification	.0001"-.005"	4"	10%
Evanohm	Customer Specification	.0001"-.005"	4"	10%
Base Metals and Alloys				
Ingot Iron	AMS 7706A	.001"-.015"	15"	5%
Low Carbon Steel	AMS 5040G	.0005"-.015"	16"	5%
Aluminum 2024	AMS 4103	.0015"-.010"	16"	5%

Metals and Alloys	Manufacturing Specifications	Gauge Ranges	Minimum Width .035" Maximum Width	Standard Gauge Tolerance
Stainless Steels Continued				
AM 350	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 410	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 420	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 430	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
Alloy 455	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
15-7 Mo	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
17-4 Ph	To Applicable AMS and ASTM MIL-S Specs	.0005"-.015"	16½"	5%
17-7 Ph	To Applicable AMS and ASTM MIL-S Specs	.0005"-.015"	16½"	5%
Silicon Steel C-10 Coating				
Silectron .001 Oriented	Customer Specification and MIL-S 46084	N/A	7"	10%
Silectron .002 Oriented	Customer Specification and MIL-S 46084	N/A	14½"	10%
Silectron .004 Oriented	Customer Specification and MIL-S 46084	N/A	14½"	10%
Silectron .006 Oriented	Customer Specification and MIL-S 46084	N/A	14½"	10%
Arnon™ .005 Non-Oriented	Customer Specification and MIL-S 46084	N/A	12-3/8"	10%
Arnon™ .007 Non-Oriented	Customer Specification and MIL-S 46084	N/A	12-3/8"	10%
Nickel Base and High Temperature Alloys				

Aluminum 3003	AMS 4010A	.0015"-.010"	16"	5%
Aluminum 5052	AMS 4017F	.0015"-.010"	16"	5%
Aluminum 6061	Customer Specification	.0015"-.010"	16"	5%
Aluminum 1100	AMS 4003E	.0015"-.010"	16"	5%
Titanium and Alloys				
Titanium ASTM B-265 Gd. 1	ASTM B-265	.0002"-.025"	16½"	10%
Titanium ASTM B-265 Gd. 2	ASTM B-265	.0002"-.025"	16½"	10%
Titanium AMS 4902 50A	AMS 4902	.0002"-.025"	16½"	10%
Titanium AMS 4900B 65A	AMS 4900B	.0003"-.025"	16½"	10%
Titanium AMS 4901C 75A	AMS 4901C	.0003"-.025"	16½"	10%
3Al-2.5V	Customer Specification	.0005"-.025	16½"	10%
6Al-4V	Customer Specification	.0005"-.025"	16½"	10%
15-3-3-3	Customer Specification	.0003"-.025"	16½"	10%
Stainless Steels				
AISI Type 301	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 302	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 304	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 304L	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 316	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 316L	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 321	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%
AISI Type 347	To Applicable AMS and ASTM MIL-S Specs	.0001"-.015"	16½"	5%

Nickel 200	Customer Specification	.0001"-.020"	16½"	5%
Nickel 201	Customer Specification	.0001"-.020"	16½"	5%
Nickel 270	Customer Specification	.0001"-.020"	16½"	5%
Monel*400	AMS 5544C	.0001"-.020"	16½"	5%
Monel*500 K Monel	MIL-N 17506	.0003"-.020"	16½"	5%
Inconel*600	AMS 5540H	.0003"-.020"	16½"	5%
Inconel*601	AMS 5870	.0003"-.020"	16½"	5%
Inconel*617	Customer Specification	.0005"-.020"	16½"	5%
Inconel*625	AMS 5599A	.0005"-.020"	16½"	5%
Inconel*718	AMS 5596C	.0005"-.020"	16½"	5%
Inconel*X750	AMS 5598 AMS 5542H	.0005"-.020"	16½"	5%
Incoloy*800	AMS 5871	.0005"-.020"	16½"	5%
Incoloy*825	Customer Specification	.0005"-.020"	16½"	5%
Haynes 25**	AMS 5537C	.0007"-.016"	16½"	5%
L-605***	Customer Specification	.0007"-.016"	16½"	5%
Hastelloy**B-2	Customer Specification	.0007"-.016"	16½"	5%
Hastelloy**C-276	Customer Specification	.0007"-.016"	16½"	5%
Hastelloy**G	ASTM B582	.0007"-.016"	16½"	5%
Hastelloy**S	AMS 5873	.0007"-.016"	16½"	5%
Hastelloy**X	AMS 5536G	.0007"-.016"	16½"	5%
Alloy 20	Customer Specification	.0007"-.016"	8"	5%
Rene 41	AMS 5545	.001"-.020"	16½"	10%
Spring Alloys				
301 S/S Arno 250	Per Customer Specification	.001"-.015"	16" 1½" Edged	5%
301 S/S Arno 285	Per Customer Specification	.001"-.015"	16" 1½" Edged	5%
Arnavar™	Per Customer Specification	.001"-.015"	16" 1½" Edged	5%
Arnoflex™ 250	Per Customer Specification	.001"-.015"	16" 1½" Edged	5%
Arnospring™ 300	Per Customer Specification	.001"-.015"	16" 1½" Edged	5%

Arnoflex™ and Arnospring™ are our new high corrosion resistant, high tensile spring material available at 250KSI or 300 KSI tensile strength. As our other spring materials, we offer a #5 edge or other special edge.

Vanadium Permendur Bars
Available from stock or production order in sizes ½" diameter to 8½" diameter.

*Registered Trademark of International Nickel Company.
**Registered Trademark of Stellite Div., Cabor Corporation.
***Registered Trademark Cyclops Corporation.

The high-performance aerospace alloys produced by Arnold's precision-metal rolling mill helped get man off the earth.

It took a lot of technology to put a human footprint on the moon.

The obstacles involved in readying man for farther-reaching advances into the universe are no less demanding.

The ultra-thin aerospace alloys produced by Arnold to counter some of these obstacles are available to you. Today.

And the cost of their use in your application doesn't have to be astronomical.

You can get them off the shelf.

An alloy of Titanium—rolled to a thinness (.0015") not previously available, and capable of withstanding 1,000-plus degrees at re-entry—was NASA's development specification for the thermal protective system of a new series of hypersonic space vehicles.

These vehicles will depend for re-entry protection on materials produced and rolled by Arnold.

Your thin-roll requirements may be less stringent. But we won't treat them as if they were less important.

The nation's leading re-roller of Titanium, Arnold is uniquely equipped to bring the special problems involved in ultra-thin rolling of a wide variety of metals and alloys to a successful conclusion.

We can be of service, whether your per-year requirement is 50 pounds or 50,000.

Our control capabilities extend from first melt to finished product. So we are prepared to undertake the development of new alloys you may need to meet particular product requirements.

And we also maintain a large inventory of the most-requested grades and types of alloys.

The chart below represents only a partial list of materials now available from Arnold. For full information regarding our precision-metal rolling capabilities, write us. Tell us what you need. And don't be afraid to shoot for the moon.

	Alloys	Production Specifications	Gauge Ranges	Width Ranges	Standard Gauge Tolerance
Titanium & Titanium Alloys	Grade I	ASTM B265	.0001-.025	.060-16½"	±10%
	Grade II	ASTM B265 AMS 4902	.0001-.025	.060-16½"	±10%
	Grade III	ASTM B265 AMS 4900C	.0002-.025	.060-16½"	±10%
	Grade IV	ASTM B265 AMS 4901	.0002-.025	.060-16½"	±10%
	3AL-2.5V	Upon Application	.0005-.025	.060-16½"	±10%
	6AL-4V	Upon Application	.0005-.025	.060-16½"	±10%
Electrical & Magnetic Alloys	Moly Permalloy	Per customer	.0001-.014	.060-16½"	± 5%
	Mumetal	Per customer	.0001-.014	.060-16½"	± 5%
	4750	Per customer	.0001-.014	.060-16½"	± 5%
High Technology Alloys	Inconel® 617	Upon Application	.0002-.020	.060-16½"	± 5%
	Inconel® 625	AMS 5599A	.0002-.020	.060-16½"	± 5%
	Hastelloy® B2	ASTM B333	.0002-.020	.060-16½"	± 5%

Inconel® is a Registered Trademark of International Nickel Company
Hastelloy® is a Registered Trademark of Stellite Div., Cabot Corporation

ARNOLD
Subsidiary, Magnetics & Electronics, Inc.

Precision Metal Rolling Mill
P.O. Box 207 / Marengo, Illinois 60152
Phones Marengo (815) 568-2471
Chicago (312) 263-6300

With twelve plants located throughout this country and South America, Magnetics & Electronics, Inc. is the nation's leading manufacturer of magnetic materials and related instrumentation, electronic equipment and components. For a free booklet describing the range of our primary operations, write to:
Magnetics & Electronics, Inc.
6132 Hanging Moss Road
Orlando, Florida 32807

Magnetics & Electronics, Inc.
An Allegheny Ludlum Industries Company

Our world of components makes a world of *difference*

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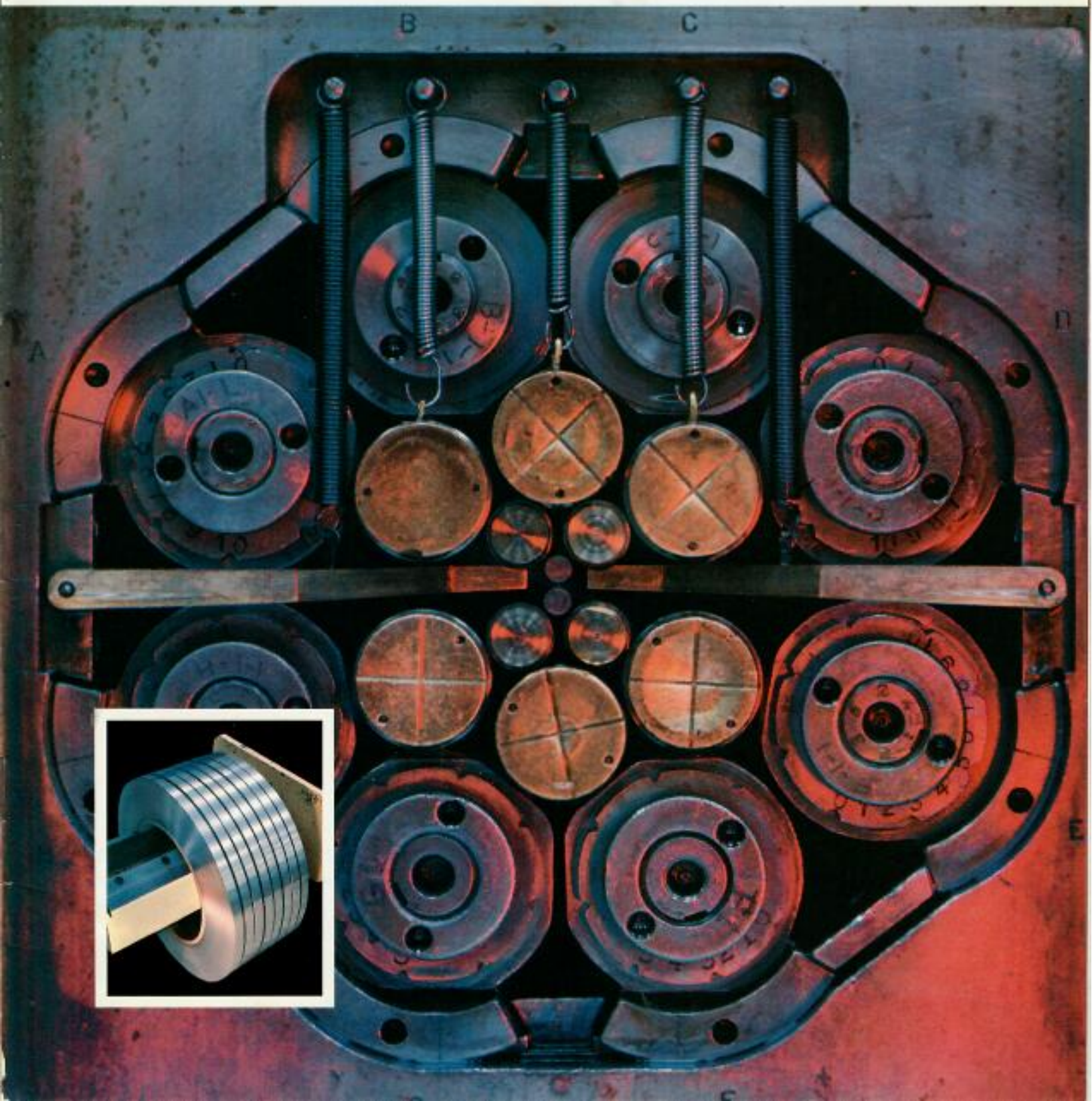
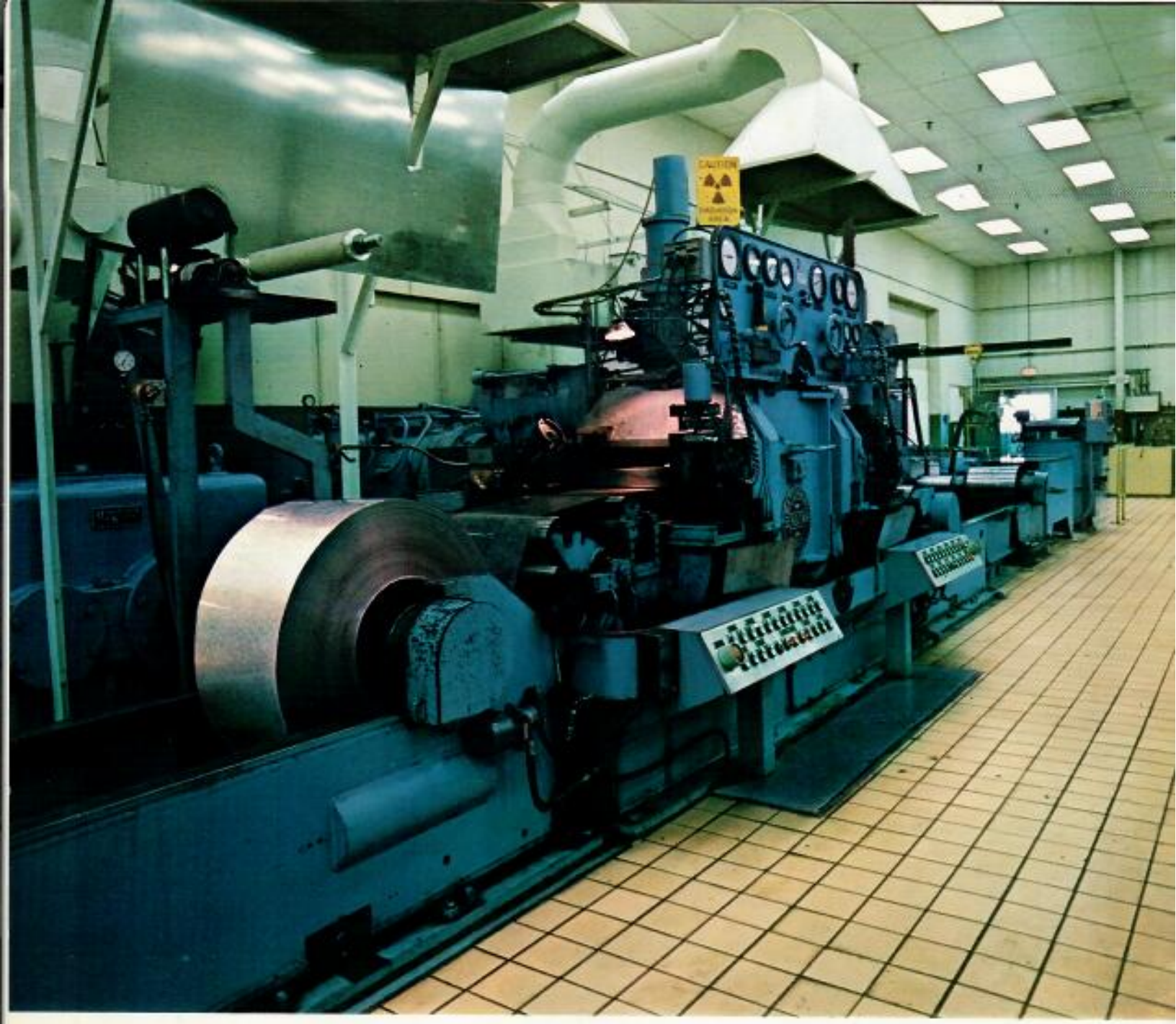
ARNOLD

PRECISION METAL ROLLING





Cover: Roll cluster of 4-inch Sendzimir mill (actual size).

Cover insert: Slit coils ready for packing.

Above: Computer gauge controlled Sendzimir mill.

the micro-thin world of Arnold PRECISION

Since its founding in 1936, the Arnold Engineering Company has always been engineering and research oriented, pacing the industry with new products and production refinements.

In 1950 the Arnold rolling facility was established to produce extremely precise material thicknesses which could not be supplied by other rolling mills for our wound magnetic core production.

From this beginning Arnold has now built a unique facility for the ultra-precise rolling, annealing, slitting, and edging of a wide range of ferrous and non-ferrous alloys. The twenty-five years of research and development Arnold has invested in the production of extremely exact thin metal strip for our own use has created a capability that is now available to meet the needs of other industries.

Unlike most rolling mills—which consider .010" to be a thin gauge—Arnold seldom rolls anything thicker than this. Thus, what is special to most mills is standard procedure for Arnold.

As a member company of Allegheny Ludlum Industries, Inc., Arnold draws upon the resources of one of the world's largest specialty metals groups. Control extends from the research laboratories for new alloys through original melt to the finished strip.

Precision and quality

We at Arnold have gone to the utmost lengths to achieve ultimate precision and the highest possible quality. The building that houses the rolling mills is completely temperature controlled and air filtered. A level of illumination suitable for precision watchmaking ensures that the slightest surface defects are observable at every operation. Our philosophy is that accuracy and quality depend not only on the machines being used but also on the people who operate them and the environment in which they work.

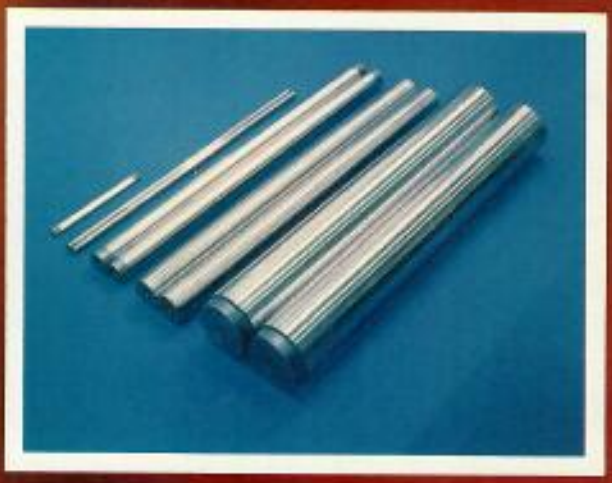
We specialize in producing material to exacting customer requirements. Thus, design engineers are freed from the restriction of conventional tolerances and specifications and can design to achieve optimum performance of their products. Our own engineers and metallurgists, plus the resources of Allegheny Ludlum Research Laboratories, are available to assist our customers in meeting their needs.

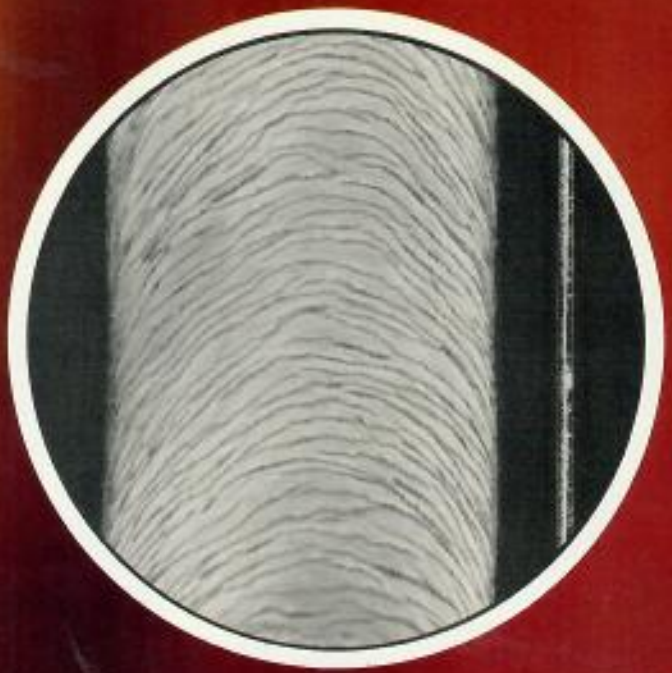
Some metals processed by Arnold:

Vicalloy • Inconel • Monel • Arnavar • Remendur • 300 Series Stainless • AM-350 • Beryllium Copper • Nickel-iron alloys • Hastelloys • Titanium and alloys • 17-7 PH • Aluminum and alloys • Waspalloy • Phosphor Bronze • Vibralloy • Carbon Steel • Electromagnetic Iron • Silectron

Sendzimir mill work rolls for:

- *ZR-32-4 (.250" diam)*
- *ZR-34-15 (.400" diam)*
- *ZR-33-17½ (1.125-1.500-2.750" diam)*





At 700X magnification—
Left: Human hair.
Right: Slit edge of .000085" (85 millionths) Beryllium Copper.

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Precision rolling to .000085"

The heart of the Arnold precision rolling facility consists of specially modified Sendzimir mills. These mills roll metals as thin as .000085" (eighty-five millionths of an inch). By means of computer controls, tolerances as tight as ± .000005" (five millionths) can be maintained on the thinnest material.

Although the Sendzimir mill is not an unusual means of precision cold rolling, our mills have been modified and enhanced through a continuous program of development to achieve quality and precision beyond the normal capabilities of this type of mill.

The automatic before-the-fact gauge control system was developed and patented by engineers at Allegheny Ludlum. Called Regal Control, the system is continuously being modified and improved here at Arnold to ensure state-of-the-art capabilities.

The use of computer controls has been a major advance in improving gauge tolerance. The addition of linearized Beta Ray gauges has given optimum instant thickness measurement and control.

Both carbide and steel rolls are used, depending on the material to be rolled and the final specification requirements. Diamond lapping of work rolls enables us to produce finishes down to one micro-inch.

A unique feature is that various sizes and shapes of mill rolls can be used to maximize flatness and minimize gauge variation across the strip width. Significantly, Arnold holds a patent in this field.

The mills vary in maximum rolled width capability from 17½" to 4" wide and in minimum thicknesses from .001" to .000085".

Because the mills are operated in a temperature controlled, virtually dust-free environment, optimum precision and consistency can be achieved through the Sendzimir design.

Quality control

Production and control of a high-quality precision product are not merely a matter of inspectors and gauges but rather an attitude and commitment on the part of the company.

Arnold has always been noted for its high-quality products, and this is nowhere better seen than in our rolling facility.

A complete range of mechanical, metallurgical, electrical, and magnetic testing equipment is utilized for measuring material properties. The equipment is backed by the necessary calibration standards and devices to ensure continuously high-level accuracy of all testing. Routine measurements can be made of such parameters as tensile and compressive properties, fatigue strength, surface finish, hardness, grain size, and chemical composition. In addition, Arnold has the full support of the Allegheny Ludlum Research Laboratories, which maintain one of the most extensive metallurgical testing facilities in the world.

Every coil that is rolled has a **strip chart record** (left) of the thickness along its entire length. In addition to this, the computer control prints out an analysis of thickness variations. Checks of thickness are also carried out by X-Ray gauges during the later slitting operations.

While the quality of the product is being constantly monitored, all equipment components such as mills, furnaces, and slitters are continuously checked to ensure that they are operating at optimum capability. Even the cooling oil used on the mills, apart from being temperature controlled and filtered, is regularly analyzed to ensure freedom from contamination.

In many cases where perfection of the surface is critical, every inch of both sides of the strip is visually inspected on special rewind lines.

All aspects of the Arnold ultra-precision rolling facility are geared to production of the highest possible quality at minimum cost.

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Precision annealing

Many materials require intermediate or final annealing to produce the necessary mechanical or magnetic properties. The main strip anneal line in operation at Arnold combines surface cleaning with annealing.

The line cleans strip by means of alkali cleaners, scrubbing, and final rinsing in deionized water.

Annealing can be done at a range of temperatures up to 2250°F in a variety of protective atmospheres, such as, hydrogen, argon, nitrogen, dissociated ammonia, and dissociated natural gas. The dewpoints of these gases can be maintained as low as −80°F to ensure purity of the atmosphere.

This anneal line, custom-built to Arnold specifications, also utilizes a computer to maintain tension control in the strip throughout the line.

Precision edging

In some cases it is necessary to have a shaped edge on the material for such reasons as increase of fatigue life and greater safety in handling. To provide this, Arnold has developed edging equipment which can handle material as thin as .002" and as narrow as .060".

Products with full-round, broken-corner, or partial-radius edges can be provided.

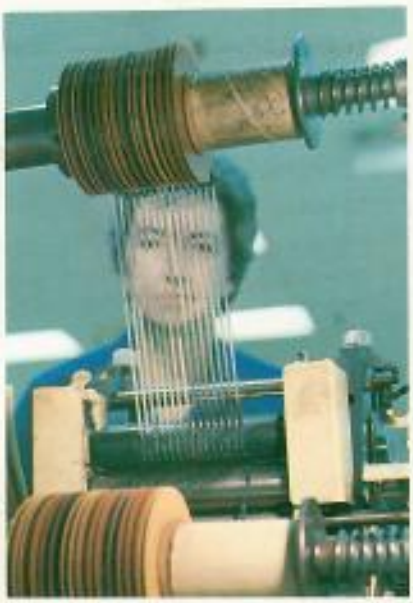
Precision slitting

A critical operation in producing thin gauge metal strip is slitting it to the width required for end use. Apart from ensuring that the width is accurate, it is necessary to minimize the burr, camber, cross bow, and damage to the material.

Arnold's many years of experience in slitting for our own production needs have enabled us to design, and have built to our specifications, slitting equipment incorporating the features found to give optimum results.

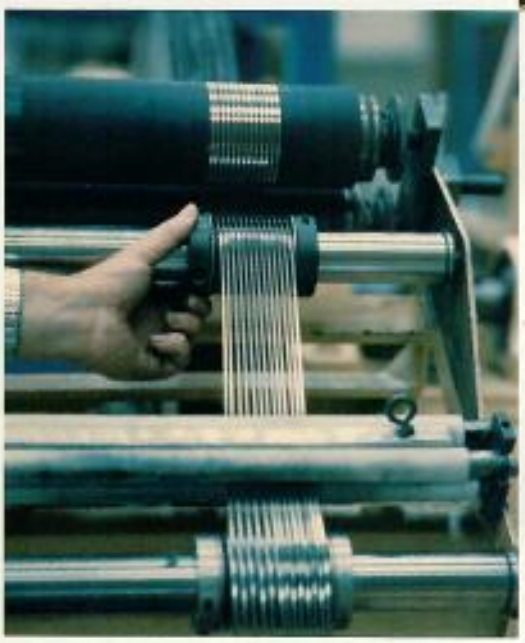
This equipment can slit the full range of material thicknesses that Arnold rolls to widths as narrow as .030". Width tolerance can be maintained as close as ± .0005".

Different types and sizes of materials require various slitting methods. Arnold's slitting equipment is designed to operate in several modes, such as double loop, pull through, and taut band. Thus a wide range of materials and thicknesses can always be slit in the optimum manner.



Above: Collection bridles on slitters.
Below: Slitting line with X-Ray thickness gauge.

Precision and quality



In addition to the facilities described in this brochure, Arnold has the ability to provide commercial quantities of powder-produced alloys with chemical composition and physical properties controlled to a degree unachievable by conventional melting practices.

Utilization of the capabilities within Allegheny Ludlum Industries also makes available materials unique in their composition or melting practice.

Whether your requirement is for special rolling, annealing, slitting, edging or basic alloy, the people and facilities of Arnold Engineering are waiting to serve you.

ARNOLD

ARNOLD MAGNETICS AND MICROELECTRONICS
MEMBER COMPANY OF ALLEGHENY LUDLUM INDUSTRIES, INC.

Marengo, Illinois 60152
Telephone: Area Code (815) 568-2471

Manufacturing Plants: Marengo, Illinois; Columbus, Ohio; Ogallala, Nebraska; Sevierville, Tennessee; Fullerton, Los Angeles and Redwood City, California; Sao Paulo, Brazil.