

UNCLASSIFIED

AD **272 257**

*Reproduced
by the*

ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA



Best Available Copy

UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

REPORT NO: FTDM-2123
DATE: 16 January 1962

272257

AD INU.

PROCESS - BRAZING - STAINLESS STEEL TO TITANIUM
EVALUATION

Published and Distributed Under
Contract No. AF33(657)-7248

XEROX

62-2-3

GENERAL DYNAMICS | FORT WORTH

**Best
Available
Copy**

TEST DATA MEMORANDUM

F-TOM NO. 2123

MODEL B-58

TEST NO. F-7204

Page 1 of 4

TEST: PROCESS - BRAZING - STAINLESS STEEL TO TITANIUM - EVALUATION OF

OBJECT:

The object of this test was to determine if commercially pure titanium tubing could be satisfactorily brazed to 321 stainless steel tubing and to evaluate the resulting brazed joint.

TEST SPECIMENS & PROCEDURE:

Titanium and stainless steel tubes, 1" O.D. by .035" wall, were used for this test. The titanium tube was inserted into the expanded end of a stainless tube, with various amounts of 98% silver-2% lithium alloy foil and wire. The assembly was placed in a vycor glass tube with a flowing argon gas atmosphere. An induction coil with five turns was placed around the joint. A Westinghouse 10 kw (450 kc) induction generator was used as the heating source. The arrangement is shown in Figure 1. The brazing cycle consisted of argon purge for 5 to 10 minutes and heating to the brazing temperature of 1450 to 1500 F in 2 to 4 minutes. The brazed tubes were then examined visually and metallographic specimens prepared. Salt spray specimens were prepared and exposed 100 hours.

RESULTS & DISCUSSION:

Typical brazed tubing sections are shown in Figure 2. A photomicrograph of a brazed titanium tube to stainless steel tube is shown in Figure 3, and of a titanium tube to nickel plated stainless steel tube in Figure 4.

In all cases, up to 75% of the circumference of the tubing joint was brazed. No benefits were obtained from either silver plating the titanium tubing, or nickel plating the stainless steel tubing. All the sections of the brazed joints that were exposed to salt spray failed within 100 hours. It is felt that with improved techniques, a completely brazed joint could be obtained, but the resultant joint would still have poor salt spray resistance using the 98-2 brazing alloy.

CONCLUSION:

Stainless steel tubing can be brazed to titanium tubing with 98 silver 2 lithium brazing alloy, but the resultant joint has poor corrosion resistance in salt spray.

The tests described in this report were conducted between March 1, 1958 and July 21, 1958.

DATE 11-19-58

BY

V. Leung

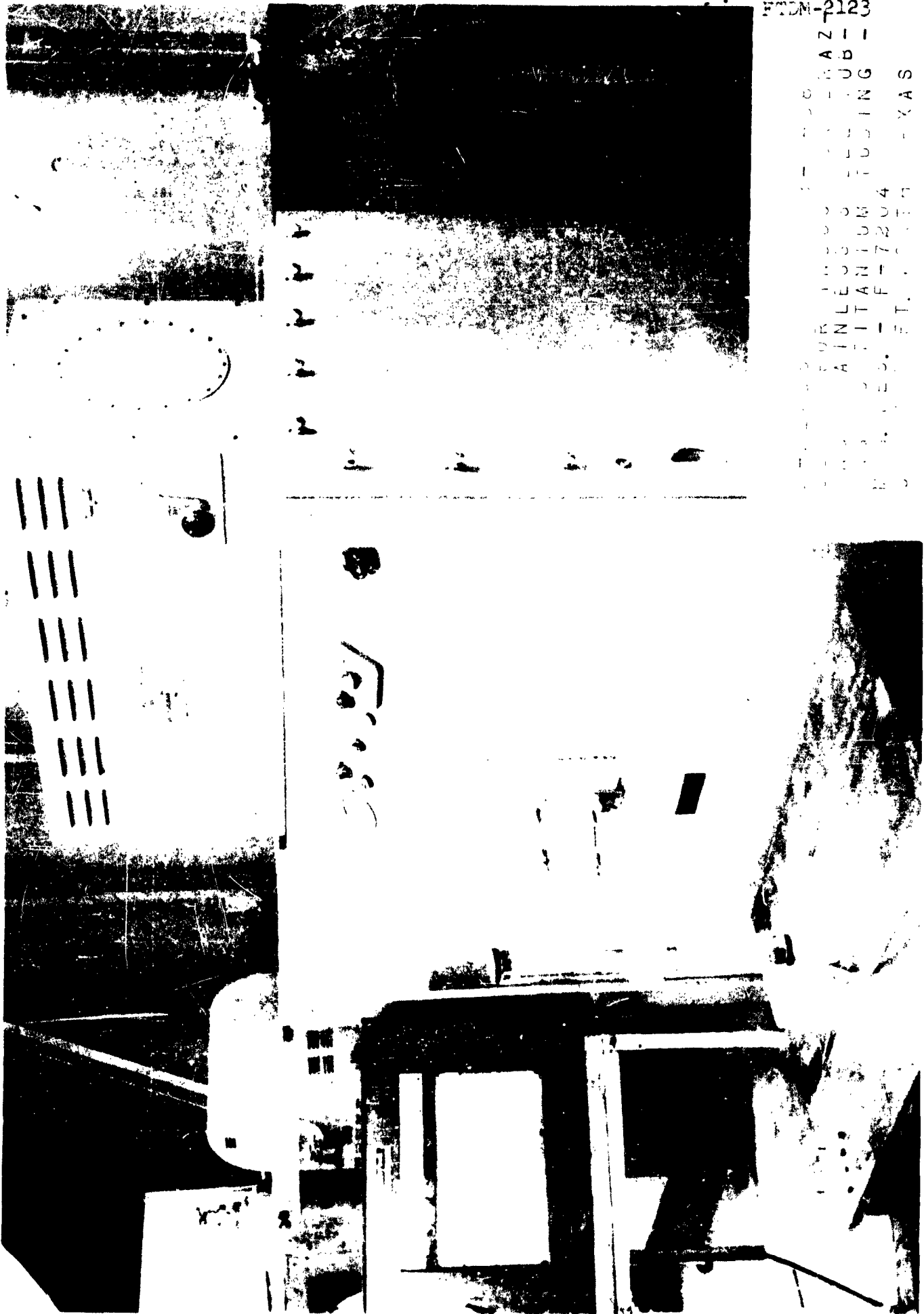
CHECKED

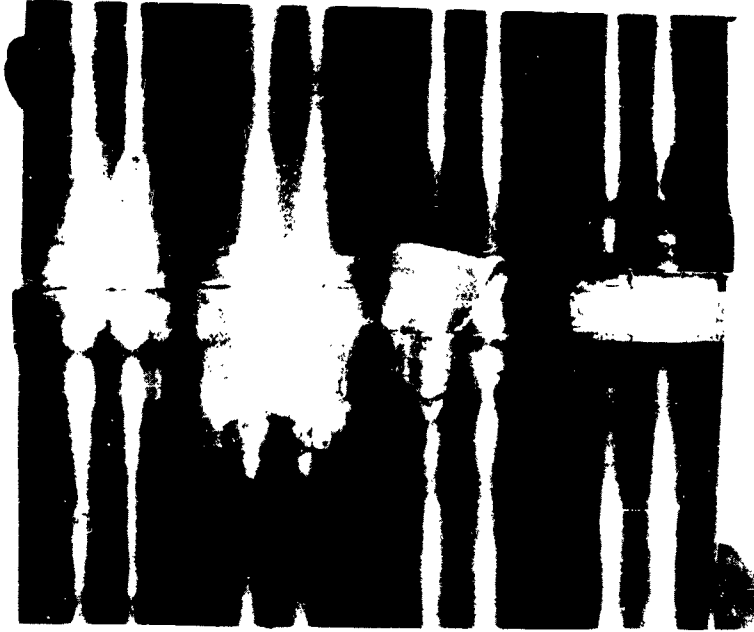
A. Hordquist

APPROVED

J. M. Clark

A B
C D
E F
G H
I J
K L
M N
O P
Q R
S T
U V
W X
Y Z
AA AB
AC AD
AE AF
AG AH
AI AJ
AK AL
AM AN
AO AP
AQ AR
AS AT
AU AV
AW AX
AY AZ
BA BB
BC BD
BE BF
BG BH
BI BJ
BK BL
BM BN
BO BP
BQ BR
BS BT
BU BV
BW BX
BY BZ
CA CB
CC CD
CE CF
CG CH
CI CJ
CK CL
CM CN
CO CP
CQ CR
CS CT
CU CV
CW CX
CY CZ
DA DB
DC DD
DE DF
DG DH
DI DJ
DK DL
DM DN
DO DP
DQ DR
DS DT
DU DV
DW DX
DY DZ
EA EB
EC ED
EE EF
EG EH
EI EJ
EK EL
EM EN
EO EP
EQ ER
ES ET
EU EV
EW EX
EY EZ
FA FB
FC FD
FE FF
FG FH
FI FJ
FK FL
FM FN
FO FP
FQ FR
FS FT
FU FV
FW FX
FY FZ
GA GB
GC GD
GE GF
GG GH
GI GJ
GK GL
GM GN
GO GP
GQ GR
GS GT
GU GV
GW GX
GY GZ
HA HB
HC HD
HE HF
HG HH
HI HJ
HK HL
HM HN
HO HP
HQ HR
HS HT
HU HV
HW HX
HY HZ
IA IB
IC ID
IE IF
IG IH
II IJ
IK IL
IM IN
IO IP
IQ IR
IS IT
IU IV
IW IX
IY IZ
JA JB
JC JD
JE JF
JG JH
JI JJ
JK JL
JM JN
JO JP
JQ JR
JS JT
JU JV
JW JX
JY JZ
KA KB
KC KD
KE KF
KG KH
KI KJ
KK KL
KM KN
KO KP
KQ KR
KS KT
KU KV
KW KX
KY KZ
LA LB
LC LD
LE LF
LG LH
LI LJ
LK LL
LM LN
LO LP
LQ LR
LS LT
LU LV
LW LX
LY LZ
MA MB
MC MD
ME MF
MG MH
MI MJ
MK ML
MM MN
MO MP
MQ MR
MS MT
MU MV
MW MX
MY MZ
NA NB
NC ND
NE NF
NG NH
NI NJ
NK NL
NM NN
NO NP
NQ NR
NS NT
NU NV
NW NX
NY NZ
OA OB
OC OD
OE OF
OG OH
OI OJ
OK OL
OM ON
OO OP
OQ OR
OS OT
OU OV
OW OX
OY OZ
PA PB
PC PD
PE PF
PG PH
PI PJ
PK PL
PM PN
PO PP
PQ PR
PS PT
PU PV
PW PX
PY PZ
QA QB
QC QD
QE QF
QG QH
QI QJ
QK QL
QM QN
QO QP
QQ QR
QS QT
QU QV
QW QX
QY QZ
RA RB
RC RD
RE RF
RG RH
RI RJ
RK RL
RM RN
RO RP
RQ RR
RS RT
RU RV
RW RX
RY RZ
SA SB
SC SD
SE SF
SG SH
SI SJ
SK SL
SM SN
SO SP
SQ SR
SS ST
SU SV
SW SX
SY SZ
TA TB
TC TD
TE TF
TG TH
TI TJ
TK TL
TM TN
TO TP
TQ TR
TS TT
TU TV
TW TX
TY TZ
UA UB
UC UD
UE UF
UG UH
UI UJ
UK UL
UM UN
UO UP
UQ UR
US UT
UU UV
UW UX
UY UZ
VA VB
VC VD
VE VF
VG VH
VI VJ
VK VL
VM VN
VO VP
VQ VR
VS VT
VU VV
VW VX
VY VZ
WA WB
WC WD
WE WF
WG WH
WI WJ
WK WL
WM WN
WO WP
WQ WR
WS WT
WU WV
WW WX
WY WZ
XA XB
XC XD
XE XF
XG XH
XI XJ
XK XL
XM XN
XO XP
XQ XR
XS XT
XU XV
XW XX
XY XZ
YA YB
YC YD
YE YF
YG YH
YI YJ
YK YL
YM YN
YO YP
YQ YR
YS YT
YU YV
YW YX
YY YZ
ZA ZB
ZC ZD
ZE ZF
ZG ZH
ZI ZJ
ZK ZL
ZM ZN
ZO ZP
ZQ ZR
ZS ZT
ZU ZV
ZW ZX
ZY ZZ

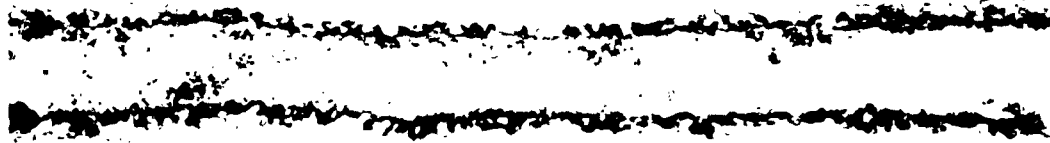




Photograph of commercially pure titanium tubing
induction brazed to 301 stainless steel tubing.
The expanded tube is stainless steel.

Mag. 1X

Figure 2



Photomicrograph of joint cut from tubes shown in Fig. 2.

250X

Etchant: 1% HF - 10% HNO₃

Figure 3

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION
(FORT WORTH)

PAGE 4
REPORT NO. FD-0123
MODEL B-38
DATE 11-10-58



Mag. 100X

Photomicrograph of commercially pure titanium
(top) brazed to nickel plated 321 stainless
steel (bottom). Etchant - Chromic-Sulfuric Acid

Figure 4