EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES

Addendum to ER-5542

PEDIGREES OF METALS AND ALLOYS

September 1963

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION CONTRACT NASw-114

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Lockheed-Georgia Company

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INTRODUCTION

The expansion of the screening test program under Contract NASw-114 to include several additional alloys necessitates the issuance of this report to provide the pedigree information on these alloys required as a basis for the evaluation of test results in the experimental program.

The additional alloys included in the screening program and the identification of the manufacturers for the materials for which pedigrees appear in this report are:

- Aluminum Company of America: Aluminum alloys 7079-T6 and A 356-T61
- International Nickel Company, Allvac Metals: Inconel X
- Allegheny Ludlum Steel Corporation: Stainless steel alloys Type A-286 and AM-350
- Carpenter Steel Company: Stainless Steel alloy Type 440-C and austenitic manganese steel alloy Type T-450
- Republic Steel Corporation: Stainless steel alloy Type 17-7PH
- Titanium Metals Corporation of America: Titanium alloy Ti-5Al-2.5Sn (low interstitial)

The pedigree data for these alloys appear in the order listed.

ALUMINUM ALLOYS

Alloy	7079	Lot Number	ARL-281577
Form	1/2" Extruded Rod	Vendor Code	--
Specification	Vendor	Lockheed Code	13 Ba
Temper	T-6	Vendor	ALCOA

Chemical Analyses

Element	Vendor Laboratory			Limits	
	1	2	3	Low	High
Copper	0.74	0.75	0.73	0.40	0.8
Iron	0.17	0.17	0.16	-	-
Silicon	0.10	0.10	0.09	-	-
Manganese	0.15	0.15	0.15	0.10	0.30
Magnesium	3.43	3.43	3.39	2.9	3.7
Zinc	4.49	4.53	4.47	3.8	4.8
Nickel	0.00	0.00	0.00	-	-
Chromium	0.16	0.16	0.16	0.10	0.25
Titanium	0.01	0.01	0.01	-	0.10

ALUMINUM ALLOYS

Alloy	7079	Lot Number	ARL-281577
Form	1/2" Extruded Rod	Vendor Code	-
Specification	Vendor	Lockheed Code	13 Ba
Temper	T-6	Vendor	ALCOA

Mechanical Properties Data (75°F)

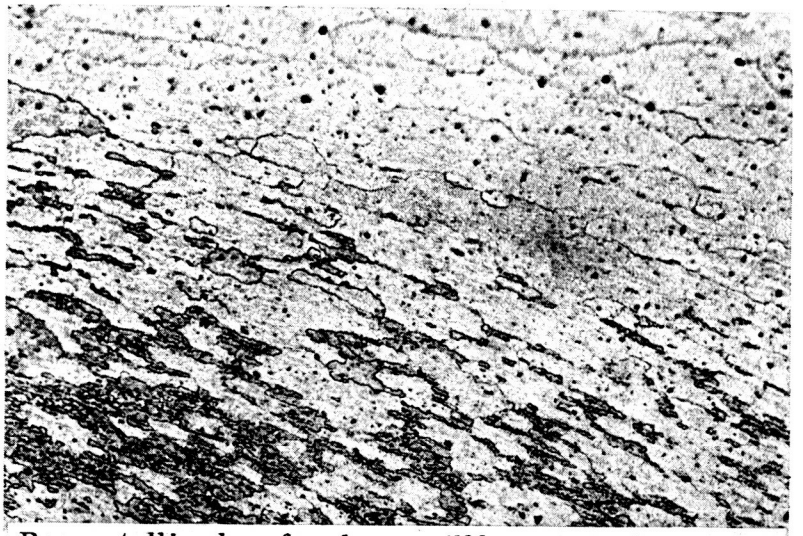
Property	Test Results	Minimum Allowable (Alcoa Aluminum Handbook)
Tensile Ultimate (psi)	A. 92,200 B. 90,600	78,000
Tensile Yield (psi)	A. 87,400 B. 86,000	70,000
Elongation 40 (%)	A. 11.2 B. 10.4	7
Compression Yield (psi)	A. 82,000 B. 80,900	70,000 (per Mil-HDBK-5)
Shear Strength (psi)	A. 48,400 B. 48,600	43,000 (per Mil-HDBK-5)
Hardness, Brinell (500 Kg load)	A. 152 B. 151	
Electrical Conductivity at 20°F, % IACS	A. 30.6 B. 30.6	

ALUMINUM ALLOYS

Alloy	7079	Lot Number	ARL-281577
Form	1/2" Extruded Rod	Vendor Code	--
Specification	Vendor	Lockheed Code	13 Ba
Temper	T-6	Vendor	ALCOA

Microstructure

Mag. 100X
Transverse
Section
Etch:
Keller's



Recrystallized surface layer will be removed in sample preparation and so will not influence test results.

Mag. 100X
Longitudinal
Section
Etch:
Keller's

ALUMINUM ALLOYS

Alloy	A 356	Lot Number	ARL-281682
Form	1/2" Permanent Mold Castings	Vendor Code	--
Specification	Vendor	Lockheed Code	14 Ba
Temper	T-61	Vendor	ALCOA

Chemical Analyses

Element	Vendor Laboratory			Limits	
	1	2	3	Low	High
Copper	0.01	0.01	0.01	-	0.20
Iron	0.15	0.15	0.15	-	0.20
Silicon	6.85	6.86	6.88	6.5	7.5
Manganese	0.01	0.01	0.01	-	0.10
Magnesium	0.38	0.37	0.38	0.20	0.40
Zinc	0.02	0.02	0.02	-	0.10
Nickel	0.02	0.02	0.02	-	-
Chromium	0.00	0.00	0.00	-	-
Titanium	0.13	0.13	0.13	-	0.20

ALUMINUM ALLOYS

Alloy	A 356	Lot Number	ARL-281682
Form	1/2" Permanent Mold Castings	Vendor Code	-
Specification	Vendor	Lockheed Code	14 Ba
Temper	T-61	Vendor	ALCOA

Mechanical Properties Data (75°F)

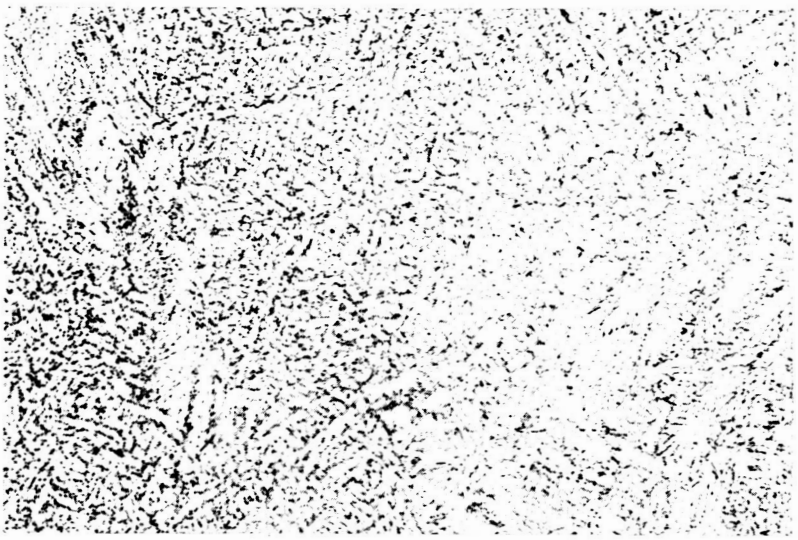
Property	Test Results	Minimum Allowable (Alcoa Aluminum Handbook)
Tensile Ultimate (psi)	A. 42,100 B. 42,200	37,000
Tensile Yield (psi)	A. 27,000 B. 28,100	
Elongation - 4D (%)	A. 18 B. 18	5
Compressive Yield (psi)	A. 29,800 B. 28,700	
Shear Strength (psi)	A. 28,300 B. 28,000	
Hardness, Brinell (500 Kg load)	A. 80 B. 79	
Electrical Conductivity at 20°C, % IACS	A. 38.4 B. 38.4	

ALUMINUM ALLOYS

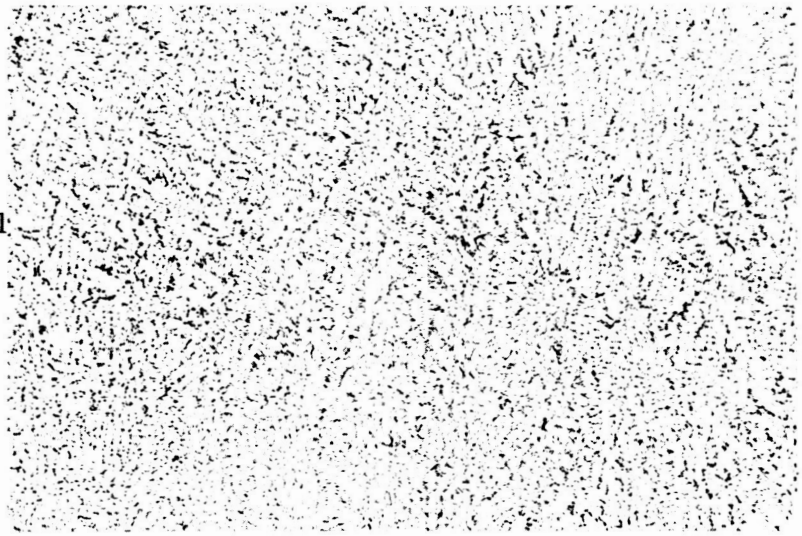
Alloy	A356	Lot Number	ARL-281682
Form	1/2" Permanent Mold Casting	Vendor Code	-
Specification	Vendor	Lockheed Code	14 Ba
Temper	T-61	Vendor	ALCOA

Microstructure

Mag. 100X
Transverse
Section
Etch:
Keller's



Mag. 100X
Longitudinal
Section
Etch:
Keller's



NICKEL ALLOYS

Alloy	Inconel X	Heat Number	2645
Form	1/2" Diameter Rod	Vendor Code	45745
Specification	AMS 5667	Lockheed Code	3 Fa
Temper	Precipitation Hardened	Vendor	INCO

Manufacturing Data

Furnace Process	Induction vacuum electrode, remelted vacuum consumable arc.
Manufacturer and Date	Induction by Allvac, 10/21/61. Consumable arc by Latrobe Steel, 11/10/61.
Mill Practice	Ingot cogged at 2125°F by Latrobe to 2-3/8 x 3-1/2 billet. Finish rolled from 2100°F by Allvac.
Heat Treatment	Solution treated at 1625°F for 24 hours 9/29/62, air cooled; precipitation treated at 1300°F for 20 hours 10/11/62, air cooled.

NICKEL ALLOYS

Alloy	Inconel X	Heat Number	2645
Form	1/2" Diameter Rod	Vendor Code	45745
Specification	AMS 5667	Lockheed Code	3 Fa
Temper	Precipitation Hardened	Vendor	INCO

Chemical Analyses

Element	F. L. Crobaugh Company	National Spec. Lab.	Spectro-Chemical Lab.	Limits	
				Low	High
Carbon	0.07	0.034	0.04	-	0.08
Manganese	0.14	0.10	0.05	-	1.0
Silicon	0.05	0.17	0.15	-	0.01
Chromium	15.42	15.44	14.80	14.0	17.0
Cobalt	0.05	0.13	0.05	-	1.0
Cb + Ta	0.88	0.85	0.85	0.7	1.2
Titanium	2.68	2.71	2.51	2.25	2.75
Aluminum	0.68	0.93	0.85	0.40	1.0
Iron	7.68	7.61	7.45	5.0	9.0
Copper	0.01	0.10	0.03	-	0.50
Boron	-	0.001	-	-	-
Zirconium	-	-	0.01	0.0	-
Oxygen	0.0035	-	-	-	-
Hydrogen	0.0001	-	-	-	-
Nitrogen	0.006	-	-	-	-
Molybdenum	0.09	-	-	-	0.06
Magnesium	Trace	-	-	-	-

NICKEL ALLOYS

Alloy	Inconel X	Heat Number	2645
Form	1/2" Diameter Rod	Vendor Code	45745
Specification	AMS 5667	Lockheed Code	3 Fa
Temper	Precipitation Hardened	Vendor	INCO

Mechanical Properties Data (75°F)

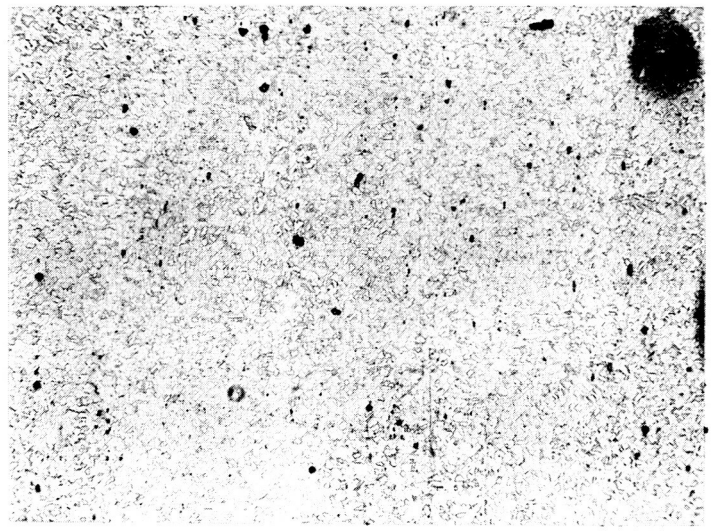
Property	Test Results
Tensile Ultimate (psi)	188,900
Tensile Yield (0.2% offset, psi)	128,330
Elongation 1" (%)	26.4
Reduction of Area (%)	43.2
Tensile Notch (psi) (0.252 notch drain, net radius 0.007")	237,420
Hardness (Rockwell C)	38
Grain Size (ASTM E-112-58T)	No. 8 or finer
Inclusion Rating (ASTM E-45-60T)	0 Excepting Normal Precipitates

NICKEL ALLOYS

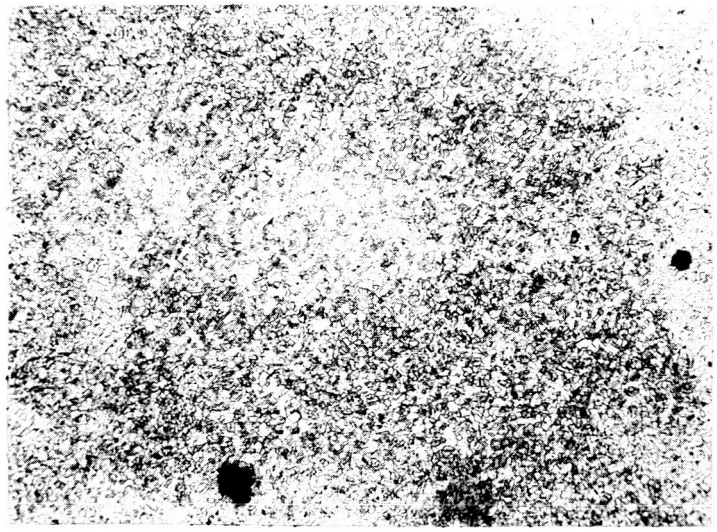
Alloy	Inconel X	Heat Number	2645
Form	1/2" Diameter Rod	Vendor Code	45745
Specification	AMS 5667	Lockheed Code	3 Fa
Temper	Precipitation Hardened	Vendor	INCO

Microstructure

Mag. 100X
Transverse
Section
Etch:
92% HCl
5% H_2SO_4
3% HNO_3



Mag. 100X
Longitudinal
Section
Etch:
92% HCl
5% H_2SO_4
3% HNO_3



STAINLESS STEEL ALLOYS

Alloy	A-286	Heat Number	W-23742
Form	1/2" Diameter Bar	Vendor Code	--
Specification	AMS 5737	Lockheed Code	8 Ca
Temper	Solution Treated and Aged	Vendor	Allegheny Ludlum

Manufacturing Data

Heat Treatment	Held 2 hours at 1650°F Water quenched Held 16 hours at 1325°F on January 22, 1963

Cleanliness Rating (ASTM E 45-60T):

	A	B	C	D
Thin	0	0	0	1.0
Thick	0	0	0	0

STAINLESS STEEL ALLOYS

Alloy	A-286	Heat Number	W-23742
Form	1/2" Diameter Bar	Vendor Code	--
Specification	AMS 5737	Lockheed Code	8 Ca
Temper	Sol. Treated & Aged	Vendor	Allegheny-Ludlum

Chemical Analyses

Element	Vendor Analysis		Limits	
	Ladle	Check	Low	High
Carbon	0.036	0.053	-	0.08
Manganese	1.20	1.20	1.00	2.00
Silicon	0.58	0.55	-	1.00
Phosphorus	0.016	0.012	-	0.040
Sulfur	0.001	0.001	-	0.040
Chromium	15.00	14.77	13.50	16.00
Nickel	26.02	25.90	24.00	27.00
Molybdenum	1.18	1.22	1.00	1.50
Vanadium	0.22	0.21	0.10	0.50
Titanium	2.03	2.19	1.75	2.35
Aluminum	0.16	0.16	-	0.35
Boron	0.004	0.004	-	-

STAINLESS STEEL ALLOYS

Alloy	A-286	Heat Number	W-23742
Form	1/2" Diameter Bar	Vendor Code	--
Specification	AMS 5737	Lockheed Code	8 Ca
Temper	Sol. Treated & Aged	Vendor	Allegheny-Ludlum

Mechanical Properties Data (75°C)

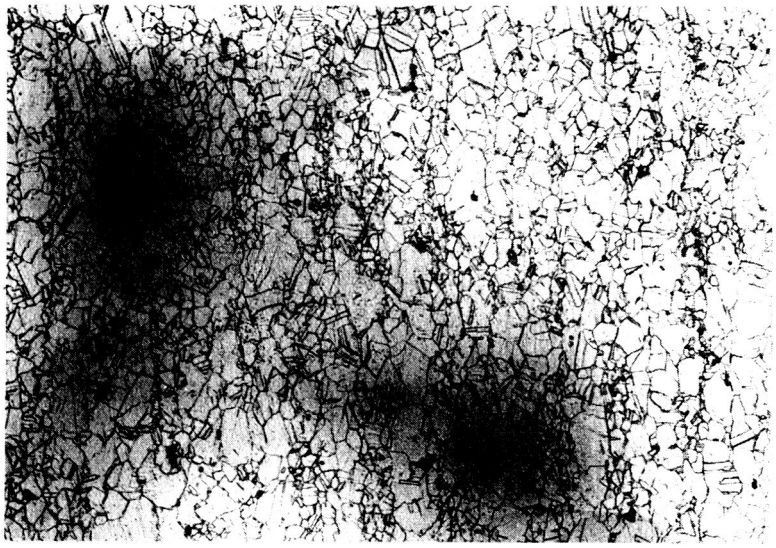
Property	Test Results
Tensile Ultimate (psi)	159,000
Tensile Yield (0.2% offset, psi)	127,000
Elongation 2" (%)	20
Reduction of Area (%)	49
Hardness, Brinell (1000 Kg load)	302
Grain Size	7-8

STAINLESS STEEL ALLOYS

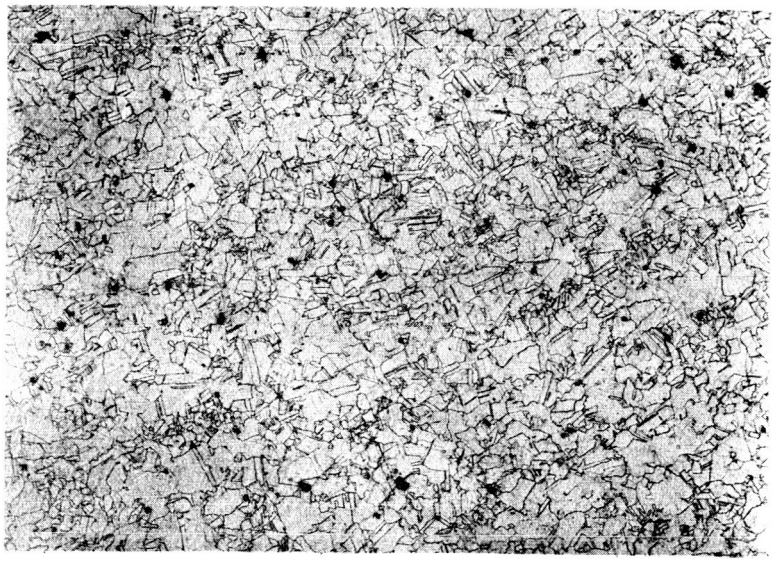
Alloy	A-286	Heat No.	W-23742
Form	1/2" Diameter Bar	Vendor Code	--
Specification	AMS 5737	Lockheed Code	8 Ca
Temper	Sol. Treated & Aged	Vendor	Allegheny Ludlum

Microstructure

Mag. 100X
Transverse
Section



Mag. 100X
Longitudinal
Section



STAINLESS STEEL ALLOYS

Alloy	AM 350	Heat Number	28579-H
Form	1/2" Diameter Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	10 Ca
Temper	SCT	Vendor	Allegheny Ludlum

Manufacturing Data

Heat Treatment	Held 1 hour at 1750°F Water quenched Held 3 hours at -100°F Held 3 hours at 850°F on December 18, 1962
Hardness	Rockwell C 46

Cleanliness Rating (per ASTM E 45-60T):

	A	B	C	D
Thin	0	2.0	0	2.0
Thick	0	1.5	0	0

STAINLESS STEEL ALLOYS

Alloy	AM 350	Heat Number	28579-H
Form	1/2" Diameter Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	10 Ca
Temper	SCT	Vendor	Allegheny Ludlum

Chemical Analyses

Element	Vendor Analysis
Carbon	0.099
Manganese	0.95
Phosphorus	0.028
Sulfur	0.011
Silicon	0.41
Chromium	16.49
Nickel	4.31
Molybdenum	2.76
Nitrogen	0.007
Copper	0.10

STAINLESS STEEL ALLOY

Alloy	AM 350	Heat Number	28579-H
Form	1/2" Diameter Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	10 Ca
Temper	SCT	Vendor	Allegheny Ludlum

Mechanical Properties Data (75°F)

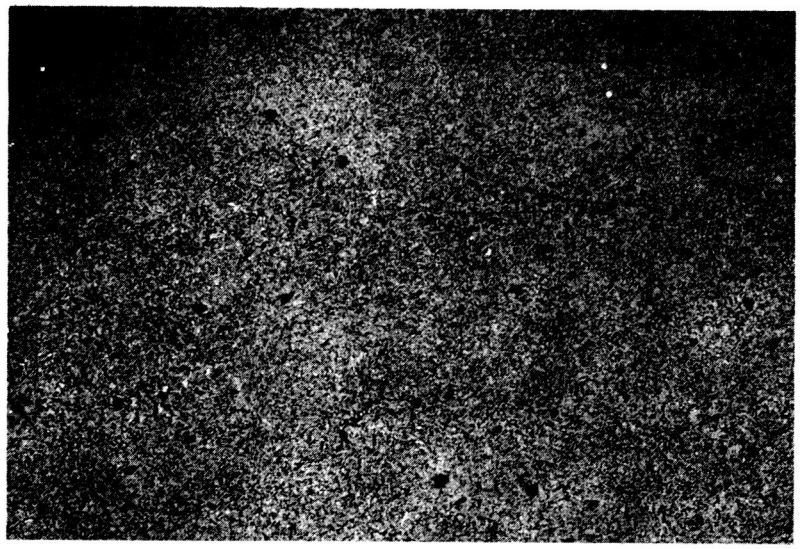
Property	Test Results
Tensile Ultimate (psi)	207,000
Tensile Yield (psi)	184,000
Elongation 2" (%)	14
Reduction of Area (%)	50
Hardness (Rockwell C)	46
Grain Size	

STAINLESS STEEL ALLOYS

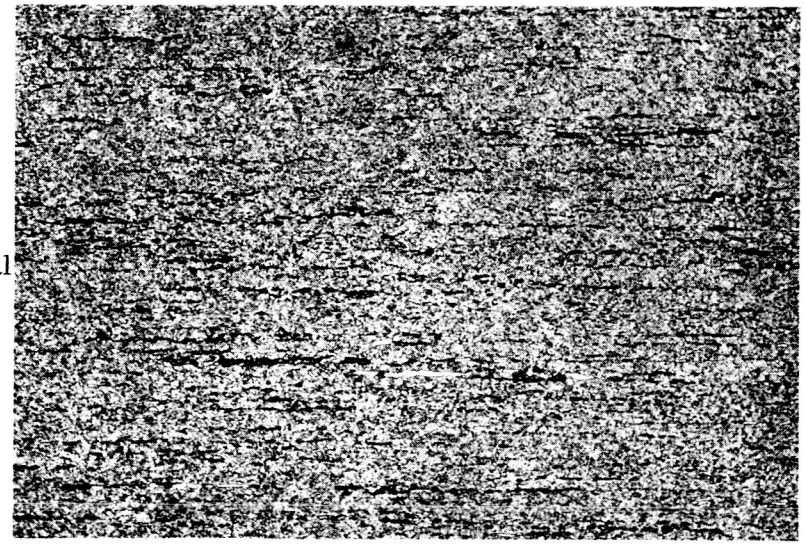
Alloy	AM 350	Heat No.	28579-H
Form	1/2" Diameter Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	10 Ca
Temper	SCT	Vendor	Allegheny Ludlum

Microstructure

Mag. 100X
Transverse
Section



Mag. 100X
Longitudinal
Section



STAINLESS STEEL ALLOYS

Alloy	440-C	Heat Number	805931
Form	1/2" Round Bar	Vendor Code	W44461
Specification	ASTM-A 276-57T	Lockheed Code	9 Ca
Temper	Quenched & Drawn	Vendor	Carpenter

Manufacturing Data

Furnace Process	Basic Electric Arc
Ingot Size	19" Square
Date of Heat	March 15, 1962
Ingot Treatment	Soaked at 2150°F
Fabrication Process	Hot Rolled
Heat Treatment	Mill annealed; held at 1550°F for 8 hours, cooled at 25°/hr to 1250 and air cooled. Quenched and drawn; held at 1925°F in neutral salt bath for 25 minutes, oil quenched, cooled to -100°F for 1 hour, tempered at 350°F for 1 hour, air cooled.
Hardness	Rockwell C 56 to 58

STAINLESS STEEL ALLOYS

Alloy	440-C	Heat Number	805931
Form	1/2" Round Bar	Vendor Code	W44461
Specification	ASTM A276-57T	Lockheed Code	9 Ca
Temper	Quenched & Drawn	Vendor	Carpenter

Chemical Analyses

Element	Vendor Laboratory			Limits	
	1	2	3	Low	High
Carbon	1.09	1.10	1.08	0.95	1.20
Manganese	0.37	0.37	0.36	-	1.50
Silicon	0.21	0.22	0.21	-	1.00
Phosphorus	0.014	0.015	0.014	-	0.040
Sulfur	0.011	0.009	0.010	-	0.030
Chromium	17.43	17.43	17.47	16.00	18.00
Nickel	0.30	0.30	0.29	-	-
Vanadium	0.05	0.05	0.05	-	-
Molybdenum	0.51	0.51	0.51	-	0.75
Copper	0.10	0.11	0.11	-	-
Cobalt	0.02	0.02	0.02	-	-
Silver	0.002	0.002	0.002	-	-
Tin	.001	.001	.001	-	-
Lead	.001	.001	.001	-	-
Nitrogen	.020/.021	.021/.021	.020/.020	-	-
Oxygen	75 ppm	73 ppm	68 ppm	-	-

STAINLESS STEEL ALLOYS

Alloy	440-C	Heat Number	805931
Form	1/2" Round Bar	Vendor Code	W44461
Specification	ASTM A 276-57T	Lockheed Code	9 Ca
Temper	Quenched & Drawn	Vendor	Carpenter

Mechanical Properties Data (75°F)

Property	Test Results	
	Annealed	Quenched & Drawn
Tensile Ultimate (psi)	1. 104,100 2. 103,500	146,000 142,000
Tensile Yield (0.2% offset, psi)	1. 77,000 2. 75,000	Approximates Ultimate
Elongation (%)	1. 17.3 2. 15.7	Nil Nil
Reduction of Area (%)	1. 29.2 2. 28.9	Nil Nil
Tensile Modulus (psi)	1. 29.4×10^6 2. 29.4×10^6	-- --
Hardness (Brinell)	1. 229 BHN 2. 229 BHN	Rc 59 Rc 60
Grain Size	1. #10 & finer 2. #10 & finer	-- --

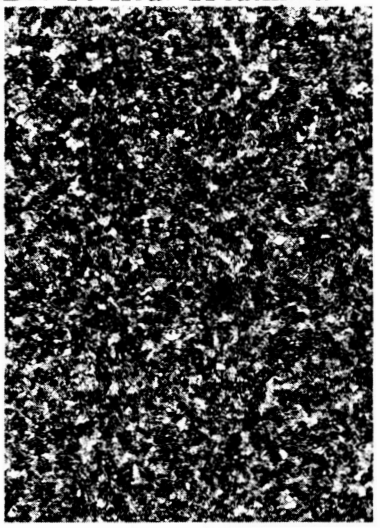
STAINLESS STEEL ALLOYS

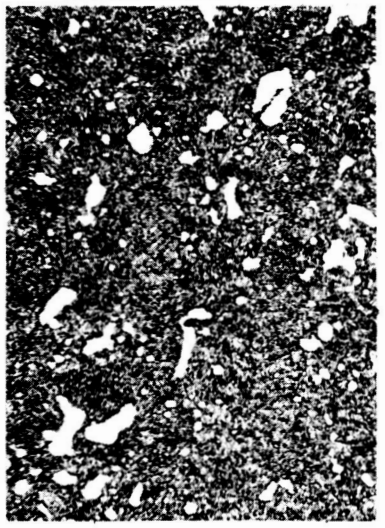
Alloy	440-C	Heat Number	805931
Form	1/2" Round Bar	Vendor Code	W4461
Specification	ASTM A 276-57T	Lockheed Code	9 Ca
Temper	Quenched & Drawn	Vendor	Carpenter

Microstructure

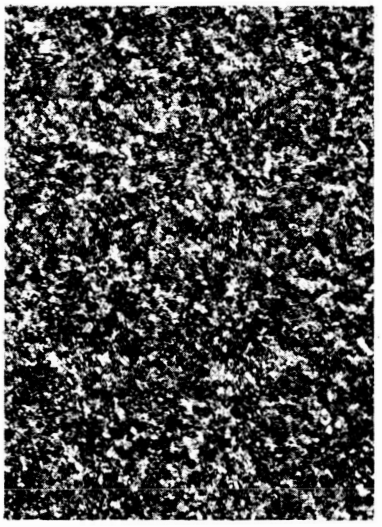
Before Heat Treatment | After Heat Treatment

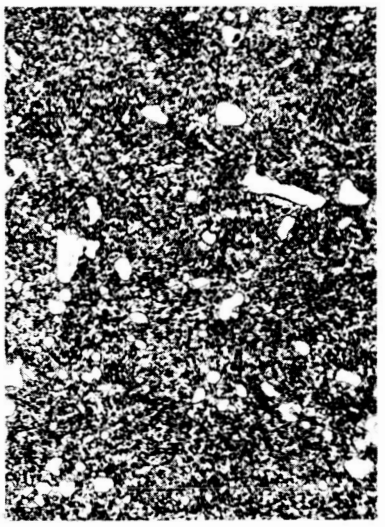
Mag. 100X
Transverse
Section
Etch:
Picric and
Hcl





Mag. 100X
Longitudinal
Section
Etch:
Picric and
Hcl





AUSTENITIC MANGANESE STEEL

Alloy	T450	Heat Number	B-03116
Form	0.484" Round Bar	Vendor Code	W-73664
Specification	Lockheed	Lockheed Code	1 E
Temper	Annealed	Vendor	Carpenter Steel

No Manufacturing Data Available

Chemical Analyses

Element	Vendor Analysis	Limits	
		Low	High
Carbon	0.15	0.14	0.16
Manganese	18.24*	18.75*	19.25
Phosphorus	0.004	-	-
Sulfur	0.008	-	-
Silicon	0.22	-	-
Nickel	2.06*	1.95	2.05*
Chromium	3.08	2.80	3.20
Molybdenum	0.02	-	-
Copper	1.59*	1.45	1.55*
Nitrogen	0.02	0.02	0.05
Cobalt	0.013	-	-
Tin	0.002	-	-
Lead	0.023	-	-
Silver	0.005	-	-

* Specification requirements waived due to experimental nature of alloy.

AUSTENITIC MANGANESE STEEL

Alloy	T450	Heat Number	B-03116
Form	0.484" Round Bar	Vendor Code	W-73664
Specification	Lockheed	Lockheed Code	1 E
Temper	Annealed	Vendor	Carpenter Steel

Mechanical Properties Data (75°C)

Property	Test Results
Tensile Ultimate (psi)	94,950
Tensile Yield (psi)	37,650
Elongation (%)	57
Reduction of Area (%)	73

Photomicrographs, grain size, and inclusion count not available.

STAINLESS STEEL ALLOYS

Alloy	17-7 PH	Heat Number	3331411
Form	1/2" Round Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	11 Ca
Temper	RH-950	Vendor	Republic Steel

No Manufacturing Data Available

Chemical Analyses

Element	Vendor Analysis
Carbon	0.062
Manganese	0.55
Phosphorus	0.023
Sulfur	0.008
Silicon	0.28
Nickel	6.98
Chromium	16.70
Aluminum	1.26

STAINLESS STEEL ALLOYS

Alloy	17-7 PH	Heat Number	3331411
Form	1/2" Round Bar	Vendor Code	--
Specification	Vendor	Lockheed Code	11 Ca
Temper	RH-950	Vendor	Republic Steel

Mechanical Property Data (75°F)

Property	Test Results
Tensile Ultimate (psi)	209,000
Tensile Yield (psi)	185,000
Elongation (%)	12
Reduction of Area (%)	42.5
Hardness (Rockwell C)	47

Photomicrographs, grain size, and inclusion count not available.

TITANIUM ALLOYS

Alloy	5 Al-2.5Sn Eli	Heat Number	Various
Form	1/2" Round Bar	Vendor Code	-
Specification	TMCA Melting Research Div. S. O. P. #49021-1	Lockheed Code	8 A
Temper	Annealed	Vendor	TMCA

Manufacturing Data

Melting Practice	Consumable electrode Vacuum Arc Melting
Date of Melt	V-2402, November 26, 1962 V-2403, November 28, 1962 V-2404, November 27, 1962
Ingot Size	25 lb
Ingot Treatment	Heated to 2000°F
Manufacturing Process	Forged to 1-1/2" square bar from 2000°F with 5 reheatings required. Rolled 1-1/2" square to 3/4" round from 1950°F using six passes and one reheat. Rolled 3/4" round to 1/2" round from 1750°F using 6 passes and one reheat.
Final Heat Treatment	Held for two (2) hours at 1400°F - air cool on December 7, 1962.

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2402
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA Melting Research Div. S. O. P. #49021-1	Lockheed Code	8 Aa
Temper	Annealed	Vendor	TMCA

Chemical Analyses

Element	Vendor Laboratories			Limits	
	Toronto, Ohio	Henderson, Nevada	Henderson, Nevada	Low	High
Carbon	0.056	0.022	0.022	-	0.15
Iron	0.028	0.025	0.030	-	-
Nitrogen	0.012	0.010	0.011	-	0.07
Aluminum	5.52	5.36	5.41	4.00	6.00
Hydrogen	0.0054	0.0055	0.0059	0.003	0.020
Tin	2.54	2.35	2.33	2.00	3.00
Oxygen	0.045	0.059	0.054		0.20

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2402
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA Melting Research Div. S. O. P. #49021-1	Lockheed Code	8 Aa
Temper	Annealed	Vendor	TMCA

Mechanical Properties Data (75°F)

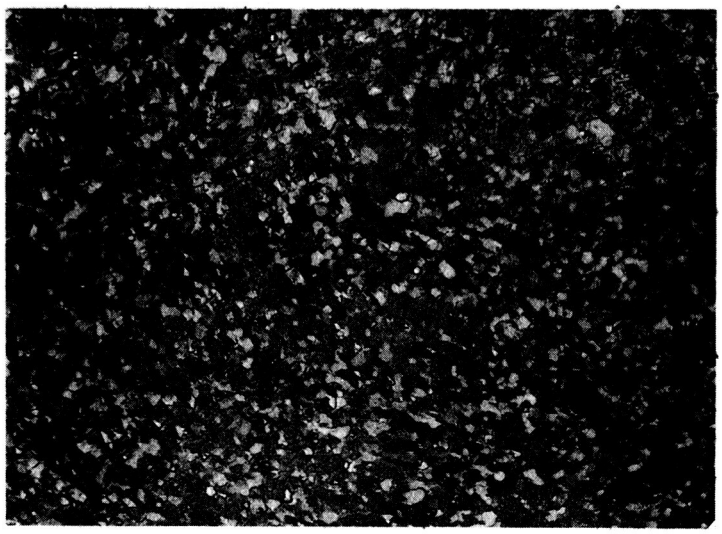
Property	Test Results
Tensile Ultimate (psi)	119,300
Tensile Yield (0.2% offset, psi)	101,200
Elongation 1" (%)	17.0
Reduction of Area (%)	38.0
Hardness (Rockwell C)	24.9
Notched Tensile (psi)	186,000

TITANIUM ALLOYS

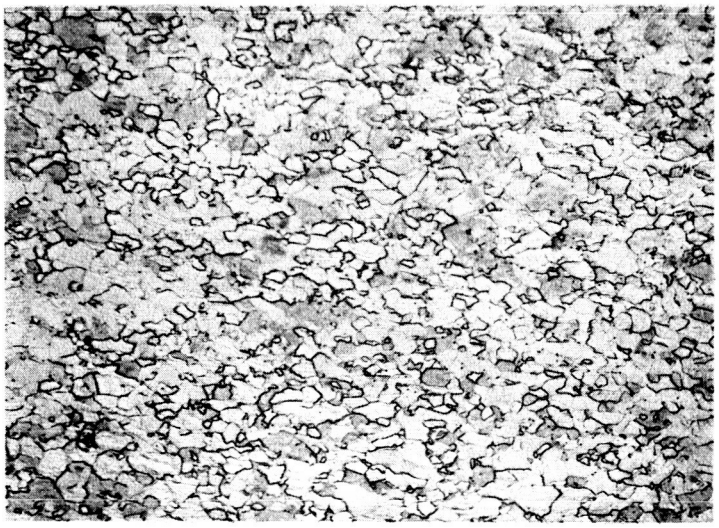
Alloy	5Al-2.5Sn Eli	Heat Number	V-2402
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA Melting Research Div. S. O. P. #49021-1	Lockheed Code	8 Aa
Temper	Annealed	Vendor	TMCA

Microstructure

Mag. 100X
Transverse
Section
Etch:
Stain



Mag. 100X
Longitudinal
Section
Etch:
Stain



TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2403
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8 Ab
Temper	Annealed	Vendor	TMCA

Chemical Analyses

Element	Vendor Laboratories			Limits	
	Toronto, Ohio	Henderson, Nevada	Henderson, Nevada	Low	High
Carbon	0.052	0.022	0.022	-	0.15
Iron	0.019	0.067	0.070	-	-
Nitrogen	0.012	0.010	0.009	-	0.07
Aluminum	5.30	5.11	5.14	4.00	6.00
Hydrogen	0.0040	0.0050	0.0048	0.003	0.020
Tin	2.84	2.45	2.48	2.00	3.00
Oxygen	0.041	0.050	0.056	-	0.20

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2403
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8 Ab
Temper	Annealed	Vendor	TMCA

Mechanical Properties Data (75°F)

Property	Test Results
Tensile Ultimate (psi)	125,500
Tensile Yield (0.2% offset, psi)	109,100
Elongation 1" (%)	17
Reduction of Area (%)	35.5
Hardness (Rockwell C)	26.1
Notched Tensile (psi)	192,000

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2403
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8Ab
Temper	Annealed	Vendor	TMCA

Microstructure

Mag. 100X
Transverse
Section
Etch:
Stain

Mag. 100X
Longitudinal
Section
Etch:
Stain

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2404
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8 Ac
Temper	Annealed	Vendor	TMCA

Chemical Analyses

Element	Vendor Laboratories			Limits	
	Toronto, Ohio	Henderson, Nevada	Henderson, Nevada	Low	High
Carbon	0.050	0.022	0.026	-	0.15
Iron	0.020	0.029	0.028	-	-
Nitrogen	0.011	0.010	0.009	-	0.07
Aluminum	5.30	5.49	5.55	4.00	6.00
Hydrogen	0.0056	0.0029	0.0037	0.003	0.020
Tin	2.83	2.42	2.45	2.00	3.00
Oxygen	0.039	0.046	0.050	-	0.20

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2404
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8 Ac
Temper	Annealed	Vendor	TMCA

Mechanical Properties Data (75°F)

Property	Test Results
Tensile Ultimate (psi)	118,100
Tensile Yield (0.2% offset, psi)	100,000
Elongation 1" (%)	17
Reduction of Area (%)	39.2
Hardness (Rockwell C)	25.3
Notched Tensile (psi)	182,000

TITANIUM ALLOYS

Alloy	5Al-2.5Sn Eli	Heat Number	V-2403
Form	1/2" Round Bar	Vendor Code	--
Specification	TMCA-MRD-49021-1	Lockheed Code	8Ab
Temper	Annealed	Vendor	TMCA

Microstructure

Mag. 100X
Transverse
Section
Etch:
Stain

Mag. 100X
Longitudinal
Section
Etch:
Stain