COMPILATION OF CHEMICAL COMPOSITIONS AND RUPTURE STRENGTHS OF SUPERALLOYS

Issued Under the Auspices of
Subcommittee XII on Specifications for High-Temperature, Super-Strength Alloys of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys
and
The Defense Metals Information Center

Prepared by

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This revision of DS-9 is the second cooperative publication of ASTM and DMIC. The first was the ASTM Data Series Publication, "The Elevated-Temperature Properties of Selected Superalloys", DS 7-S1, issued in July, 1968.

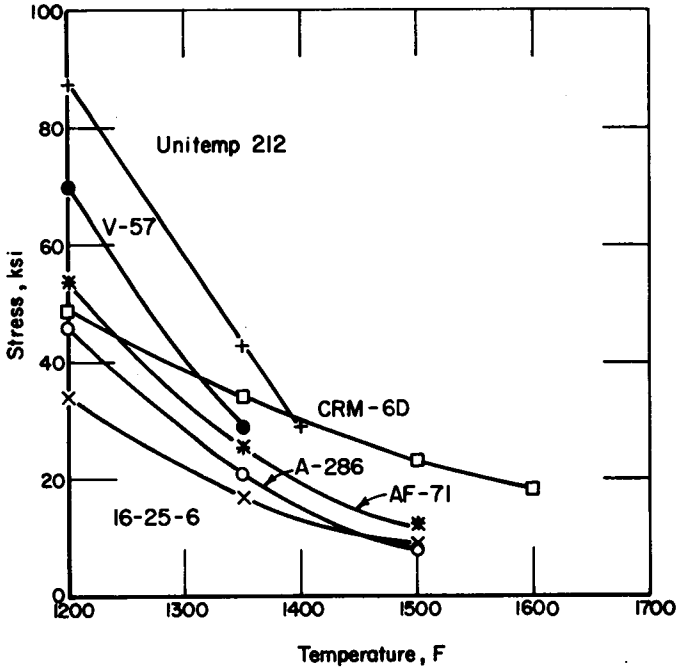

FIGURE 1. 1000-HOUR RUPTURE STRENGTHS OF SELECTED IRON-BASE ALLOYS

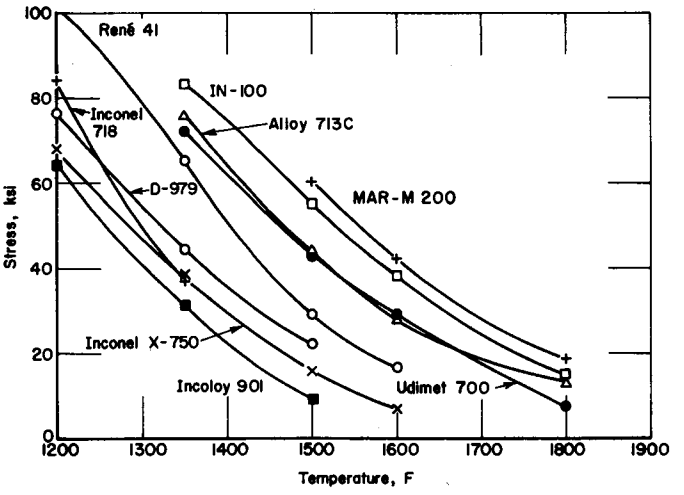

FIGURE 2. 1000-HOUR RUPTURE STRENGTHS OF SELECTED NICKEL-BASE ALLOYS

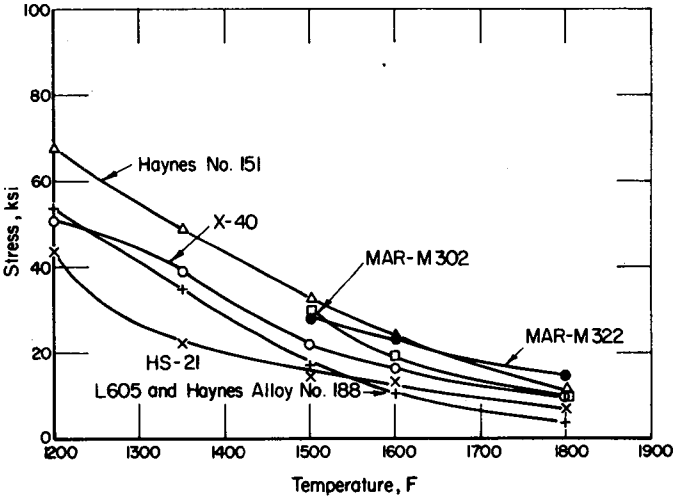

FIGURE 3. 1000-HOUR RUPTURE STRENGTHS OF SELECTED COBALT-BASE ALLOYS

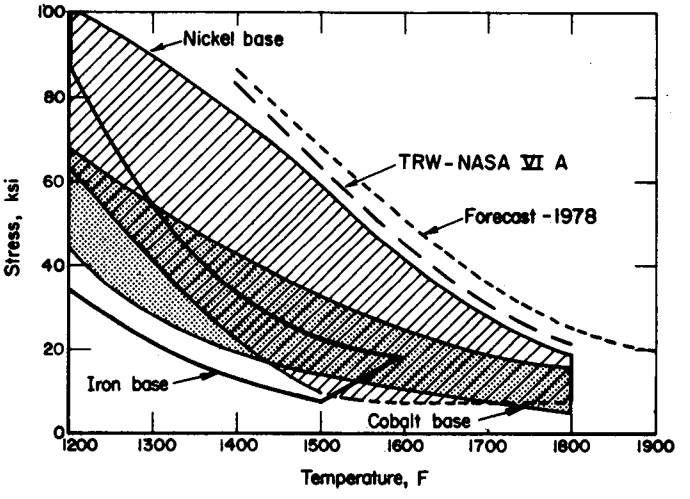

FIGURE 4. 1000-HOUR RUPTURE STRENGTHS

COMPILATION OF CHEMICAL COMPOSITIONS AND RUPTURE STRENGTHS OF SUPERALLOYS

ISSUED UNDER THE AUSPICES OF SUBCOMMITTEE XII ON SPECIFICATIONS FOR HIGH-TEMPERATURE, SUPER-STRENGTH ALLOYS OF ASTM COMMITTEE A-10 ON IRON-CHROMIUM, IRON-CHROMIUM-NICKEL, AND RELATED ALLOYS AND THE DEFENSE METALS INFORMATION CENTER[1]

This compilation lists the name, nominal chemical composition, and characteristic rupture strengths for rupture in 100 and 1000 hours, and identifies the patentee, assignee, or developer for approximately 235 domestic and 180 foreign alloys. Stress versus temperature curves for rupture in 1000 hours are given for selected alloys. The compilation includes the ferritic (martensitic) "superalloys" and age-hardening stainless steels. It does not include the conventional AISI 300 or 400 series stainless steels.

The current revision of this long-time ASTM publication has been prepared jointly by the Defense Metals Information Center (DMIC) and Subcommittee XII on Specifications for High-Temperature, Super-Strength Alloys, ASTM Committee A-10. In general, the alloys included meet the definition of "super-strength alloy" approved by Subcommittee XII in 1952 as follows:

"The super alloys are heat-resistant materials having superior strengths at high temperature. They generally may be divided into two classes: ferritic (martensitic) and austenitic (used in its broad sense to include such materials as Ni- and Co-base alloys). The distinguishing characteristic of these two classes is marked superiority of these alloys over the AISI 300 series alloys under the service conditions for which these alloys are intended. This superiority is exhibited at or above 800 F for the ferritic (martensitic) class, and at or above 1100 F for the austenitic class. These alloys generally contain Fe, Ni, Co, or Cr, singly or in combination as the basis of their composition, but they invariably contain one or more additions of elements, such as Mo, W, Cb, Ti and Al for the express purpose of effecting strengthening. The strength properties of these alloys are generally dependent on special processing and/or heat treatment."

One of the original purposes of this compilation was to preserve "for the record" a listing of alloys that are no longer in production, and also to include the promising new alloys that have reached the experimental application stage of development. Therefore, this compilation includes, in addition to production superalloys, some non-current and developmental alloys. These alloys are identified whenever possible. However, many of the older alloys listed are undoubtedly non-current, but they have not been so designated because the positive knowledge of such designation is not available to the author.

The data tabulated in this compilation have been gathered from all possible sources, but primarily from a direct solicitation of the producers. The chemical compositions given are, for the most part, based on the mid-point of the specification range. However, the compositions should be considered as approximate and are indicated in the table as "nominal chemical composition" Usually, the rupture properties listed are the average values for the normal form (bar, sheet, forging, etc.) and condition of processing and heat treatment. When available, rupture strengths for other than the "normal condition" also have been included in this revision.

Because creep and rupture strengths of superalloys are as dependent upon processing and heat treatment as they are upon chemical composition, it is recommended that data in this compilation not be used for design purposes. The data are intended to give only a rough idea of the relative strengths of the various alloys. The alloy producers will be glad to supply the latest processing and heat-treatment information as well as physical properties and other technical data for their alloys.

Most of the alloys listed are proprietary, and many are manufactured by several alloy producers, under license agreements. The producers of these alloys are not listed in the present document, but they may be found in ASTM Data Series Publication DS-45, "Compilation of Trade Names, Specifications, and Producers of Stainless Alloys and Superalloys", November, 1969.

The age-hardenable stainless steels have been listed under a subheading in Group 1. This was done primarily because their rupture strengths fall within the same temperature range as those for the Group 1 alloys. Another reason for placing the age-hardenable stainless steels in Group 1 is that they are ferritic (martensitic) in the aged condition, although they may be martensitic or austenitic as annealed.

The 1000-hour rupture strengths for selected iron-, nickel-, and cobalt-base superalloys are given in Figures 1, 2, and 3 to display the range of strengths that can be expected from these alloys. Some data from non-current alloys have been included in these figures. For instance, in Figure 1, the strongest alloy (Unitemp 212 to 1400 F and CRM 6D from 1400 to 1600 F) demonstrate the strengths that are possible in iron-base alloys, even though these particular alloys are not being produced. Another non-current iron-base alloy, AF -71, is of interest because it does not contain nickel. Figure 4 shows a comparison of the 1000-hour rupture strength ranges for the iron-, nickel-, and cobalt-base superalloys and includes data for the nickel-base developmental alloy TRW-VI A and a forecast of the 1000-hour rupture strength to be expected by about 1978.

The pertinent ASTM and AMS specifications are given in the first table, which also lists the AISI numbers that have been assigned. Also, a listing of trade names and proprietors has been included.

[1] Prepared by Ward F. Simmons, Associate Director, DMIC, Battelle Memorial Institute, Columbus, Ohio

This compilation is based upon the best information available to the author. Corrections and additional information for future revisions are solicited and should be sent to Ward F. Simmons, Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio 43201.

TRADE NAMES

AiResist	AiResearchManufacturing Co, The Garrett Corp.
Almar	Allegheny Ludlum Industries, Inc.
Croloy	The Babcock & Wilcox Co.
Custom	Carpenter Technology Corp.
Elgiloy	Elgiloy Co.
Hastelloy	Stellite Div., Cabot Corp.
Haynes Alloy	Stellite Div., Cabot Corp.
Haynes Stellite Alloy	Stellite Div., Cabot Corp.
Havar	Hamilton Precision Metals
Illium	Stainless Foundary & Engineering, Inc.
Incoloy	Huntington Alloy Products Div., INCO
Inconel	Huntington Alloy Products Div., INCO
Kromarc	Westinghouse Electric Corp.
Lapelloy	General Electric Co.
MAR-M	Martin Metals Div., Martin Marietta Corp.
"MO-RE"	Blaw-Knox Co.
Nivco	Westinghouse Electric Corp.
Pyromet	Carpenter Technology Corp.
Refractaloy	Westinghouse Electric Corp.
René	General Electric Co.
Thermalloy	Abex Corp.
Turbaloy	General Electric Co.
Udimet	Special Metals Corp.
Unimar	Universal-Cyclops Specialty Steel Div.
Unitemp	Universal-Cyclops Specialty Steel Div.
USAmet	Elgiloy Co.

TRADEMARKED PRODUCTS

AM-350	Allegheny Ludlum Industries, Inc.
AM-355	Allegheny Ludlum Industries, Inc.
Astroloy	General Electric Co.
Chromoloy	General Electric Co.
Discaloy	Westinghouse Electric Corp.
D6ac	Ladish Co.
Multimet	Stellite Div., Cabot Corp.
Nicrotung	Westinghouse Electric Corp.
PH 13-8Mo	Armco Steel Corp.
PH 14-8Mo	Armco Steel Corp.
PH 15-7Mo	Armco Steel Corp.
René 41	Teledyne Allvac
SEL	Teledyne Allvac
Stainless W	U. S. Steel Corp.
Tenelon	U. S. Steel Corp.
Thetaloy	Pratt & Whitney Aircraft
Waspaloy	Pratt & Whitney Aircraft
15-5 PH	Armco Steel Corp.
17-4 PH	Armco Steel Corp.
17-7 PH	Armco Steel Corp.
17-14 CuMo	Armco Steel Corp.
"17-22A"	Timken Roller Bearing Co.
"17-22A"S	Timken Roller Bearing Co.
"17-22A"V	Timken Roller Bearing Co.
21-6-9	Armco Steel Corp.
22-4-9	Armco Steel Corp.

ASTM AND AMS SPECIFICATIONS

Group I

Ref. No.	Alloy Designation	AISI No.	ASTM Specifications	AMS Specifications
1	Chromoloy	604	–	–
2	D6ac	–	–	6431, 6432, 6438
3	Greek Ascoloy	615	–	5354, 5470, 5508, 5616, 5817
4	H-11	610		6437, 6485, 6487, 6488
7	Lapelloy	619	A-565	–
11	"17-22A"	601	–	6304
12	"17-22A"S	602	–	6302, 6385, 6458
13	"17-22A"V	603	–	6303, 6436
18	AFC-77	–	–	5748
19	Almar 362	–	–	5739, 5740
20	AM-350	633	–	5546, 5548, 5554, 5745, 5774, 5775
21	AM-355	634	A-461-A-564	5359, 5368, 5547, 5549, 5594, 5743, 5744, 5780, 5781
26	PH 13-8Mo	–	–	5629, 5840
27	PH 14-8Mo	–	–	5601, 5603
28	PH 15-7Mo	632	A-461, A-564	5520, 5657, 5812, 5813
30	Stainless W	635	–	–
34	15-5 PH	–	–	5658, 5659
35	17-4 PH	630	A-461, A-564	5344, 5355, 5398, 5604, 5622, 5643, 5825, 5827
36	17-7 PH	631	A-461, A-564	5528, 5529, 5568, 5644, 5673

Group II

Ref. No.	Alloy Designation	AISI No.	ASTM Specifications	AMS Specifications
1	A-286	660	A-453, A-461	5525, 5731, 5732, 5734, 5735, 5736, 5737, 5804, 5805, 7235, 7478, 7479, 7481
3	CG-27	–	–	5633, 5634
12	Discaloy	662	A-453, A-461	5733
13	D-979	664	–	5509, 5746
18	HK-40	–	A-297, A-351, A-567	5365
19	HN	–	A-297	–
21	Incoloy alloy 800	–	B-163, B-407, B-408, B-409	–
22	Incoloy alloy 801	–	–	5552, 5742
25	Incoloy alloy 825	–	B-423, B-424, B-425	–
26	Incoloy alloy 901	–	–	5660, 5661
38	V-57	663	–	–
39	W-545	665	A-453	5543, 5741
40	16-25-6	650	A-457, A-458, A-477	5725, 5727, 5728
41	17-14 CuMo	653	–	–
42	19-9 DL	651	A-453, A-457, A-458, A-477	5369, 5526, 5527, 5579 5720, 5721, 5722
43	19-9 DX	652	A-457, A-458, A-477	5538, 5539, 5723, 5724, 5729
44	19-9WMo	–	–	5782, 5783
45	19-9WX	–	–	5782, 5783
57	21-6-9	–	A-276, A-580	5595, 5656

Group III

Ref. No.	Alloy Designation	AISI No.	ASTM Specifications	AMS Specifications
7	N-155, Multimet	661	A-461	5376, 5531, 5532, 5585, 5768, 5769, 5794, 5795
9	Refractaloy 26	690	–	–
13	S-590	–	–	5533, 5770

Group IV

Ref. No.	Alloy Designation	AISI No.	ASTM Specifications	AMS Specifications
1	Alloy 713C	–	–	5391
11	GMR 235	686	–	–
15	Hastelloy B	–	A-494, B-295, B-304, B-333, B-335	5396
17	Hastelloy C	–	A-194, A-567 B-295, B-304 B-334, B-336	5388, 5389, 5530, 5750
20	Hastelloy N	–	B-334	–
22	Hastelloy W	–	–	5755, 5786, 5787
23	Hastelloy X	680	B-435	5390, 5536, 5587, 5588, 5754, 5798, 5799, 7237
27	Inconel alloy 600	–	B-163, B-166, B-167, B-168	5540, 5580, 5665, 5683, 5687, 7232
29	Inconel alloy 625		B-443, B-444, B-446	5599, 5666
31	Inconel alloy 702	–	–	5550
33	Inconel alloy 718	–	–	5383, 5589, 5590, 5596, 5597, 5662, 5663, 5664, 5832
35	Inconel alloy 722	–	–	5541
36	Inconel alloy X-750	688	A-461	5542, 5582, 5598, 5667, 5668, 5669, 5670, 5671, 5698, 5699, 5779
38	IN-100	–	–	5397
39	IN-102	–	B-445	5550
50	M-252, J-1500	689	A-461	5551, 5756, 5757
54	RA-333	–	–	5593, 5717
55	René 41	683	–	5399, 5545, 5712, 5713, 5800, 7469
72	Udimet 500	684	–	5384, 5751, 5753
75	Udimet 700	687	–	–
79, 80	Waspaloy	685	A-461	5544, 5586, 5704, 5706, 5707, 5708, 5709, 5828, 7471

Group V

Ref. No.	Alloy Designation	AISI No.	ASTM Specifications	AMS Specifications
12	Haynes Stellite No. 21	–	–	5385
13	Haynes Stellite No. 23	–	–	5375
14	Haynes Stellite No. 27	–	–	5378
15	Haynes Stellite No. 30	–	–	5380
33	S-816	671	A-461	5534, 5765
37	WF-11, L605, HS-25	670	–	5537, 5759, 5796, 5797, 7236
40	X-40, HS-31	–	–	5382

GROUP I–FERRITIC (MARTENSITIC) STEELS

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent													
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
1	Chromoloy	0.20	–	–	1.0	–	–	1.00	–	–	–	–	–	–	Bal.	0.10V
2	D6ac	0.46	0.75	0.22	1.0	0.55	–	1.00	–	–	–	–	–	–	Bal.	0.08V
3	Greek Ascoloy	0.12	0.40	0.30	13.0	2.00	–	–	3.00	–	–	–	–	–	Bal.	–
4	H-11 (Mod.)	0.40	0.30	0.90	5.0	–	–	1.30	–	–	–	–	–	–	Bal.	0.50V
5	H-12	0.40	–	–	5.0	–	–	1.50	1.50	–	–	–	–	–	Bal.	0.50V
6	H-13	0.40	–	–	5.0	–	–	1.50	–	–	–	–	–	–	Bal.	1.00V
7	Lapelloy	0.30	1.00	0.25	12.0	0.30	–	2.75	–	–	–	–	–	–	Bal.	0.25V
8	Lapelloy C	0.22	0.80	0.25	11.5	0.30	–	2.75	–	–	–	–	–	–	Bal.	2.0Cu, 0.08N
9	Moly Ascoloy	0.08	–	–	13.0	–	–	2.00	–	–	–	–	–	–	Bal.	–
10	Pyromet X-12	0.12	0.90	0.25	10.5	–	6.00	4.75	–	–	–	–	–	–	Bal.	1.25Cu, 0.08N
11	"17-22A"	0.45	0.55	0.65	1.25	–	–	0.50	–	–	–	–	–	–	Bal.	0.25 V
12	"17-22A"S	0.30	0.55	0.65	1.25	–	–	0.50	–	–	–	–	–	–	Bal.	0.25V
13	"17-22A"V	0.28	0.75	0.65	1.25	–	–	0.50	–	–	–	–	–	–	Bal.	0.85V
14	418	0.20	1.00	0.50	12.5	–	–	–	3.00	–	–	–	–	–	Bal.	–
15	419	0.25	1.00	0.30	11.5	0.50	–	0.50	2.50	–	–	–	–	–	Bal.	0.40V
16	422	0.22	0.65	0.36	12.0	0.70	–	1.00	1.00	–	–	–	–	–	Bal.	0.25V
17	422M	0.28	0.84	0.25	12.0	0.20	–	2.25	1.70	–	–	–	–	–	Bal.	0.50V
						Age-Hardening Stainless Steels										
18	AFC-77	0.15	–	–	14.5	–	13.00	5.00	–	–	–	–	–	–	Bal.	0.40V
19	Almar 362	0.03	0.30	0.20	14.5	6.50	–	–	–	–	0.80	–	–	–	Bal.	–
20	AM-350	0.08	1.00	0.40	16.5	4.25	–	2.75	–	–	–	–	–	–	Bal.	0.10N
20	AM-350															
21	AM-355	0.13	1.00	0.40	15.5	4.25	–	2.75	–	–	–	–	–	–	Bal.	0.10N
21	AM-355															
22	Custom 450	0.05[c]	0.50	0.50	15.0	6.50	–	0.80	–	0.50	–	–	–	–	Bal.	1.5Cu
23	Custom 455	0.03[c]	0.50	0.50	11.5	8.50	–	–	–	0.25	1.2	–	–	–	Bal.	2.2Cu
24	Illium P	0.20	0.75	0.75	28.0	8.00	–	2.25	–	–	–	–	–	–	56.8	3.25Cu
25	Illium PD	0.07	0.75	0.75	26.0	5.00	6.50	–	–	–	–	–	–	–	58.	–
26	PH 13-8Mo	0.04	0.05	0.05	12.75	8.10	–	2.20	–	–	–	1.10	–	–	Bal.	–
27	PH 14-8Mo	0.04	0.30	0.40	14.35	8.15	–	2.20	–	–	–	1.10	–	–	Bal.	–
28	PH 15-7Mo	0.07	0.50	0.30	15.1	7.10	–	2.20	–	–	–	1.10	–	–	Bal.	–
29	Pyromet X-15	0.03[c]	0.10[c]	0.10[c]	15.0	0.20[c]	20.00	2.90	–	–	–	–	–	–	Bal.	–
30	Stainless W	0.12	–	–	17.0	7.00	–	–	–	–	1.00[c]	1.00[c]	–	–	Bal.	0.2N
31	Unimar CR-1	0.01	0.06	0.03	11.5	10.25	–	–	–	–	0.30	1.15	–	–	Bal.	–
32	Unimar CR-2	0.01	0.06	0.03	11.5	10.25	–	–	–	–	0.30	0.70	–	–	Bal.	–
33	USAmet	0.10	2.00[c]	1.40[c]	17.2	7.20	–	–	–	–	–	–	–	–	Bal.	–
34	15-5 PH	0.04	0.30	0.40	15.0	4.60	–	–	–	0.25	–	–	–	–	Bal.	3.30Cu
35	17-4 PH	0.04	0.30	0.60	16.0	4.25	–	–	–	0.25	–	–	–	–	Bal.	3.30 Cu
36	17-7 PH	0.07	0.50	0.30	17.0	7.10	–	–	–	–	–	1.10	–	–	Bal.	–
36	17-7 PH															

a For rupture in 100 and 1000 hr. Not for design purposes.
c Maximum.

Condition	Characteristic Rupture Strengths[a], 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
	800F		900F		1000F		1100F		1200F				
	100	1000	100	1000	100	1000	100	1000	100	1000			
–	115	110	105	85	75	–	40	20	–	–	General Electric	Chromoloy	1
–	–	–	144	97	–	–	–	–	–	–	Ladish	D6ac	2
1800/½hr,AC,1260F/1½hr	–	–	55	48	42	36	31	25	20	11	–	Greek Ascoloy	3
–	205	190	175	135	100	50	–	–	–	–	–	H-11 (Mod.)	4
–	–	–	–	–	–	–	–	–	–	–	–	H-12	5
–	–	–	–	–	–	–	–	–	–	–	–	H-13	6
–	110	105	102	95	80	65	50	34	28	16	General Electric	Lapelloy	7
–	–	–	–	–	70	55	45	35	24	13	Carpenter	Lapelloy C	8
–	–	–	–	–	–	–	–	–	–	–	–	Moly Ascoloy	9
–	–	–	–	–	95	75	50	39	24	17	Carpenter	Pyromet X-12	10
–	–	–	–	–	70	56	38.5	21	–	–	Timken	"17-22A"	11
1725AC,1200F/6hr,AC	–	–	105	–	75	56	40	19	14	6.5	Timken	"17-22A"S	12
–	–	–	–	–	–	–	55	35	25.5	14	Timken	"17-22A"V	13
–	–	–	–	–	–	–	39	33	25	20	Allegheny Ludlum	418	14
–	–	–	–	–	–	–	60	47	32	19	Allegheny Ludlum	419	15
1900F OQ,1200F/2hr,AC	–	–	–	–	63	57	46	37	25	17	Crucible	422	16
–	–	–	–	–	86	72	61	39	26	16	Crucible	422M	17
Age-Hardening Stainless Steels													
–	–	–	200	–	160	125	90	–	33	–	Crucible	AFC-77	18
–	–	–	–	–	–	–	–	–	–	–	Allegheny Ludlum	Almar 362	19
(SCT + 850F)	184	182	121	95	–	–	–	–	–	–	Allegheny Ludlum	AM-350	20
(SCT + 1000F)	131	128	103	91	–	–	–	–	–	–	Allegheny Ludlum	AM-350	20
(SCT + 850F)	186	180	121	98	70	58	–	–	–	–	Allegheny Ludlum	AM-355	21
(SCT + 1000F)	134	132	105	98	73	61	–	–	–	–	Allegheny Ludlum	AM-355	21
–	–	–	–	–	–	–	–	–	–	–	Carpenter	Custom 450	22
–	117	91	82	54	–	–	–	–	–	–	Carpenter	Custom 455	23
–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry, & Eng.	Illium P	24
–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry. & Eng.	Illium PD	25
–	–	–	–	–	–	–	–	–	–	–	Armco Steel	PH 13-8Mo	26
–	–	–	–	–	–	–	–	–	–	–	Armco Steel	PH 14-8Mo	27
(RH 950)	174	171	125	108	–	–	–	–	–	–	Armco Steel	PH 15-7Mo	28
–	–	–	180	160	140	96	–	–	–	–	Carpenter	Pyromet X-15	29
–	–	–	–	–	–	–	–	–	–	–	U. S. Steel	Stainless W	30
–	–	–	–	–	–	–	–	–	–	–	Universal-Cyclops	Unimar CR-1	31
–	–	–	–	–	–	–	–	–	–	–	Universal-Cyclops	Unimar CR-2	32
–	–	–	–	–	–	–	–	–	–	–	Elgiloy	USAmet	33
–	–	–	–	–	–	–	–	–	–	–	Armco Steel	15-5 PH	34
(H 900)	140	128	95	60	–	–	–	–	–	–	Armco Steel	17-4 PH	35
(RH 950)	113	92	61	44	–	–	–	–	–	–	Armco Steel	17-7 PH	36
(TH 1050)	110	90	78	52	–	–	–	–	–	–	Armco Steel	17-7 PH	36

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
1	A-286	0.05	1.40	0.40	15.0	26.0	–	1.25	–	–	2.15	0.2	0.003	–	Bal.	0.3V
2	ATV-3	0.35	1.36	1.17	14.9	27.4	–	–	4.0	–	–	–	–	–	Bal.	–
3	CG-27	0.05	0.1	0.1	13.0	38.0	–	5.5	–	0.6	2.5	1.5	0.01	–	Bal.	–
4	Cinidur	0.25	–	–	19.0	24.0	–	2.0	1.0	–	2.25	1.0	–	–	Bal.	–
5	CRM-4[b]	0.02[c]	0.40[c]	0.10[c]	0.50[c]	0.20[c]	–	–	–	–	Nil	6.0	–	–	Bal.	
6	CRM-6D[b]	1.05	5.00	0.50	22.0	5.0	–	1.0	1.0	1.0	–	–	0.003	–	Bal.	–
7	CRM-15D[b]	1.00	5.00	0.50	20.0	5.0	–	2.0	2.0	2.0	–	–	0.003	–	Bal.	0.20N
8	CRM-17D[b]	0.70	5.00	0.50	20.0	5.0	–	1.0	1.0	2.0	–	–	0.003	–	Bal.	0.20N
9	CRM-18D[b]	0.75	5.00	0.50	23.0	5.0	5.00	1.0	1.0	2.0	–	–	0.003	–	Bal.	0.25N
10	Croloy 15-15N	0.15[c]	2.00[c]	0.75[c]	16.0	15.0	–	1.55	1.40	1.05	–	–	–	–	Bal.	0.15N
11	CSA	0.25	4.00	0.40	18.0	5.0	–	1.3	1.3	1.0	–	–	–	–	Bal.	–
12	Discaloy	0.04[c]	0.5	0.4	13.5	25.0	–	3.00	–	–	1.75	–	–	–	Bal.	–
13	D-979	0.05	0.75[c]	0.75[c]	15.0	45.0	–	4.0	4.0	–	3.0	1.0	0.01	–	27	–
14	EME	0.10	0.50	0.70	19.0	12.0	–	–	3.2	1.2	–	–	–	–	Bal.	0.15N
15	Gannaloy	0.03	1.40	0.40	5.5	24.5	–	–	–	–	2.25	0.65	0.003	–	Bal.	–
16	Gamma Cb[e]	0.40	0.54	0.62	15.2	24.6	–	4.1	–	2.2	–	–	–	–	Bal.	–
17	Hastelloy F	0.05[c]	1.50	1.00[c]	22.0	45.5	2.5[c]	6.5	1.0[c]	2.0	–	–	–	–	Bal.	–
18	HK-40[b]	0.44	0.60	1.35	25.1	21.2	–	0.30[f]	–	–	–	–	–	–	Bal.	0.45N
19	HN[b]	0.35	2.00[c]	2.00[c]	21.0	25.0	–	0.05[cf]	–	–	–	–	–	–	Bal.	–
20	HNM	0.30	3.50	0.50	18.5	9.5	–	–	–	–	–	–	–	–	Bal.	0.23P
21	Incoloy alloy 800	0.05	0.75	0.50	21.0	32.5	–	–	–	–	0.38	0.38	–	–	46	–
21	Incoloy alloy 800															
22	Incoloy alloy 801	0.05	0.75	0.50	20.5	32.0	–	–	–	–	1.13	–	–	–	44.5	–
23	Incoloy alloy 802	0.35	0.75	0.38	21.0	32.5	–	–	–	–	0.75	0.58	–	–	46	–
24	Incoloy alloy 804	0.05	0.75	0.38	29.5	41.0	–	–	–	–	0.60	0.30	–	–	25.4	–
24	Incoloy alloy 804															
25	Incoloy alloy 825	0.03	1.00[c]	0.50[c]	21.5	41.8	–	3.0	–	–	0.9	0.15	–	–	30	18.Cu
26	Incoloy alloy 901	0.05	0.45	0.40	13.5	42.7	–	6.2	–	–	2.50	0.25	–	–	34	–
27	J-1300, M-308[e]	0.08	–	–	14.0	33.0	–	4.0	6.5	–	2.0	0.25	0.005	0.10	Bal.	–
28	M-813	0.08	–	–	18.0	35.0	–	4.0	–	–	2.25	1.40	–	–	Bal.	–
29	"MO-RE" 2[b]	0.40[c]	–	–	33.0	50.0	–	–	17.0	–	–	–	–	–	Bal.	–
30	NA-22H[b]	0.50	1.3	1.0	27.0	48.0	–	–	6.0	–	–	–	–	–	Bal.	–
31	Pyromet 860	0.05	0.25	0.10	13.0	44.0	4.0	6.0	–	–	3.0	1.00	0.01	–	Bal.	–
32	S-495[e]	0.45	0.55	0.60	14.0	20.0	–	4.0	4.0	4.0	–	–	–	–	Bal.	–
33	S-588[e]	0.46	1.20	0.80	18.5	20.0	–	4.0	4.0	4.0	–	–	–	–	Bal.	–
34	Thermalloy 40A2[b]	0.50	1.00	1.00	26.0	15.0	–	–	–	1.0	–	–	–	–	Bal.	0.13N
35	Thermalloy 50CQ[b]	0.50	1.00	1.70	15.0	35.0	–	–	–	1.0	–	–	–	–	Bal.	–
36	Turbaloy 13	0.13	1.70	0.75	17.8	23.6	–	2.5	1.0	–	1.4	1.4	–	–	Bal.	–
37	Unitemp 212[e]	0.08	0.05	0.15	16.0	25.0	–	–	–	0.50	4.0	0.15	0.06	0.05	Bal.	–
38	V-57	0.08[c]	0.35[c]	0.75[c]	14.8	27.0	–	1.25	–	–	3.0	0.25	0.01	–	Bal.	0.5V[c]
39	W-545	0.08[c]	1.75	0.50	13.5	25.0	–	1.80	–	–	2.85	–	0.06	–	Bal.	–
40	16-25-6	0.08[c]	1.35	0.70	16.0	25.0	–	6.0	–	–	–	–	–	–	Bal.	0.15N
41	17-14 CuMo	0.12	0.75	0.50	15.9	14.1	–	2.5	–	0.45	0.25	–	–	–	Bal.	3.0Cu
42	19-9DL	0.30	1.10	0.60	19.0	9.0	–	1.25	1.20	0.40	0.30	–	–	–	Bal.	–
43	19-9DX	0.30	1.00	0.55	19.2	9.0	–	1.50	1.20	–	0.55	–	–	–	Bal.	–
44	19-9WMo	0.10	0.50	0.60	19.0	9.0	–	0.40	1.30	0.44	0.40	–	–	–	Bal.	–
45	19-9WX	0.11	–	–	20.5	8.5	–	0.50	1.55	1.30	0.20	–	–	–	Bal.	–

Condition	Characteristic Rupture Strengths[a], 1000 psi										Identification:	Alloy	Ref.
	1200F		1350F		1500F		1600F		1800F		Patentee, Assignee,	Designation	No.
	100	1000	100	1000	100	1000	100	1000	100	1000	Developer, Etc.		
Solution treated, aged	61	46	35	21	13	8.0	–	–	–	–	Allegheny Ludlum	A-286	1
–	–	–	–	–	10.5	–	–	–	–	–	–	ATV-3	2
Solution treated, aged	98	77	63	44	35	22	–	–	–	–	Crucible, General Electric	CG-27	3
–	–	–	–	–	–	–	–	–	–	–	–	Cinidur	4
–	–	–	–	–	–	–	–	–	–	–	Chrysler	CRM-4[b]	5
–	61	49	41.5	34	30	23.5	23.5	18.5	10	–	Chrysler	CRM-6D[b]	6
–	68	54	43	33	27	20.5	19.5	15	9.5	–	Chrysler	CRM-15D[b]	7
–	62	49.5	39	30	24	18.5	–	–	–	–	Chrysler	CRM-17D[b]	8
–	63	54	42	34	25.5	19	18.5	14	9	–	Chrysler	CRM-18D[b]	9
–	40	33	21	18	13	9.0	–	–	–	–	Babcock & Wilcox	Croloy 15-15N	10
–	50	39	22.5	12.5	–	–	–	–	–	–	Crucible	CSA	11
Solution treated, aged	52	41	30	20	15	–	–	–	–	–	Westinghouse	Discaloy	12
Solution treated, aged	94	76	60	44	33	22	19	–	–	–	Allegheny Ludlum	D-979	13
–	44	35	20	13	–	–	–	–	–	–	Midvale Heppenstall	EME	14
–	–	–	–	–	–	–	–	–	–	–	–	Gannaloy	15
–	44	36	–	–	16.7	11.0	10.8	8.0	–	–	–	Gamma Cb[e]	16
–	42	36	26	17	14	9	9	7.4	–	–	Stellite/Cabot	Hastelloy F	17
–	–	–	–	–	14	9.5	10	6.7	5.5	3.2	Alloy Casting Inst.	HK-40[b]	18
–	–	–	–	–	–	–	9.5	6.5	4.9	3.3	Alloy Casting Inst.	HN[b]	19
–	49	35	26	15.5	11	–	–	–	–	–	Crucible	HNM	20
Solution treated	32	23	–	–	9.2	6.0	6.0	3.6	2.6	1.6	INCO*	Incoloy alloy 800	21
Annealed	31	22	–	–	8.1	4.4	4.8	2.8	2.4	1.4	INCO*	Incoloy alloy 800	21
Annealed	50	–	30	–	10	–	–	–	3.0	–	INCO*	Incoloy alloy 801	22
Annealed	38	27	–	–	–	–	15	10	7.0	3.5	INCO*	Incoloy alloy 802	23
Solution treated	–	–	–	–	–	–	5.8	4.0	2.9	1.9	INCO*	Incoloy alloy 804	24
Annealed	–	–	–	–	–	–	2.4	1.3	2.0	1.3	INCO*	Incoloy alloy 804	24
Annealed	–	–	–	–	–	–	–	–	–	–	INCO*	Incoloy alloy 825	25
Age hardened	80	64	49	31	19	11	–	–	–	–	INCO*	Incoloy alloy 901	26
–	80	63	46	37	17	–	–	–	–	–	Teledyne Allvac	J-1300, M-308[e]	27
–	–	52	41	30	22	13	–	–	–	–	General Electric	M-813	28
–	–	–	–	–	–	–	–	–	–	–	Blaw-Knox	"MO-RE" 2[b]	29
–	–	–	–	–	–	–	–	–	5.0	3.5	Blaw-Knox	NA-22H[b]	30
Solution treated, aged	95	81	60	45	33	17	–	–	–	–	Carpenter	Pyromet 860	31
Solution treated, aged	43	35	26	21	19	14.5	13.3	9.2	–	–	Allegheny Ludlum	S-495[e]	32
Solution treated, aged	45	35	28	20	16.5	11	–	–	–	–	Allegheny Ludlum	S-588[e]	33
–	–	–	–	–	–	–	12.2	8.6	6.5	4.8	Abex	Thermalloy 40A2[b]	34
–	–	–	–	–	–	–	10.0	7.1	5.8	3.8	Abex	Thermalloy 50CQ[b]	35
–	65	54	–	–	–	–	–	–	–	–	General Electric	Turbaloy 13	36
Solution treated, aged	100	88	63	42.5	–	–	–	–	–	–	Universal-Cyclops	Unitemp 212[e]	37
Solution treated, aged	85	70	50	29	–	–	–	–	–	–	Allegheny Ludlum	V-57	38
Solution treated, aged	80	65	49	37	–	–	–	–	–	–	Westinghouse	W-545	39
–	45	34	25	17	13.5	9	–	–	–	–	Timken	16-25-6	40
–	43	37	26	20.5	16.5	12	–	–	–	–	Armco Steel	17-14 CuMo	41
–	44	37	22.5	17	13	8.6	–	–	–	–	Universal-Cyclops	19-9DL	42
–	52.2	42	–	–	–	–	–	–	–	–	Universal-Cyclops	19-9DX	43
–	41	34	28.5	–	11	–	–	–	–	–	Universal-Cyclops	19-9WMo	44
–	–	–	–	–	–	–	–	–	–	–	Universal-Cyclops	19-9WX	45

GROUP II–(Continued)

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
							High-Manganese Modifications									
46	AF-71[e]	0.30	18.0	0.30	12.5	–	–	3.0	–	–	–	–	0.20	–	Bal.	0.2N, 0.9V
47	AF-183[e]	0.30	18.0	0.30	12.5	–	–	3.0	–	–	–	–	–	–	Bal.	0.2N, 0.8V
48	CMN	0.65	12.0	–	25.0	15.0	–	–	–	–	–	–	–	–	Bal.	0.45N
49	Croloy 299	0.18	14.7	1.00[c]	17.2	1.45	–	–	–	–	–	–	–	–	Bal.	0.36N
50	Gaman H	0.53	11.5	2.6	21.0	–	–	–	–	–	–	–	–	–	Bal.	0.40N
51	G-192[e]	0.60	8.5	0.55	22.0	–	–	–	–	–	–	–	–	–	Bal.	0.35N
52	HTX	0.45	8.5	0.45	21.0	8.0	–	1.5	–	–	–	–	–	–	Bal.	0.2N, 0.23P
53	Kromarc 55	0.04	9.5	0.30	16.0	20.0	–	2.25	–	–	–	–	–	–	Bal.	–
54	Kromarc 58	0.02	10.0	0.20	15.0	22.0	–	2.25	–	–	–	–	0.008	0.01	Bal.	0.23N, 0.25V
55	Tenelon	0.10	15.0	0.60	18.0	0.3	–	–	–	–	–	–	–	–	Bal.	0.45N
56	16-15-6	0.07[c]	7.5	0.50	16.0	15.0	–	6.0	–	–	–	–	–	–	Bal.	0.35N
57	21-6-9	0.04	9.0	0.15	20.5	6.5	–	–	–	–	–	–	–	–	Bal.	0.30N
58	22-4-9	0.55	8.5	0.15	20.5	3.5	–	–	–	–	–	–	–	–	Bal.	0.40N
59	205	0.08[c]	8.25	0.50[c]	19.75	6.0	–	2.50	–	–	–	–	–	–	Bal.	0.37N
60	216	0.18	15.0	0.40	17.0	1.25	–	–	–	–	–	–	–	–	Bal.	0.35N

a For rupture in 100 and 1000 hr. Not for design purposes.
b Cast alloy
c Maximum
e Non-current alloy–listed to provide a more complete reference.
f Mo not intentionally added.
*Huntington Alloy Products Div.

GROUP III–CHROMIUM, NICKEL, COBALT, IRON ALLOYS

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
1	Haynes Alloy No. 56[e]	0.27	1.5	1.0[c]	21.0	13.0	11.5	4.5	1.5	0.75	–	–	–	–	Bal.	0.10N
2	Haynes Alloy No. 96[e]	0.05	1.5	0.5	21.0	20.0	20.0	3.0	2.5	–	–	–	–	–	Bal.	–
3	Haynes Alloy No. 99[e]	0.10	1.5	0.7	21.0	18.0	12.0	4.0	2.5	–	–	–	0.05	–	Bal.	–
4	K-42B	0.03	0.7	0.7	18.0	42.0	22.0	–	–	–	2.1	0.2	–	–	Bal.	–
5	N-153[e]	0.32	1.5	0.5	17.0	15.0	12.0	3.0	2.0	1.0	–	–	–	–	Bal.	–
6	N-154[e]	0.32	1.5	0.5	17.0	24.0	21.0	3.0	2.0	1.0	–	–	–	–	Bal.	–
7	N-155, Multimet	0.15	1.5	0.5	21.0	20.0	20.0	3.0	2.5	1.0	–	–	–	–	Bal.	0.15N
7	N-155, Multimet															
7	N-155, Multimet															
7	N-155, Multimet[b]															
8	N-156[e]	0.33	1.5	0.5	17.0	33.0	24.0	3.0	2.0	1.0	–	–	–	–	Bal.	–
9	Refractaloy 26	0.03	0.8	0.4	18.0	36.0	19.0	3.0	–	–	2.6	–	–	–	Bal.	–
10	Refractaloy 70	0.04	2.0	0.3	20.0	21.0	30.0	8.0	4.2	–	–	–	–	–	Bal.	–
11	Refractaloy 80[e]	0.10	0.6	0.7	20.0	20.0	30.0	10.0	5.0	–	–	–	–	–	Bal.	–
12	S-497[e]	0.45	0.47	0.61	14.0	20.0	20.0	4.0	4.0	4.0	–	–	–	–	Bal.	–
13	S-590	0.43	1.25	0.40	20.5	20.0	20.0	4.0	4.0	4.0	–	–	–	–	Bal.	–
14	Ticonium	0.01	0.8	0.3	23.0	35.0	31.0	6.0	–	–	–	–	–	–	Bal.	–
15	W-912	0.35	–	–	20.0	25.0	30.0	4.0	8.0	–	–	–	–	–	Bal.	–

a For rupture in 100 and 1000 hr. Not for design purposes.
b Cast alloy
c Maximum
e Non-current alloy–listed to provide a more complete reference.

Condition	Characteristic Rupture Strengths,[a] 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
	1200F		1350F		1500F		1600F		1800F				
	100	1000	100	1000	100	1000	100	1000	100	1000			
High-Manganese Modifications													
Solution treated, aged	69	54	40	26	22	12	–	–	–	–	Allegheny Ludlum	AF-71[e]	46
Solution treated, aged	53	38.5	26.5	–	10.5	–	–	–	–	–	Allegheny Ludlum	AF-183[e]	47
–	65	55	25	18	13	10	–	–	–	–	Crucible	CMN	48
–	–	–	–	–	–	–	–	–	–	–	Babcock & Wilcox	Croloy 299	49
–	41	34.5	26	14.5	12.5	5.9	–	–	–	–	–	Gaman H	50
–	42	–	27	17	15	8.5	9.5	5.2	–	–	Allegheny Ludlum	G-192[e]	51
–	68	53	36	28	19	–	–	–	–	–	Crucible	HTX	52
–	–	–	–	–	–	–	–	–	–	–	Westinghouse	Kromarc 55	53
–	–	–	–	–	–	–	–	–	–	–	Westinghouse	Kromarc 58	54
–	–	24.9	–	11.5	–	5.6	–	–	–	–	U. S. Steel	Tenelon	55
–	60	40	30	20	–	–	–	–	–	–	Timken	16-15-6	56
Annealed (bar)	33.5	27.5	21.0	13.5	10.2	6.1	–	–	–	–	Armco Steel	21-6-9	57
–	45	36	28	18	14	8	–	–	–	–	Armco Steel	22-4-9	58
–	35	29	22	17	15	5	–	–	–	–	Allegheny Ludlum	205	59
–	–	–	–	–	–	–	–	–	–	–	Allegheny Ludlum	216	60

Condition	Characteristic Rupture Strengths,[a] 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
	1200F		1350F		1500F		1600F		1800F				
	100	1000	100	1000	100	1000	100	1000	100	1000			
–	48	38	29	22	16	12	11	7.8	5.0	–	Stellite/Cabot	Haynes Alloy No. 56[e]	1
–	–	–	–	–	–	–	–	–	–	–	Stellite/Cabot	Haynes Alloy No. 96[e]	2
–	50	–	–	–	15	–	–	–	–	–	Stellite/Cabot	Haynes Alloy No. 99[e]	3
–	66	40	37	27	17.5	11.0	–	–	–	–	Westinghouse	K-42B	4
–	–	38	–	23	19.5	12	–	–	–	–	Stellite/Cabot	N-153[e]	5
–	–	–	–	–	20	15	–	–	–	–	Stellite/Cabot	N-154[e]	6
Solution treated, aged, bar	52	43	28	22	20	16	14	9.5	–	–	Stellite/Cabot	N-155 Multimet	7
Stress-relieved forging	55	42	–	–	–	–	–	–	–	–	Stellite/Cabot	N-155, Multimet	7
Solution treated, aged, sheet	–	–	–	–	–	–	–	–	5.6	2.9	Stellite/Cabot	N-155, Multimet	7
Investment cast, aged	49	47	29	24	–	–	–	–	–	–	Stellite/Cabot	N-155, Multimet[b]	7
–	–	–	–	–	–	–	–	–	–	–	Stellite/Cabot	N-156[e]	8
–	80	63	51	38	27	18	–	–	–	–	Westinghouse	Refractaloy 26	9
–	56	42	33	24	19	15	12	10	–	–	Westinghouse	Refractaloy 70	10
–	–	–	–	–	–	–	–	–	–	–	Westinghouse	Refractaloy 80[e]	11
–	40	32	28.5	23	14.5	10	8	–	–	–	Allegheny Ludlum	S-497[e]	12
–	50	38	32	25	22	16	12.5	9	–	–	Allegheny Ludlum	S-590	13
–	52.5	33	22	16	–	–	–	–	–	–	–	Ticonium	14
–	–	–	–	–	–	–	–	–	–	–	–	W-912	15

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
1	Alloy 713C[b]	0.12	0.25[c]	0.50[c]	12.5	Bal.	–	4.2	–	2.0	0.80	6.1	0.012	0.10	2.5[c]	–
2	Alloy 713LC[b]	0.05	0.25[c]	0.50[c]	12.0	Bal.	–	4.5	–	2.0	0.60	5.9	0.01	0.10	0.5[c]	–
3	Astroloy	0.06	–	–	15.0	Bal.	17.0	5.25	–	–	3.5	4.0	0.03	–	–	–
4	B & B	0.08	–	–	15.0	45	30.0	5.0	–	–	2.5	3.0	0.5	–	–	–
5	B-1900[b]	0.10	0.2[c]	0.25[c]	8.0	Bal.	10.0	6.0	0.1[c]	0.1[c]	1.0	6.0	0.015	0.08	0.35[c]	4.3Ta
6	B-1910[bd]	0.10	–	–	10.0	Bal.	10.0	3.0	–	–	1.0	6.0	0.015	0.10	–	7.0Ta
7	DCM[e]	0.08[c]	0.10[c]	0.15	15.0	Bal.	–	5.25	–	–	3.5	4.6	0.08	–	5.0	0.10 Cu[c]
8	F-342[bd]	0.15	0.40	0.40	15.0	Bal.	–	5.0	–	–	–	5.0	0.3	–	5.0	–
9	Ford 406	–	–	–	6.0	Bal.	10.0	1.0	8.5	2.0	2.0	4.5	–	–	–	6.0Ta
10	GE-B-129	0.06	0.40	0.40	5.0	Bal.	–	15.0	–	2.0	–	6.0	0.5	–	4.0	–
11	GMR 235[b]	0.15	0.25[c]	0.60[c]	15.5	Bal.	–	5.25	–	–	2.0	3.0	0.06	–	10.0	–
12	GMR 235D[b]	0.15	0.10[c]	0.30[c]	15.5	Bal.	–	5.0	–	–	2.5	3.5	0.05	–	4.5	–
13	G-157[e]	0.06	1.25	0.40	27.0	Bal.	–	1.5	1.5	–	2.0	0.75	–	–	6.0[c]	–
14	Hastelloy A[e]	0.10	2.00	0.70	–	59	2.5[c]	20.0	–	–	–	–	–	–	20.0	–
15	Hastelloy B	0.10	0.80	0.70	0.6	Bal.	2.5[c]	28.0	–	–	–	–	–	–	5.0	0.30V
16	Hastelloy B-282	0.02	0.60	0.35	0.6	Bal.	–	28.0	–	–	–	–	–	–	5.0	2.0V
17	Hastelloy C	0.07	0.80	0.70	16.0	Bal.	2.5[c]	17.0	4.0	–	–	–	–	–	5.0	–
18	Hastelloy C-276	lap	1.0[c]	lap	15.5	Bal.	2.5[c]	16.0	3.75	–	–	–	–	–	5.5	0.35V
19	Hastelloy D[b]	0.12	1.0	9.0	–	Bal.	2.5[c]	–	–	–	–	–	–	–	1.0	3.0Cu
20	Hastelloy N	0.06	0.8[c]	0.5[c]	7.0	Bal.	0.5[c]	16.5	–	–	–	–	0.01	–	5.0[c]	–
21	Hastelloy R-235	0.15	–	–	15.5	Bal.	2.5[c]	5.5	–	–	2.5	2.0	–	–	10.0	–
22	Hastelloy W	0.12[c]	1.0[c]	1.0[c]	5.0	Bal.	2.5[c]	24.5	–	–	–	–	–	–	5.5	0.6V
23	Hastelloy X	0.10	0.5	0.5	22.0	Bal.	1.5	9.0	0.6	–	–	–	–	–	18.5	–
24	Illium B	0.05	1.25	3.5	28.0	52	–	8.5	–	–	–	–	–	–	1.15	5.5Cu
25	Illium G	0.20	1.25	0.65	22.5	56	–	6.4	–	–	–	–	–	–	6.5	6.5Cu
26	Illium 98	0.05	1.25	0.70	28.0	55	–	8.5	–	–	–	–	–	–	1.0	5.5Cu
27	Inconel alloy 600	0.08	0.5	0.25	15.5	76.0	–	–	–	–	–	–	–	–	8.0	–
27	Inconel alloy 600															
27	Inconel alloy 600															
28	Inconel alloy 601	0.05	0.5	0.25	23.0	60.5	–	–	–	–	–	1.35	–	–	14.1	–
29	Inconel alloy 625	0.05	0.25	0.25	21.5	61.0	–	9.0	–	–	0.2	0.2	–	–	2.5	–
30	Inconel alloy 700	0.12	0.10	0.30	15.0	46.0	28.5	3.75	–	–	2.2	3.0	–	–	0.7	–
31	Inconel alloy 702	0.05	0.50	0.35	15.5	79.5	–	–	–	–	0.63	3.25	–	–	1.0	–
32	Inconel alloy 706[d]	0.03	0.18	0.18	16.0	41.5	0.5	0.5	–	2.9[g]	1.75	0.20	–	–	40.0	–
33	Inconel alloy 718	0.04	0.18	0.18	19.0	52.5	–	3.05	–	5.13[g]	0.90	0.50	–	–	18.5	–
34	Inconel alloy 721	0.04	2.25	0.08	16.0	71.0	–	–	–	–	3.05	–	–	–	6.5	–
35	Inconel alloy 722	0.04	0.50	0.35	15.5	75.0	–	–	–	–	2.38	0.70	–	–	7.0	–
36	Inconel alloy X-750	0.04	0.50	0.25	15.5	73.0	–	–	–	0.95[g]	2.50	0.70	–	–	7.0	–
37	Inconel alloy 751	0.05	0.50	0.25	15.5	72.5	–	–	–	0.95[g]	2.30	1.20	–	–	7.0	–
38	IN-100[b]	0.15	–	–	10.0	Bal.	15.0	3.0	–	–	4.7	5.5	0.015	0.06	–	1.0V
39	IN-102	0.06	0.75[c]	0.40[c]	15.0	Bal.	–	2.9	3.0	2.9	0.5	0.5	0.005	0.03	7.0	0.02 Mg
40	IN-162[b]	0.12	0.20[c]	0.30[c]	10.0	Bal.	–	4.0	2.0	1.0	0.9	6.4	0.02	0.10	0.05[c]	2.0Ta
41	IN-731[bd]	0.18	0.20[c]	0.20[c]	9.5	Bal.	10.0	2.5	–	–	4.65	5.5	0.015	0.06	0.50[c]	0.95V
42	IN-738[bd]	0.17	0.20[c]	0.30[c]	16.0	Bal.	8.5	1.75	2.6	0.9	3.4	3.4	0.01	0.10	0.50[c]	1.75Ta
43	IN-792[bd]	0.21	–	–	12.7	Bal.	9.0	2.0	3.9	–	4.2	3.2	0.02	0.10	–	3.9Ta
44	I-1360[b]	0.10	–	–	10.0	70.5	–	5.0	–	2.0	–	6.0	–	0.3	4.5	–
45	MAR-M 200[b]	0.15	–	–	9.0	Bal.	10.0	–	12.5	1.0	2.0	5.0	0.015	0.05	–	–
46	MAR-M 211[b]	0.15	–	–	9.0	Bal.	10.0	2.5	5.5	2.7	2.0	5.0	0.015	0.05	–	–
47	MAR-M 246[b]	0.15	–	–	9.0	Bal.	10.0	2.5	10.0	–	1.5	5.5	0.015	0.05	–	1.5Ta
48	MAR-M 421[b]	0.15	–	–	15.8	Bal.	9.5	2.0	3.8	2.0	1.75	4.25	0.015	0.05	–	–
49	MAR-M 432[bd]	0.15	0.10[c]	0.10[c]	15.5	Bal.	20.0	–	3.0	2.0	4.3	2.8	0.015	0.05	0.50[c]	2.0Ta
50	M-252, J-1500	0.15	0.50[c]	0.50[c]	19.0	Bal.	10.0	10.0	–	–	2.6	1.0	0.005	–	–	–
51	M-600	0.08	–	–	19.0	Bal.	–	7.0	–	–	2.3	1.1	–	–	13.0	–
52	Nicrotung[b]	0.10	–	–	12.0	Bal.	10.0	–	8.0	–	4.0	4.0	0.05	0.05	–	–
53	NX-188[bd]	0.04	–	–	–	Bal.	–	18.0	–	–	–	8.0	–	–	–	–

Condition	Characteristic Rupture Strengths,[a] 1000 psi												Identification: Patentee, Assignee Developer, Etc.	Alloy Designation	Ref. No.
	1200F		1350F		1500F		1600F		1800F		2000F				
	100	1000	100	1000	100	1000	100	1000	100	1000	100	1000			
As cast	–	–	97	76	60	44	42	29	21	13	6.4	–	INCO	Alloy 713C[b]	1
As cast	–	–	–	–	62	47	43	35	20	15	–	–	INCO	Alloy 713LC[b]	2
Heat treated	–	112	93	73	59	42	37	25	15	8	–	–	General Electric	Astroloy	3
–	–	–	–	–	–	–	37	–	–	–	–	–	General Electric	B&B	4
–	–	–	–	–	73	55	56	37	26	15.4	–	–	Pratt & Whitney	B-1900[b]	5
–	–	–	–	–	–	–	–	–	–	–	–	–	Pratt & Whitney	B-1910[b]	6
–	–	–	90	75	58	42	40	27	17	10	–	–	Teledyne Allvac	DCM[e]	7
–	–	–	–	–	45	29	30.5	18.5	–	–	–	–	Allegheny Ludlum	F-342[bd]	8
–	–	–	–	–	86	68	–	–	31	–	–	–	Ford	Ford 406	9
–	–	–	–	–	47	29	–	–	–	–	–	–	Teledyne Allvac	GE-B-129	10
–	–	–	62	47	38	29	26	18	11	–	–	–	General Motors	GMR 235[b]	11
–	110	100	90	74	56	39	37	25	17.5	–	–	–	General Motors	GMR 235D[b]	12
–	–	–	29	–	14.5	–	9	–	–	–	–	–	Allegheny Ludlum	G-157[e]	13
–	–	–	–	–	11.6	8.8	–	–	–	–	–	–	Stellite/Cabot	Hastelloy A[e]	14
–	51	40.5	35	25.5	18.5	12.7	–	–	–	–	–	–	Stellite/Cabot	Hastelloy B	15
2165F, WQ	66	–	40	–	21	–	14	9.5	–	–	–	–	Stellite/Cabot	Hastelloy B-282	16
Heat treated	49.5	42.5	32	25	19	14.5	13.2	9.2	–	–	–	–	Stellite/Cabot	Hastelloy C	17
–	56	41	31	–	16	–	11	7.4	–	–	–	–	Stellite/Cabot	Hastelloy C-276	18
–	–	–	–	–	–	–	–	–	–	–	–	–	Stellite/Cabot	Hastelloy D[b]	19
–	42	29	24	15	13	6.8	8	3.5	–	–	–	–	Stellite/Cabot	Hastelloy N	20
–	85	63	58	45	40	30	21	16.5	7.6	4.6	–	–	Stellite/Cabot	Hastelloy R-235	21
–	–	–	–	–	–	–	–	–	–	–	–	–	Stellite/Cabot	Hastelloy W	22
2150F, RAC	44.5	30.5	26	18.5	15.5	10	10	7	5.2	3.0	–	–	Stellite/Cabot	Hastelloy X	23
–	–	–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry.&Eng.	Illium B	24
–	–	–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry.&Eng.	Illium G	25
–	–	–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry.&Eng.	Illium 98	26
Solution treated	–	–	14.0	9.8	8.0	5.6	5.3	3.5	2.8	1.8	1.4	0.9	INCO*	Inconel alloy 600	27
Hot rolled, Annealed	–	–	13.5	9.2	–	–	5.3	3.5	2.8	1.8	1.4	0.9	INCO*	Inconel alloy 600	27
Cold drawn, Annealed	23	14.5	–	–	–	–	4.8	3.0	2.8	1.8	1.4	0.9	INCO*	Inconel alloy 600	27
Solution treated	37	28.0	–	–	10.0	6.5	7.2	4.5	3.5	2.2	1.7	1.0	INCO*	Inconel alloy 601	28
Solution treated	64	53	36	28	18	13	11	7.8	–	–	–	–	INCO*	Inconel alloy 625	29
Age hardened	100	86	70	59	42	31	27	16	6.0	–	–	–	INCO*	Inconel alloy 700	30
Age hardened	55	41	32	20	14	8.9	8.0	5.2	3.2	2.4	–	–	INCO*	Inconel alloy 702	31
–	–	–	–	–	–	–	–	–	–	–	–	–	INCO*	Inconel alloy 706[d]	32
Age hardened	100	84	60	38	–	–	–	–	–	–	–	–	INCO*	Inconel alloy 718	33
Age hardened	54	35	29	18	16	9.5	–	–	–	–	–	–	INCO*	Inconel alloy 721	34
Age hardened	74	54	45	30	19	11.5	7.5	4.8	3.2	–	–	–	INCO*	Inconel alloy 722	35
Age hardened	80	68	48	38	26	16	12	6.9	3.3	–	–	–	INCO*	Inconel alloy X-750	36
Age hardened	–	68	–	38	–	18.5	–	10	–	–	–	–	INCO*	Inconel alloy 751	37
As cast	–	–	97	83	73	55	55	38	25	15	9	–	INCO	IN-100[b]	38
1800F, AC	67	52	28	19	12	7.4	–	–	–	–	–	–	INCO	IN-102	39
As cast	–	–	–	–	65	50	50	36	25	16.5	–	–	INCO	IN-162[b]	40
As cast	–	–	96	77	61	46	–	–	20	12	–	–	INCO	IN-731[bd]	41
Heat treated	–	–	96	85	76	52	–	–	26	14	–	–	INCO	IN-738[bd]	42
Heat treated	–	–	–	–	73[h]	56[h]	52[h]	35.5[h]	22.1[h]	14.1[h]	–	–	INCO	IN-792[bd]	43
–	–	–	70	52.5	40.5	27.3	26	16.5	9.4	4.8	–	–	Teledyne Allvac	I-1360[b]	44
As cast	–	–	–	–	76	60	58	42	27	19	11	6.5	Martin Metals	MAR-M 200[b]	45
As cast	–	–	–	–	75	55	54	38	24	16	–	–	Martin Metals	MAR-M 211[b]	46
As cast	–	–	–	–	82	65	61	42	27	18	10	6	Martin Metals	MAR-M 246[b]	47
As cast	–	–	–	–	62	46	44	31	18	12	5.3	3.4	Martin Metals	MAR-M 421[b]	48
As cast	–	–	–	–	65	48	48	34	20	14	–	–	Martin Metals	MAR-M 432[bd]	49
–	102	88	70	51	37	23	23	14	–	–	–	–	Teledyne Allvac	M-252, J-1500	50
–	–	–	55	39	28	17	–	–	–	–	–	–	General Electric	M-600	51
–	–	–	–	–	68	45	48	31	22	13	–	–	Westinghouse	Nicrotung[b]	52
Directionally Solidified	–	–	–	–	–	–	–	–	–	–	–	–	Pratt & Whitney	NX-188[bd]	53

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
54	RA-333	0.05	1.5	1.25	25.0	Bal.	3.0	3.0	3.0	–	–	–	–	–	18.0	–
55	René 41	0.09	–	–	19.0	Bal.	11.0	10.0	*–	–	3.1	1.5	0.010[c]	–	–	–
56	René 62[e]	0.05	0.25[c]	0.25[c]	15.0	Bal.	–	9.0	–	2.25	2.5	1.25	0.010[c]	–	22.0	–
57	René 80[d]	0.17	–	–	14.0	Bal.	9.5	4.0	4.0	–	5.0	3.0	0.015	0.03	–	–
58	René 85[d]	0.27	–	–	9.3	Bal.	15.0	3.25	5.35	–	3.3	5.3	0.015	0.03	–	–
59	René 95[d]	0.15	–	–	14.0	Bal.	8.0	3.5	3.5	3.5	2.5	3.5	0.01	0.05	–	–
60	SEL[b]	0.08	0.3	0.5	15.0	Bal.	22.0	4.5	–	–	2.4	4.4	0.015	–	1.0	–
61	SEL-15[b]	0.07	0.3[c]	0.5[c]	11.0	Bal.	14.5	6.5	1.5	0.5	2.5	5.4	0.015	–	0.5[c]	–
62	TAZ-8[bd]	0.125	–	–	6.0	Bal.	–	4.0	4.0	–	–	6.0	–	1.0	–	8.0Ta, 2.5V
63	TAZ-8A[bd]	0.125	–	–	6.0	Bal.	–	4.0	4.0	2.5	–	6.0	0.004	1.0	–	8.0Ta
64	TAZ-8B[bd]	0.125	–	–	6.0	Bal.	5.0	4.0	4.0	1.5	–	6.0	0.004	1.0	–	8.0Ta
65	TDNi	–	–	–	–	Bal.	–	–	–	–	–	–	–	–	–	2.0 ThO_2
65	TDNi															
66	TDNiCr	–	–	–	20.0	Bal.	–	–	–	–	–	–	–	–	–	2.0 ThO_2
66	TDNiCr															
67	Thetaloy[b]	0.38	2.5	1.0[c]	25.0	Bal.	12.5	3.0	7.0	–	–	–	–	–	5.0[c]	–
68	TRW-NASA VI A[bd]	0.13	–	–	6.1	Bal.	7.5	2.0	5.5	0.5	1.0	5.4	0.02	0.13		9.0Ta, 0.3Rh, 0.43Hf
69	TRW 1800[b]	0.09	–	–	13.0	Bal.	–	–	9.0	1.5	0.6	6.0	0.07	0.07	–	–
70	TRW 1900[b]	0.11	–	–	10.3	Bal.	10.0	–	9.0	1.5	1.0	6.3	0.03	0.10	–	–
71	TRW MOD-1900[bd]	0.13	–	–	10.3	Bal.	10.0	–	9.0	1.5	1.0	6.3	0.03	0.13	–	0.5Ta, 0.5Hf 0.5V
72	Udimet 500	0.08	0.75[c]	0.75[c]	19.0	Bal.	18.0	4.0	–	–	2.9	2.9	0.005	–	4.0[c]	–
73	Udimet 520	0.05	–	–	19.0	Bal.	12.0	6.0	1.0	–	3.0	2.0	0.005	–	–	–
74	Udimet 630	0.04[c]	0.2[c]	0.2[c]	17.0	Bal.	1.0[c]	3.1	3.0	6.0	1.1	0.6	0.005	–	17.5	–
75	Udimet 700	0.15[c]	–	–	15.0	Bal.	18.5	5.2	–	–	3.5	4.25	0.05[c]	–	1.0[c]	–
76	Udimet 710[d]	0.07	–	–	18.0	Bal.	15.0	3.0	1.5	–	5.0	2.5	0.20	–	–	–
77	Unitemp 1753[e]	0.24	0.05	0.10	16.2	Bal.	7.2	1.6	8.4	–	3.2	1.9	0.008	0.06	9.5	–
78	Unitemp AF 2-1DA[d]	0.32	–	–	12.0	Bal.	10.0	3.0	6.0	–	3.0	4.6	0.015	0.10	–	1.5Ta
79	Waspaloy A	0.07	0.5[c]	0.5[c]	19.5	Bal.	13.5	4.3	–	–	3.0	1.4	0.006	0.09	2.0[c]	0.03S[c], 0.10Cu[c]
80	Waspaloy B	0.07	0.75[c]	0.75[c]	19.5	Bal.	13.5	4.3	–	–	3.0	1.4	0.006	0.07	2.0[c]	0.02S[c], 0.10Cu[c]
81	WAZ-20[bd]	0.15	–	–	–	Bal.	–	–	18.5	–	–	6.5	–	1.5	–	–

a For rupture in 100 and 1000 hr. Not for design purposes.
b Cast alloy
c Maximum
d Developmental alloy
e Non-current alloy–listed to provide a more complete reference.
g Ta included
h Estimated from limited data by Larson-Miller parameter method.
i Waspaloy A has a higher solution temperature and longer time at stabilization temperature than Waspaloy B.
lap low as possible
*Huntington Alloy Products Div.

Condition	Characteristic Rupture Strengths,[a] 1000 psi												Identification: Patentee, Assignee Developer, Etc.	Alloy Designation	Ref. No.
	1200F		1350F		1500F		1600F		1800F		2000F				
	100	1000	100	1000	100	1000	100	1000	100	1000	100	1000			
Mill annealed, bar	–	–	–	–	–	8.5	8.5	5.2	4.1	2.1	1.6	0.9	Rolled Alloys	RA-333	54
–	110	102	81	65	45	29	28	17	10	–	–	–	Teledyne Allvac	René 41	55
–	100	78	55	40	25	–	–	–	–	–	–	–	General Electric	René 62[e]	56
–	–	–	–	–	–	–	–	–	–	–	–	–	General Electric	René 80[d]	57
–	–	–	91	82	72	57	55	37	20	10	–	–	General Electric	René 85[d]	58
Heat treated, forging	135[h]	120[h]	–	–	–	–	–	–	–	–	–	–	General Electric	René 95[d]	59
1400F/16hr,AC	98	78	75	63	50	39	38	25	13	7	–	–	Teledyne Allvac	SEL[b]	60
1435F/2-4hr, AQ	–	110	95	82	66	43	47	34	19	11	–	–	General Electric	SEL-15[b]	61
–	–	–	–	–	–	–	–	–	–	–	–	–	NASA	TAZ-8[bd]	62
–	–	–	–	–	–	–	–	–	17.7	–	9.6	–	NASA	TAZ-8A[bd]	63
Directionally Solidified	–	–	–	–	–	–	–	–	25	17.5	11.5	–	NASA	TAZ-8B[bd]	64
Sheet	22	21	18.5	16.5	15	14	14	13	12	10	8	6.5	Fansteel	TDNi	65
Bar	–	–	–	–	–	–	–	–	14.5	–	12	–	Fansteel	TDNi	65
Sheet	–	–	–	–	–	–	–	–	8	–	6	–	Fansteel	TDNiCr	66
Bar	–	–	–	–	–	–	–	–	–	–	10	–	Fansteel	TDNiCr	66
–	–	–	–	–	18	13.6	13.2	9.7	7	–	–	–	Pratt & Whitney	Thetaloy[b]	67
As cast	–	–	–	–	81	64	63	47	32	21	13	8	TRW	TRW-NASA VI A[bd]	68
–	–	–	–	–	–	–	46	32	20	11	–	–	TRW	TRW 1800[b]	69
As cast	119	–	99	81	74	58	57	44	25	18	–	–	TRW	TRW 1900[b]	70
As cast	–	–	–	–	–	–	–	–	26	–	–	–	TRW	TRW MOD-1900[bd]	71
–	–	–	73	59	44	32	30.5	20.5	–	–	–	–	Special Metals	Udimet 500	72
–	–	–	73	59	44	32	30.5	–	–	–	–	–	Special Metals	Udimet 520	73
–	–	–	–	–	–	–	–	–	–	–	–	–	Special Metals	Udimet 630	74
–	–	102	88	72	58	43	42	29	16	7.5	–	–	Special Metals	Udimet 700	75
Heat treated	–	–	–	78	68	48	47	32	17.5	–	–	–	Special Metals	Udimet 710[d]	76
–	115	98	76	61	47	34	32	20	10	6.5	–	–	Universal-Cyclops	Unitemp 1753[e]	77
Heat treated	150	125	110	85	70	52	52	35	22	–	–	–	Universal-Cyclops	Unitemp AF 2-1DA[d]	78
Heat treated[i]	108	88	70	53	40	25.5	24	13.8	6.8	–	–	–	Pratt & Whitney	Waspaloy A	79
Heat treated[i]	112	101	76	60	36	–	–	–	–	–	–	–	Pratt & Whitney	Waspaloy B	80
Directionally solidified	–	–	–	–	–	–	–	–	–	15	11.5	–	NASA	WAZ-20[bd]	81

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
1	AF-94[e]	0.12	1.2	–	15.0	10.0	56	5.5	10.0	1.0	–	–	–	–	2.0	–
2	AiResist 13[b]	0.45	0.5[c]	–	21.0	1.0[c]	Bal.	–	11.0	2.0	–	3.5	–	–	2.5[c]	0.1Y
3	AiResist 213	0.18	–	–	19.0	–	Bal.	–	4.7	–	–	3.5	–	0.15	–	0.1Y, 6.5Ta
4	AiResist 215[b]	0.35	–	–	19.0	–	Bal.	–	4.5	–	–	4.3	–	0.13	–	0.17Y, 7.5Ta
5	CF-43[b]	0.50	–	–	25.0	10.0	55	–	7.5	–	–	–	–	–	1.5	–
6	Elgiloy	0.15	2.00	–	20.0	15.0	40.0	7.0	–	–	–	–	–	–	Bal.	0.04Be
7	FSX-414[bj]	0.35	1.0	–	29.5	10.5	Bal.	–	7.0	–	–	–	0.01	–	2.0	–
8	Havar	0.20	1.6	–	20.0	13.0	42.5	2.0	2.8	–	–	–	–	–	Bal.	0.04Be
9	Haynes Alloy No. 150	0.08	0.6	1.0[c]	27.5	3.0[c]	Bal.	1.5	–	–	–	–	–	–	20.	–
10	Haynes Alloy No. 151[b]	0.50	1.0[c]	1.0[c]	20.0	–	Bal.	–	12.7	–	–	–	0.05	–	–	–
11	Haynes Alloy No. 188	0.10	0.75	0.40	22.0	22.0	Bal.	–	14.0	–	–	–	–	–	1.5	0.08La
12	Haynes Stellite Alloy No. 21[b]	0.25	0.60	0.60	27.0	3.0	62	5.0	–	–	–	–	–	–	1.0	–
13	Haynes Stellite Alloy No. 23[be]	0.40	0.30	0.60	24.0	2.0	Bal.	5.0	–	–	–	–	–	–	1.0	–
14	Haynes Stellite Alloy No. 27[be]	0.40	0.30	0.60	25.0	32.0	Bal.	5.5	–	–	–	–	–	–	1.0	–
15	Haynes Stellite Alloy No. 30[b]	0.45	0.60	0.60	26.0	15.0	Bal.	6.0	–	–	–	–	–	–	1.0	–
16	Haynes Stellite Alloy No. 36[b]	0.40	1.2	0.50	19.0	10.0	Bal.	–	15.0	–	–	–	0.03	–	1.0	–
17	HE-1049[b]	0.40	0.8	0.8	26.0	10.0	Bal.	–	15.0	–	–	–	0.40	–	3.0[c]	–
18	Illium D	0.20	0.90	0.40	27.0	–	65	4.5	1.0	–	–	–	–	–	1.0	–
19	Illium X	0.85	0.25	0.40	28.5	1.0	52	–	15.0	–	–	–	–	–	2.0	–
20	I-336	0.19	–	–	19.2	15.5	50	–	12.0	0.9	–	–	–	–	1.3	–
21	J-1570	0.20	–	–	20.0	28.0	38	–	7.0	–	4.0	–	–	–	2.0	–
22	J-1650	0.20	–	–	19.0	27.0	Bal.	–	12.0	–	3.8	–	0.02	–	–	2.0Ta
23	MAR-M 302[b]	0.85	–	–	21.5	–	Bal.	–	10.0	–	–	–	0.005	0.20	–	9.0Ta
24	MAR-M 322[b]	1.00	–	–	21.5	–	Bal.	–	9.0	–	0.75	–	–	2.25	–	4.5Ta
25	MAR-M 509[b]	0.60	–	–	24.0	10.0	Bal.	–	7.0	–	0.20	–	–	0.50	–	3.5Ta
26	MAR-M 918	0.05	–	–	20.0	20.0	Bal.	–	–	–	–	–	–	0.10	–	7.5Ta
27	M-203	0.07	–	–	19.5	24.5	36.5	–	12.0	1.2	2.15	0.75	–	–	1.6	–
28	M-204	0.07	–	–	18.5	24.5	40.5	–	12.0	1.2	–	–	0.22	–	1.6	–
29	M-205	0.07	–	–	18.5	24.5	37.5	–	12.0	1.2	–	2.75	0.22	–	1.6	–
30	ML-1700[b]	0.20	–	–	25.0	–	Bal.	–	15.0	–	–	–	0.4	–	–	–
31	NASA Co-W,Cr, Re[bd]	0.40	–	–	3.0	–	Bal.	–	25.0	–	1.0	–	–	1.0	–	2.0Re
32	Nivco-10	0.05[c]	0.35	0.15	–	22.5	Bal.	–	–	–	1.8	0.22	–	0.20	1.0[c]	–
33	S-816	0.38	1.20	0.40	20.0	20.0	Bal.	4.0	4.0	4.0	–	–	–	–	4.0	–
34	S-816[b]	0.38	1.20	0.40	20.0	20.0	Bal.	4.0	4.0	4.0	–	–	–	–	3.0	–
35	S-816+B[b]	0.40	1.00	0.40	20.0	20.0	Bal.	4.0	4.0	4.0	–	–	1.0	–	3.0	–
36	V-36	0.27	1.00	0.40	25.0	20.0	Bal.	4.0	2.0	2.0	–	–	–	–	3.0	–
37	WF-11, L605, HS-25	0.10	1.50	0.50	20.0	10.0	Bal.	–	15.0	–	–	–	–	–	–	–
38	WF-31	0.15	1.42	0.42	20.0	10.0	Bal.	2.6	10.7	–	1.0	–	–	–	–	–
39	WI-52[b]	0.45	0.50[c]	0.50[c]	21.0	1.0[c]	Bal.	–	11.0	2.0	–	–	–	–	2.0	–
40	X-40, HS-31[b]	0.50	1.0	0.50	25.5	10.5	Bal.	–	7.5	–	–	–	0.01	–	2.0	–
41	X-45[b]	0.25	1.0	–	25.5	10.5	Bal.	–	7.5	–	–	–	0.01	–	2.0	–
42	X-50[b]	0.76	0.60	0.50	22.5	20.0	40	–	12.0	–	–	–	–	–	2.5	–
43	X-63[b]	0.40	–	–	23.0	10.0	58	6.0	–	–	–	–	–	–	1.0	–
44	25 Ni	0.17	–	–	19.0	24.5	42.5	–	10.0	1.5	–	–	–	–	1.0	–

a For rupture in 100 and 1000 hr. Not for design purposes.
b Cast alloy
c Maximum
d Developmental alloy
e Non-current alloy – listed to provide a more complete reference.
h Estimated from limited data by Larson-Miller parameter method.
j FSX-418 has the same composition as FSX-414 but also contains 0.15Y.

Condition	Characteristic Rupture Strengths,[a] 1000 psi												Identification:	Alloy	Ref.
	1200F		1350F		1500F		1600F		1800F		2000F		Patentee, Assignee	Designation	No.
	100	1000	100	1000	100	1000	100	1000	100	1000	100	1000	Developer, Etc.		
–	–	–	–	–	30	22	22	15	10	–	–	–	Allegheny Ludlum	AF-94[e]	1
–	–	–	–	35	25	17	16.8	11.7	8.4	6.2	4.4	–	AiResearch	AiResist 13[b]	2
–	65	–	–	–	20	13	12	9	5.0	3.5	2.8	–	AiResearch	AiResist 213	3
–	–	–	–	–	22	15	14	11	8.0	6.0	4.0	3.4	AiResearch	AiResist 215[b]	4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	CF-43[b]	5
–	–	–	–	–	–	–	–	–	–	–	–	–	Elgiloy	Elgiloy	6
As cast	–	–	33	26	22	17	16	12	8.0	5.0	3.1	–	General Electric	FSX-414[bj]	7
–	–	–	–	–	–	–	–	–	–	–	–	–	Hamilton Precision	Havar	8
–	–	–	–	–	–	–	–	–	–	–	–	–	Stellite/Cabot	Haynes Alloy No. 150	9
–	73	68	55	49	37	33	27	24	14	11.5	–	–	Stellite/Cabot	Haynes Alloy No. 151[b]	10
–	–	–	–	–	22.3	16.0	15.3	10.1	6.0	3.6	2.2	–	Stellite/Cabot	Haynes Alloy No. 188	11
As cast	51	44.2	32	22	22	14.2	16.7	13.2	9.4	7.0	–	–	Stellite/Cabot	Haynes Stellite Alloy No. 21[b]	12
As cast	58	47	36	27	27.2	21.8	16	12	8.6	5.4	–	–	Stellite/Cabot	Haynes Stellite Alloy No. 23[be]	13
As cast	55	46	36.5	30.5	23.4	18.4	16	12	9.3	6.8	–	–	Stellite/Cabot	Haynes Stellite Alloy No. 27[be]	14
As cast	–	–	47	36	28.6	21.7	15.8	14.8	10	7.1	–	–	Stellite/Cabot	Haynes Stellite Alloy No. 30[b]	15
As cast	–	–	48	41.5	29	25.5	23	18.5	10.5	7.2	–	–	Stellite/Cabot	Haynes Stellite Alloy No. 36[b]	16
As cast	–	–	–	–	45	35	31	22	–	–	–	–	Stellite/Cabot	HE-1049[b]	17
–	–	–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry. & Eng.	Illium D	18
–	–	–	–	–	–	–	–	–	–	–	–	–	Stainless Fdry. & Eng.	Illium X	19
–	80	62.5	48	34.6	25.8	17	–	–	–	–	–	–	Teledyne Allvac	I-336	20
–	95	78	66	53	33	24	23	16	–	–	–	–	Teledyne Allvac	J-1570	21
–	–	82	69	57	46	33	32	21	13	–	–	–	Teledyne Allvac	J-1650	22
As cast	–	–	–	–	40	30	30	23	16	11	6.0	4.0	Martin Metals	MAR-M 302[b]	23
As cast	–	–	–	–	40	28	33	23	20	15	10	8.0	Martin Metals	MAR-M 322[b]	24
As cast	–	–	–	–	39	33	29	20	17	13	8	5.5	Martin Metals	MAR-M 509[b]	25
–	67	–	–	–	30	20	16	11	6	3.2	2.5	–	Martin Metals	MAR-M 918	26
–	84	69	54.5	40	29.5	18.8	–	–	–	–	–	–	General Electric	M-203	27
–	83	67.5	53	38.7	28.5	17.5	–	–	–	–	–	–	General Electric	M-204	28
–	79	64	50.5	36.8	27	16.8	–	–	–	–	–	–	General Electric	M-205	29
–	80	–	66	–	42	–	32	–	15	–	–	–	Teledyne Allvac	ML-1700[b]	30
–	–	–	–	–	–	–	–	–	18[h]	13[h]	10	6.3	NASA	NASA Co-W, Cr, Re[bd]	31
–	54	43	–	–	–	–	–	–	–	–	–	–	Westinghouse	Nivco-10	32
Heat treated	60	46	38	29	25	18	15.5	10	–	–	–	–	Allegheny Ludlum	S-816	33
–	56	44	37	29	28	21	18	13	11	6.5	–	–	Allegheny Ludlum	S-816[b]	34
–	86	78	–	–	43.7	32.4	29.9	21	14.5	7.8	–	–	Allegheny Ludlum	S-816+B[b]	35
Heat treated	–	–	35	26.5	23	18	18	8.5	8.5	5	–	–	Allegheny Ludlum	V-36	36
Solution treated	70	54	43	34	24	17	15.5	10.5	7.0	3.8	–	–	Crucible	WF-11, L605, HS-25	37
–	–	–	–	–	25	18	–	–	–	–	–	–	Crucible	WF-31	38
As cast	–	–	–	–	–	–	24	20	11.5	7.8	–	–	Tungsten Institute	WI-52[b]	39
As cast	57	49	41	35	26	20	19.5	15	11	8	–	–	General Electric	X-40, HS-31[b]	40
As cast	–	37	30	27	19	15	14	10	7.0	4.5	–	–	General Electric	X-45[b]	41
As cast	–	–	–	–	29.5	22	–	–	10	7.7	–	–	General Electric	X-50[b]	42
As cast	54	45.5	38	31.1	24.3	17.7	–	–	8	–	–	–	General Electric	X-63[b]	43
–	52	42.5	34.5	26	19	11.2	–	–	–	–	–	–	–	25 Ni	44

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
							Belgium									
1	UMCO 50	0.12[c]	0.6	0.7	28	–	Bal.	–	–	–	–	–	–	–	21	–
2	UMCO 51	0.27	0.6	0.7	28	–	Bal.	–	–	2.1	–	–	–	–	19	–
							France									
1	X20T2	–	–	–	23	12	–	–	4[c]	–	–	–	–	–	Bal.	–
2	NOXIS 4	–	–	–	12	15	10	3	2	–	–	–	–	–	Bal.	–
3	PER 1	–	–	–	20	Bal.	5[c]	–	–	–	0.4	–	–	–	–	–
4	PER 2	–	–	–	22	Bal.	5	–	–	–	4.0	–	–	–	–	–
5	PER 2B	–	–	–	20	Bal.	20	–	–	–	2.0	–	–	–	–	–
6	PER 2Y	–	–	–	19	Bal.	2	–	–	–	2.0	1.5	–	–	–	–
7	PER 2U	–	–	–	20	Bal.	20	–	–	–	2.0	1.0	–	–	5	–
8	PER 13	–	–	–	13	Bal.	–	4	–	+	+	6	–	–	–	+Ta
9	XSH	–	–	–	20	10	Bal.	–	15	–	–	–	–	–	–	–
10	ATG B	0.4	–	–	13	13	10	2.0	2.5	3	–	–	–	–	Bal.	–
11	ATV S7	0.1	1.2[c]	1.0[c]	18.5	30	20	–	–	–	2.1	0.9	–	–	Bal.	–
12	ATG F	–	–	–	15	73	–	–	–	1.0	2.5	0.8	–	–	7	–
13	ATVS	0.15	–	–	11.5	36	–	–	–	–	1.6	1.6	–	–	Bal.	–
14	Z5NCTDV25	0.08[c]	1.5	0.7	15.0	25.5	–	–	1.25	–	2.1	0.35	–	–	53	0.3V
15	Chatillon 3538	0.20	0.80	0.80	17.5	17.5	7.0	3.75	–	–	0.90	–	–	–	Bal.	3.0Cu
16	Sirius 30	0.20	1.5	1.5	19.0	7.0	–	–	4.0	–	–	–	–	–	Bal.	–
17	Sirius HT	0.20	0.5	0.5	?	14.0	10.0	–	2.5	–	2.0	–	–	–	Bal.	–
18	NS 190	0.12[c]	–	–	16.5	13.5	–	–	3	–	0.7	–	–	–	Bal.	–
19	Oneral M-47[b]	0.8	1.0	1.0	27.5	6.5	50	10.5	–	–	0.3	–	–	–	Bal.	–
20	Oneral S-90[b]	0.3	–	–	27.5	17.5	50	5.0	–	–	–	–	–	0.1	Bal.	0.05-0.2 Ti + Zr
							United Kingdom									
1	Mova	0.2	–	–	0.25	0.25	–	0.75	–	–	–	–	–	–	Bal.	0.25V
2	Chromva-W	0.2	–	–	2.75	0.25	–	0.55	0.55	–	–	–	–	–	Bal.	0.80V
3	448	0.12	–	–	10.5	–	–	0.75	–	0.45	–	–	–	–	Bal.	0.15V
4	467	0.20	–	–	14.0	9.5	–	2.0	–	–	0.7	–	–	–	Bal.	2.5Cu
5	F. D. P.	0.1	0.8	0.8	18.0	9.0	–	–	–	–	0.6	–	–	–	Bal.	–
6	F. C. B. (T)	0.12	1.5	0.6	17.5	11.0	–	–	–	1.2	–	–	–	–	Bal.	–
7	F. V. S.	0.42	0.7	1.5	14.0	14.0	–	–	2.6	–	–	–	–	–	Bal.	–
8	326	0.25	3.0	0.8	16.0	18.5	7.0	2.5	–	1.75	–	–	–	–	Bal.	–
9	337	0.20	–	–	17	17	7.0	3.0	–	–	0.8	–	–	–	Bal.	3.0Cu
10	Rex 326D	0.43	0.90	1.25	14.3	14.6	9.5	2.0	2.2	2.8	–	–	–	–	Bal.	–
11	Rex 78	0.01	0.8	0.7	14	18	–	4.0	–	–	0.6	–	–	–	Bal.	4.0Cu
12	Rex 400	0.09	0.12	0.62	19.2	76.0	–	–	–	–	2.1	0.6	–	–	Bal.	–
13	H. R. Crown Max	0.23	0.65	1.16	23.2	12.3	–	–	3.0	–	–	–	–	–	Bal.	–
14	Hecla H. G. T. 3	0.23	0.3	0.43	3.08	0.24	–	0.57	0.52	–	–	–	–	–	Bal.	1.0V
15	Hecla H. G. T. 4	0.17	1.0	0.5	11.5	–	–	0.6	–	0.2	–	–	0.3	–	Bal.	0.2V 0.07N
16	Hecla E. M. 35(C)[b]	0.35	1.5	0.4	17.0	15.0	12.0	2.9	2.5	1.0	–	–	–	–	Bal.	0.09N
17	Hecla M. M. 35 (C)[b]	0.35	1.5	0.5	21.0	20.0	20.0	2.9	2.5	1.0	–	–	–	–	Bal.	0.12N
18	Hecla E. M. 20	0.18	1.5	0.4	17.0	15.0	12.0	2.9	2.5	1.0	–	–	–	–	Bal.	0.09N
19	Hecla M. M. 20	0.18	1.5	0.5	21.0	20.0	20.0	2.9	2.5	1.0	–	–	–	–	Bal.	0.12N
20	Era H. R. 6W (C)[b]	0.2	0.5	1.5	22.0	13.0	–	–	3.0	–	–	–	–	–	Bal.	–
21	H. 19	0.20	0.55	0.75	5.0	–	–	0.55	–	–	–	–	–	–	Bal.	–
22	H. 27	0.40	0.60	0.30	3.0	–	–	1.0	–	–	–	–	–	–	Bal.	0.2V
23	H. 31	0.40	0.40	0.30	1.0	–	–	0.7	–	–	–	–	–	–	Bal.	–
24	H. 35	0.08	3.25	1.5	11.75	4.25	–	–	–	0.6	–	–	–	–	Bal.	–
25	H. 40	0.23	0.30	0.45	2.7	0.3	–	0.5	0.5	–	–	–	–	–	Bal.	0.8V
26	H. 46	0.16	0.60	0.40	11.5	0.6	–	0.65	–	0.25	–	–	–	–	Bal.	0.3V
27	H. 51	0.2	0.50	0.20	0.75	0.3	–	0.5	–	–	–	–	–	–	Bal.	0.25V
28	H. 53	0.08	0.82	0.30	10.5	0.7	6.7	0.8	0.5	0.45	–	–	+	–	Bal.	0.55V
29	H. 57	0.15	0.45	0.30	2.25	–	–	1.0	–	–	–	–	–	–	Bal.	–
30	H. 58	0.12	1.3	0.30	10.5	0.8	7.0	0.4	0.4	1.85	–	–	+	–	Bal.	0.35V

Characteristic Rupture Strengths,[a] 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
1200F		1350F		1500F		1600F		1800F				
100	1000	100	1000	100	1000	100	1000	100	1000			
					Belgium							
–	–	19.2	12.8	8.8	5.8	5.2	3.1	–	–	Union Mjniere	UMCO 50	1
–	–	–	–	15.2	10.9	10.8	8.0	–	4.5	Co Info. Ctr.	UMCO 51	2
					France							
–	17.4	–	7.5	–	3.1	–	–	–	–	Aubert & Duval	X20T2	1
–	35	–	19.5	–	9.1	–	–	–	–	Aubert & Duval	NOXIS 4	2
–	–	–	–	–	–	–	–	–	–	Aubert & Duval	PER 1	3
–	47	–	22	–	6.0	–	–	–	–	Aubert & Duval	PER 2	4
–	66	–	36	–	15	–	–	–	–	Aubert & Duval	PER 2B	5
–	43	–	23.5	–	11	–	–	–	–	Aubert & Duval	PER 2Y	6
–	–	–	43	–	20	–	9	–	–	Aubert & Duval	PER 2U	7
–	–	–	–	–	–	39	28.5	17	9.9	Aubert & Duval	PER 13	8
–	38.5	–	25	–	15.5	–	10.2	–	4.4	Aubert & Duval	XSH	9
–	34	–	19.5	–	10.0	–	6.2	–	–	Imphy	ATG B	10
–	–	–	31	–	–	–	–	–	–	Imphy	ATV S7	11
–	–	–	–	–	–	–	–	–	–	Imphy	ATG F	12
–	–	–	–	–	–	–	–	–	–	Imphy	ATVS	13
63.0	–	35.0	–	12.0	–	–	–	–	–	Imphy	Z5NCTDV25	14
–	–	–	–	–	–	–	–	–	–	Usines Saint-Jacques	Chatillon 3538	15
–	–	–	–	–	–	–	–	–	–	–	Sirius 30	16
–	–	–	–	–	–	–	–	–	–	–	Sirius HT	17
45.5	38.4	31	23	23	15	–	–	–	–	–	NS 190	18
–	–	–	–	–	–	–	–	8.5	–	–	Oneral M-47[b]	19
–	–	–	–	–	–	–	–	7.1	–	–	Oneral S-90[b]	20
					United Kingdom							
–	–	–	–	–	–	–	–	–	–	Brown-Firth	Mova	1
–	–	–	–	–	–	–	–	–	–	Brown-Firth	Chromva-W	2
(Rupture in 1000 hr. at 1100F, 40 000 psi)						–	–	–	–	Firth-Vickers	448	3
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	467	4
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	F. D. P.	5
–	19	–	–	–	–	–	–	–	–	Firth-Vickers	F. C. B. (T)	6
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	F. V. S.	7
–	34.7	–	–	–	–	–	–	–	–	Firth-Vickers	326	8
–	40.3	–	25.1	–	–	–	–	–	–	Firth-Vickers	337	9
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	Rex 326D	10
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	Rex 78	11
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	Rex 400	12
–	–	–	–	–	–	–	–	–	–	Firth-Vickers	H. R. Crown Max	13
30.2	18.4	–	–	–	–	–	–	–	–	Hadfields	Hecla H. G. T. 3	14
37.2	24.4	–	–	–	–	–	–	–	–	Hadfields	Hecla H. G. T. 4	15
(Rupture in 1000 hr. at 1650F, 7200 psi)						–	–	–	–	Hadfields	Hecla E. M. 35(C)[b]	16
(Rupture in 1000 hr. at 1650F, 9000 psi)						–	–	–	–	Hadfields	Hecla M. M. 35(C)[b]	17
(Rupture in 1000 hr. at 1650F, 5600 psi)						–	–	–	–	Hadfields	Hecla E. M. 20	18
–	–	–	–	–	15.9	–	–	–	–	Hadfields	Hecla M. M. 20	19
–	–	–	–	–	–	–	–	–	–	Hadfields	Era H. R. 6W(C)[b]	20
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 19	21
10.1	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 27	22
12.3	8.9	–	–	–	–	–	–	–	–	Jessop-Saville	H. 31	23
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 35	24
28.0	13.4	–	–	–	–	–	–	–	–	Jessop-Saville	H. 40	25
30.5	21.6	–	–	–	–	–	–	–	–	Jessop-Saville	H. 46	26
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 51	27
31.1	24.7	–	–	–	–	–	–	–	–	Jessop-Saville	H. 53	28
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 57	29
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H.58	30

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
							United Kingdom-(Continued)									
31	H. 59	0.10	1.0	0.50	12.0	2.5	–	1.4	–	0.8	–	–	–	–	Bal.	0.25V
32	R. 20	0.12	1.3	0.50	19	12	–	–	–	1.25	–	–	–	–	Bal.	–
33	R. 22[b]	0.20	0.80	1.0	22.5	11.5	–	–	2.7	–	–	–	–	–	Bal.	–
34	R. 45	0.12	0.80	0.50	21.5	17.5	–	–	–	–	0.48	–	–	–	Bal.	–
35	R. 47	0.45	0.90	2.25	19.0	9.5	–	–	1.4	–	–	–	–	–	Bal.	–
36	G. 4	0.12	0.65	0.35	16.0	13.0	–	–	3.0	–	0.50	–	+	–	Bal.	–
37	G. 9	0.12	0.60	0.65	16.5	11.5	–	–	1.0	–	0.40	–	–	–	Bal.	–
38	G. 18B	0.4	0.8	1.0	13	13	10	1.8	2.5	3.0	–	–	–	–	Bal.	–
39	G. 19[b]	0.4	0.8	1.0	19	13	10	1.8	2.5	3.0	–	–	–	–	Bal.	–
40	G. 21	0.4	0.7	1.4	13	13.5	–	–	2.5	1.0	–	–	–	–	Bal.	–
41	G. 39[b]	0.5	0.9	0.9	19.5	Bal.	–	3.1	3.1	1.5	–	–	–	–	8.0[c]	1.5Ta
42	*G. 44[b]*	*0.08*	*0.4*	*0.4*	*20.0*	Bal.	*8.0*	*6.0*	–	–	1.7	*1.0*	–	–	*1.0[c]*	–
43	G. 54[b]	0.52	1.0	1.0	19.5	Bal.	–	3.0	3.0	1.5	–	–	–	–	–	1.5Ta
44	G. 55[b]	0.15	0.2	0.3	15.0	Bal.	–	4.0	2.0	–	2.5	2.5	+	–	1.0[c]	–
45	G. 63	0.10	0.75	0.25	15.5	Bal.	–	–	–	–	–	–	–	–	8.0	–
46	G. 64[b]	0.12	0.4	0.5	11.0	Bal.	–	3.0	3.5	2.0	–	6.0	0.25	–	5.0[c]	–
47	G. 67[b]	0.12	0.5	0.5	15.5	Bal.	–	3.0	4.0	–	1.0	6.0	0.22	+	5.0[c]	–
48	G. 70	0.10	lap	lap	15.0	Bal.	19	6.0	–	–	3.5	4.2	+	+	–	–
49	G. 73[b]	0.08	–	–	15.0	Bal.	26	4.5	–	–	2.5	4.5	+	–	–	–
50	G. 76[b]	0.06	0.4	0.4	21.5	Bal.	–	9.7	–	–	2.5	0.7	–	–	–	–
51	G. 82	0.10	–	–	16.0	Bal.	–	–	–	–	3.0	2.0	–	–	–	–
52	G. 83	0.12[c]	0.5[c]	0.5[c]	10.0	Bal.	10.0	10.0	–	–	3.0	2.0	+	–	–	–
53	G. 85	0.06	–	–	20.0	Bal.	14	4.5	–	–	3.0	1.5	+	+	–	–
54	G. 94[b]	0.08	–	–	9.5	Bal.	10.0	4.0	4.0	4.0	–	6.2	+	+	–	–
55	G. 95	0.15	–	–	15.0	Bal.	–	5.0	–	–	2.25	2.75	–	–	–	–
56	G. 101	0.06	–	–	13.0	42.5	–	5.5	–	–	2.75	0.20	+	–	–	–
57	G. 103	0.10	0.75	0.75	22.0	Bal.	1.5	9.0	0.75	–	–	–	–	–	18.5	–
58	*G. 104[b]*	*0.08*	–	–	*5.0*	*Bal.*	*15*	*3.5*	*8.0*	–	–	*6.0*	*0.1*	*0.05*	–	*8.0Ta*
59	G. 32	0.28	0.75	0.60	19.0	12.5	46	2.0	–	1.4	–	–	–	–	Bal.	2.8V
60	G. 34[b]	0.8	1.0	0.5	19.0	12.5	46	2.0	–	1.3	–	–	–	–	Bal.	2.8V
61	G. 87	0.10	1.5	0.5	20.0	10.0	Bal.	–	15	–	–	–	–	–	–	–
62	M-22[b]	0.13	–	–	5.7	Bal.	–	2.0	11	–	–	6.3	–	0.6	–	3.0Ta
63	Nimonic 75	0.01	1.0[c]	1.0[c]	20	Bal.	–	–	–	–	0.4	–	–	–	5.0[c]	–
64	Nimonic 80	0.1[c]	1.0[c]	1.0[c]	18/21	Bal.	2.0[c]	–	–	–	1.8/2.7	0.5/1.8	–	–	5.0[c]	–
65	Nimonic 80A	0.1[c]	1.0[c]	1.0[c]	18/21	Bal.	2.0[c]	–	–	–	1.8/2.7	0.5/1.8	–	–	5.0[c]	–
66	Nimonic 90	0.13[c]	1.0[c]	1.0[c]	18/21	Bal.	15/21	–	–	–	1.8/3.0	0.8/2.0	–	–	5.0[c]	–
67	Nimonic 95[e]	0.15[c]	1.0[c]	1.5[c]	18/21	Bal.	15/21	–	–	–	2.3/3.5	1.4/2.5	–	–	5.0[c]	–
68	Nimonic 100[e]	0.3[c]	–	0.5[c]	10/12	Bal.	18/22	4.5/5.5	–	–	1.0/2.0	4.0/6.0	–	–	2.0[c]	–
69	Nimonic 105	0.2[c]	1.0[c]	1.0[c]	13.5/16	Bal.	18/22	4.5/5.5	–	–	0.9/1.5	4.2/4.8	–	–	1.0[c]	–
70	Nimonic 115	0.2[c]	–	–	15	Bal	15	3.5	–	–	4	5	–	–	–	–
71	Nimonic 118	0.16	0.50[c]	0.40[c]	15	Bal.	14.9	3.55	–	–	3.85	4.9	0.016	0.045	0.7[c]	–
72	Nimocast 75[b]	0.1	0.4	0.3	20	Bal.	3[c]	–	–	–	0.4	0.2	–	–	5.0[c]	–
73	Nimocast 80[b]	0.05	0.4	0.3	20	Bal.	3[c]	–	–	–	2.4	1.2	–	–	5.0[c]	–
74	Nimocast 90[b]	0.1	0.4	0.3	20	Bal.	16	–	–	–	2.4	1.2	–	–	5.0[c]	–
75	Nimocast 257[b]	0.08	0.4	0.3	20	Bal.	16	–	–	–	1.6	0.9	–	–	5.0[c]	–
76	Nimocast 258[b]	0.22	0.25	0.25	10	Bal.	20	5	–	–	3.7	4.8	–	–	2.0[c]	–
77	Nimocast PE10[b]	0.02	0.25	0.15	20.0	Bal.	1.0	6.0	2.5	6.5	–	–	–	–	0.25	–
78	Nimonic PE11	0.05	0.2[c]	0.5[c]	18.0	39.0	1.0	5.25	–	–	2.35	0.85	0.001[c]	0.005[c]	Bal.	–
79	Nimonic PE13	0.10	1.0[c]	1.0[c]	21.8	Bal.	1.50	9.0	0.60	–	–	–	–	–	18.5	–
80	Nimonic PE16	0.05	0.1	0.15	16.5	43.5	1.0	3.3	–	–	1.2	1.2	0.02	–	Bal.	–

Characteristic Rupture Strengths,[a] 1000 psi										Identification:	Alloy	Ref.
1200F		1350F		1500F		1600F		1800F		Patentee, Assignee,	Designation	No.
100	1000	100	1000	100	1000	100	1000	100	1000	Developer, Etc.		
						United Kingdom-(Continued)						
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	H. 59	31
28.7	19.5	15.5	9.9	7.4	5.0	–	–	–	–	Jessop-Saville	R. 20	32
34.8	30.7	17.5	10.3	10.0	–	7.2	–	–	–	Jessop-Saville	R. 22[b]	33
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	R. 45	34
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	R. 47	35
53	45	–	–	–	–	–	–	–	–	Jessop-Saville	G. 4	36
47	36	–	–	–	–	–	–	–	–	Jessop-Saville	G. 9	37
44.8	34.0	29.8	22.4	15.8	11.7	8.8	6.8	–	–	Jessop-Saville	G. 18B	38
58.3	40.3	28.6	21.3	16.2	10.3	9.9	6.2	–	–	Jessop-Saville	G. 19[b]	39
37	27	19	11.9	10.3	6.3	6.3	3.6	–	–	Jessop-Saville	G. 21	40
38	29.1	24	18.2	15.9	12.2	11.7	8.8	6.6	4.6	Jessop-Saville	G. 39[b]	41
59.5	56.0	47	36	28.2	18	19.3	11.0	5.6	–	Jessop-Saville	G. 44[b]	42
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	G. 54[b]	43
95	–	75	–	48.8	–	31.5	–	7.6	–	Jessop-Saville	G. 55[b]	44
23	14.6	10.7	6.5	5.0	3.4	–	–	–	–	Jessop-Saville	G. 63	45
–	–	–	–	58.6	42.5	42.5	28.7	19.0	13.9	Jessop-Saville	G. 64[b]	46
–	–	–	–	54	46	41.4	30.7	15.5	10.6	Jessop-Saville	G. 67[b]	47
–	–	–	–	58	41	41.5	24.1	14.6	7.4	Jessop-Saville	G. 70	48
99	90	70	60	44	37	29	22	–	–	Jessop-Saville	G. 73[b]	49
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	G. 76[b]	50
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	G. 82	51
–	–	–	–	(41)	–	–	–	–	–	Jessop-Saville	G. 83	52
111	90	72	53	38	27	25	18	–	–	Jessop-Saville	G. 85	53
–	–	94	84	69	58	52	41	23	15	Jessop-Saville	G. 94[b]	54
–	–	–	–	–	–	–	–	–	–	Jessop-Saville	G. 95	55
90	72	52	32	19	–	–	–	–	–	Jessop-Saville	G. 101	56
44	33	26	18	14	9.5	9.0	5.0	4.8	2.8	Jessop-Saville	G. 103	57
–	–	–	–	–	–	56	–	36	–	Jessop-Saville	G. 104[b]	58
–	–	43.0	35.8	28.4	21.0	19.1	12.6	5.8	2.2	Jessop-Saville	G. 32	59
–	–	42.1	33.1	24.8	20.1	17.9	14.1	6.9	4.3	Jessop-Saville	G. 34[b]	60
–	–	–	–	22.5	17.3	16.5	11.8	8.0	5.0	Jessop-Saville	G. 87	61
105	–	102	–	75	56	57	41	29	19	Mond Nickel	M-22[b]	62
–	–	–	–	6.4	3.6	3.6	2.2	1.4	1.1	Henry Wiggin	Nimonic 75	63
66.2	46.1	32.2	21.3	–	–	–	–	–	–	Henry Wiggin	Nimonic 80	64
89.6	71.7	55.6	39.0	28.0	16.8	–	–	–	–	Henry Wiggin	Nimonic 80A	65
–	–	–	47.0	34.7	22.4	20.2	11.2	–	–	Henry Wiggin	Nimonic 90	66
–	–	56.0	39.2	31.4	20.2	21.2	11.2	–	–	Henry Wiggin	Nimonic 95[e]	67
–	–	–	–	39.0	25.8	27.8	18.1	9.4	2.9	Henry Wiggin	Nimonic 100[e]	68
–	–	–	58.2	47.0	32.5	20.2	19.5	9.9	4.7	Henry Wiggin	Nimonic 105	69
–	–	–	–	58.3	44.8	43.7	29.1	17.5	10.1	Henry Wiggin	Nimonic 115	70
–	–	–	–	63.4	47.0	45.3	30.9	18.8	11.4	Henry Wiggin	Nimonic 118	71
–	–	–	–	–	–	–	–	–	–	Henry Wiggin	Nimocast 75[b]	72
39.2	29.1	24.2	17.9	–	–	–	–	–	–	Henry Wiggin	Nimocast 80[b]	73
50.4	44.8	33.6	28.0	22.4	16.8	17.9	12.5	–	–	Henry Wiggin	Nimocast 90[b]	74
–	–	–	–	–	–	–	–	–	–	Henry Wiggin	Nimocast 257[b]	75
–	–	72.8	–	52.6	–	40.3	–	17.9	–	Henry Wiggin	Nimocast 258[b]	76
80.0	69.4	49.2	35.8	28.0	19.0	19.0	12.3	8.9	5.6	Henry Wiggin	Nimocast PE10[b]	77
69.9	54.9	41.7	28.7	–	–	–	–	–	–	Henry Wiggin	Nimonic PE11	78
52.6	37.4	26.9	17.0	12.5	7.2	7.8	4.0	2.9	1.3	Henry Wiggin	Nimonic PE13	79
65.0	52.2	39.9	28.9	20.8	12.3	–	–	–	–	Henry Wiggin	Nimonic PE16	80

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
							United Kingdom-(Continued)									
81	Nimonic PK31	0.05	0.1	0.15	20.0	Bal.	14.0	4.5	–	5.0	2.3	0.5	0.03	–	0.05	–
82	Nimonic PK33	0.05	0.1	0.15	18.5	Bal.	14.0	7.0	–	–	2.0	2.0	0.03	–	0.25	–
83	EPK 36[be]	0.10	–	–	10.0	Bal.	10.0	4.0	–	–	5.0	5.0	0.015	0.12	–	–
84	EPD 16[be]	0.12	–	–	6.0	Bal.	–	2	11.0	1.5	–	6.0	0.02	0.12	–	–
85	Nimonic 263	0.06	0.40	0.25	20.0	Bal.	20.0	5.85	–	–	2.15	0.45	0.001[c]	0.02[c]	0.7[c]	–
86	Nimonic 901	0.04	0.5[c]	0.4[c]	12.5	42.5	1.0[c]	5.75	–	–	2.95	0.23	0.015	–	Bal.	–
87	Nimocast 242[b]	0.3	0.3	0.3	20	Bal.	10	10	–	–	0.3[c]	0.2[c]	–	–	1.0[c]	–
88	Fox 769	–	–	–	3.0	(Cr, Mo, V Steel)			–	–	–	–	–	–	Bal.	–
89	Jethete M. 160	0.15	1.25[c]	0.6[c]	12.0	1.25	–	1.0[c]	–	–	–	–	–	–	Bal.	1.0V
90	Red Fox 33	0.08	0.7	0.8	20	30	–	–	–	–	1.5	–	–	–	Bal.	–
91	Multi-Alloy	0.25	1.6	1.0	20.5	46.5	3.0	2.7	3.5	2.9	1.2	–	–	–	Bal.	–
							USSR*									
1	EI-435	0.12[c]	0.7[c]	0.8[c]	21.0	75	–	–	–	–	0.4[c]	0.2[c]	–	–	Bal.	–
2	EI-437	0.08[c]	0.5[c]	1.0[c]	21.0	Bal.	–	–	–	–	2.5	0.7	–	–	–	–
3	EI-437A	0.06[c]	0.4[c]	0.6[c]	20.5	Bal.	–	–	–	–	2.5	0.75	–	–	1	0.01Ce
4	EI-437V	0.06[c]	0.4[c]	0.6[c]	20.5	Bal.	–	–	–	–	2.5	0.75	0.006	–	1	–
5	EI-437BU	0.07	0.4	0.65	20.5	Bal.	–	–	–	–	2.7	0.8	0.01	–	–	0.01Ce
6	EI-444	–	–	–	20	Bal.	–	4	–	–	2.5	0.7	–	–	–	–
7	EI-445R	0.08[c]	0.5[c]	0.6[c]	18.5	Bal.	–	4.5	4.5	–	2.5	1.2	0.01	–	–	–
8	EI-559, 559A	0.10[c]	0.3[c]	0.8[c]	16.5	57.5	–	–	–	–	–	–	–	–	Bal.	0.03Ce
9	EI-598	0.12[c]	0.5[c]	0.6[c]	17.5	Bal.	–	5	2.75	0.9	1.3	1.3	0.01	–	5	0.02Ce
10	EI-602	0.08[c]	0.4[c]	0.8[c]	20.5	Bal.	–	2	–	1.5	0.55	0.55	–	–	3	–
11	EI-607	0.08[c]	1.0[c]	0.8[c]	16.0	Bal.	–	–	–	1.25	2.0	0.75	–	–	3	–
12	EI-607AL	0.08	1.0	1.0	16.0	Bal.	–	–	–	1.25	1.6	0.75	–	–	3	–
13	EI-607A	0.08[c]	1.0[c]	0.8[c]	16	Bal.	–	–	–	1.25	1.6	0.75	–	–	3	–
14	EI-617	0.08[c]	0.5[c]	0.6[c]	14.5	Bal.	–	3	6.0	–	2.0	2.0	0.008	–	5	0.3V 0.02Ce
15	EI-618, ZhS3	0.13	0.6[c]	0.6[c]	16	Bal.	–	3.75	5.5	–	1.9	1.9	0.02	–	5	0.3V
16	EI-652	0.04	0.24	0.23	27	Bal.	–	–	–	–	–	3.31	–	–	2[c]	0.03Ce 0.08Ba
17	EI-661	0.07	–	–	–	Bal.	9.75	10.5	5.0	–	–	4.35	0.015	–	–	0.01Ce
18	EI-765	0.12	0.5[c]	0.5[c]	14.5	Bal.	–	4	5	–	1.1	2.0	0.01	–	3	–
19	EI-765L	0.12	1.0	0.8	14.5	Bal.	–	19.5	5.0	–	1.15	1.75	–	–	3	–
20	EP-99	–	–	–	22.5	Bal.	7.5	4.25	7.0	–	1.25	3.0	–	–	–	–
21	EP-487	0.08	–	–	18.5	Bal.	–	10.0	4.5	–	2.5	1.25	0.01	–	4	0.01Ce
22	EP-109	–	–	–	10.0	Bal.	12.0	7.0	7.0	–	–	6.0	0.01	–	–	–
23	EP-220	0.06	0.02	0.09	10.0	Bal.	15.0	5.6	5.5	–	2.4	4.2	–	–	–	0.03V
24	EI-766A, EI-827	0.47	0.9[c]	0.4[c]	10	Bal.	–	7.5	4.9	–	–	4.2	–	–	4	–
25	EI-826, EI617AB	0.12[c]	0.5[c]	0.6[c]	14.5	Bal.	–	3.2	6	–	2.0	2.6	0.015	–	5	0.3V 0.02Ce
26	EI-867	0.1[c]	–	–	9.5	Bal.	5	10	5	–	–	–	0.02	–	4[c]	0.02Ce[c]
27	EI-868, VZh98	0.07	0.33	0.28	24.3	Bal.	–	0.8	13.4	–	0.5	0.2	–	–	1.4	–
28	EI-869	0.08[c]	0.8[c]	1.0[c]	15.5	Bal.	–	–	–	1.25	1.7	1.2	0.005	–	3	0.003V
29	EI-873	0.06	0.91	0.32	16.7	Bal.	–	–	–	2.45	1.8	0.9	–	–	–	–
30	EI-893	0.08[c]	–	–	16	Bal.	–	4.25	9	–	1.4	1.4	0.01[c]	–	–	0.025Ce[c]
31	EI-894	0.09	0.75	1.02	22	Bal.	–	–	5.7	–	1.1	3.1	–	–	9.7	–
32	EI-929, VZh36-300	0.12	–	–	10.5	Bal.	14	5.0	5.5	–	1.7	4.0	0.02	–	5	–
33	ANV-300	0.10[c]	–	–	15.5	Bal.	–	–	8.5	–	1.7	5.0	0.10[c]	–	5[c]	–
34	VZhL-1	0.13	–	1.75	16.5	Bal.	–	3.3	2.2	–	1.4	2.75	0.11	–	7	–
35	VZhL-8	0.15	–	–	5.5	Bal.	–	5.25	–	–	2.2	3.0	0.06	–	10	–
36	VZh-17	–	–	–	15.0	Bal.	–	–	10	1	–	3.5	0.008	–	–	1.0V
37	VZh36L	–	–	–	19.0	Bal.	–	–	–	–	2.3	3.5	0.3	–	1.5	0.11Ce
38	VZh36-L1	–	–	–	10.0	Bal.	–	4	8	–	–	5	0.3	–	–	–
39	VZh36-L2	0.06	–	–	20.0	Bal.	–	–	–	–	2.5	3.75	0.03	–	1.5[c]	–
40	VZh-85	0.10	–	–	28.0	Bal.	–	–	8	–	0.5	0.5	–	–	–	–

Characteristic Rupture Strengths,[a] 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
1200F		1350F		1500F		1600F		1800F				
100	1000	100	1000	100	1000	100	1000	100	1000			
United Kingdom-(Continued)												
103	83	–	–	–	–	–	–	–	–	Henry Wiggin	Nimonic PK31	81
103	87.4	69.4	51.5	42.6	26.9	24.6	12.3	–	–	Henry Wiggin	Nimonic PK33	82
–	–	–	–	70.8	55.6	51.5	39.4	24.2	14.8	Henry Wiggin	EPK 36[be]	83
–	–	–	–	73.1	56.5	55.1	37.0	26.2	16.8	Henry Wiggin	EPD 16[be]	84
–	–	79.3	63.6	46.4	31.1	11.7	7.2	–	–	Henry Wiggin	Nimonic 263	85
89.6	69.4	52.0	34.3	22.2	11.4	–	–	–	–	Henry Wiggin	Nimonic 901	86
–	–	25.3	16.4	16.8	10.7	12.8	7.6	6.3	–	Rolls Royce	Nimocast 242[b]	87
–	–	–	–	–	–	–	–	–	–	Samuel Fox	Fox 769	88
31.6	21.7	–	–	–	–	–	–	–	–	Samuel Fox	Jethete M. 160	89
–	–	–	–	–	–	–	–	–	–	Samuel Fox	Red Fox 33	90
–	–	–	–	–	–	–	–	–	–	United Steel	Multi-Alloy	91
USSR*												
–	–	11.8	–	5.4	–	3.0	–	–	–	–	EI-435	1
–	–	–	–	–	–	–	–	–	–	–	EI-437	2
–	–	–	–	–	–	–	–	–	–	–	EI-437A	3
–	74	47.7	44.1	25.5	18.5	15.5	–	–	–	–	EI-437V	4
–	–	–	–	–	–	–	–	–	–	–	EI-437BU	5
–	–	–	–	–	–	–	–	–	–	–	EI-444	6
–	–	–	45.5	–	25.6	–	14.2	–	–	–	EI-445R	7
–	–	–	–	8.8	5.7	5.8	3.6	–	–	–	EI-559, 599A	8
–	–	57.8	–	31.0	–	–	–	–	–	–	EI-598	9
–	–	19.3	–	10.5	–	6.3	–	–	–	–	EI-602	10
–	57	42.3	28.5	–	–	–	–	–	–	–	EI-607	11
–	–	–	–	–	–	–	–	–	–	–	EI-607AL	12
–	51.1	42.3	32.8	–	–	–	–	–	–	–	EI-607A	13
–	–	–	45.5	36.7	25.6	25.0	14.2	–	–	–	EI-617	14
–	–	–	–	34.8	–	18.4	–	–	–	–	EI-618, ZhS3	15
–	–	–	–	11.6	–	7.0	–	–	–	–	EI-652	16
–	–	–	–	–	–	–	–	–	–	–	EI-661	17
82	68	61	37	28.4	17.1	–	–	–	–	–	EI-765	18
–	–	–	–	–	–	–	–	–	–	–	EI-765L	19
–	–	–	–	–	–	–	–	–	–	–	EP-99	20
–	–	–	–	–	–	–	–	–	–	–	EP-487	21
–	–	–	–	–	–	–	–	–	–	–	EP-109	22
–	–	–	–	–	–	–	–	–	–	–	EP-220	23
–	–	–	–	–	–	–	–	–	–	–	EI-766A, EI-827	24
–	–	78.4	–	46.0	–	30.0	–	–	–	–	EI-826, EI617AB	25
–	–	83	67	49	36	32	–	–	–	–	EI-867	26
–	–	–	–	14.3	9.7	9.7	5.7	–	–	–	EI-868, VZh98	27
–	–	–	–	–	–	–	–	–	–	–	EI-869	28
–	–	–	–	–	–	–	–	–	–	–	EI-873	29
–	–	–	41	–	–	–	–	–	–	–	EI-893	30
–	–	–	–	–	–	–	–	–	–	–	EI-894	31
–	–	87	70	57	40	28	–	–	–	–	EI-929, VZh36-300	32
–	–	–	–	41	–	31	–	–	–	–	ANV-300	33
–	–	–	–	–	–	–	–	–	–	–	VZhL-1	34
–	–	–	–	–	–	–	–	–	–	–	VZhL-8	35
–	–	–	–	–	–	–	–	–	–	–	VZh-17	36
–	–	–	–	–	–	–	–	–	–	–	VZh36L	37
–	–	–	–	–	–	–	–	–	–	–	VZh36-L1	38
–	–	–	–	36	–	23	–	–	–	–	VZh36-L2	39
–	–	–	–	–	–	–	–	–	–	–	VZh-85	40

Ref. No.	Alloy Designation	Nominal Chemical Composition, Percent														
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ti	Al	B	Zr	Fe	Other
							USSR*-(Continued)									
41	VL7-45U	0.16	0.7[c]	0.55[c]	20.0	46	–	–	8	–	–	–	0.06	–	Bal.	–
42	ZhS	–	–	–	19.0	Bal.	4.8	2.5	3.5	–	2.9	2.3	–	–	–	–
43	ZhS6	0.14	–	–	12.5	Bal.	–	4.8	7	–	2.5	5.0	0.02	–	–	–
44	ZhS6-K	0.16	–	–	11.5	Bal.	4.5	4	5	–	2.8	5.5	0.02	–	–	–
45	ZhS6-KP	0.13	–	–	10.5	Bal.	6.5	5.5	4	–	3.0	4.6	0.03	–	2.0	0.015Ce
46	LK4	0.20	–	–	26.5	3.3	Bal.	5	–	–	–	–	–	–	–	–
47	LK4Ya	0.26	–	–	26.5	3[c]	Bal.	5.5	–	–	–	–	0.02	–	–	–
48	4K66Ya	0.30	–	–	22.5	2[c]	Bal.	–	9.5	1.75	–	–	0.02	–	–	–
49	V3K	1.00	-	2.0	28.0	2.0	Bal.	–	4.0	–	–	–	–	–	2.0	–
50	40KNKhMV	0.10	2.0	0.5	19.0	15	40	3.5	4.0	–	–	–	–	–	Bal.	–
51	40KNKhMVTYu	0.05	–	0.5	12.2	19	40	3.5	6.5	–	1.75	0.35	–	–	Bal.	–

*From Slavic Library, Battelle Memorial Institute, and DMIC Report No. 235, "A Primer on Soviet Superalloys."

							West Germany									
1	ATS	0.10[c]	1.0/ 1.5	0.3/ 0.6	15/17	12/14	–	–	–	1.2	–	–	–	–	Bal.	–
2	ATS-15	0.10[c]	1.0/ 1.5	0.3/ 0.6	15.5/ 17.5	15.5/ 17.5	–	1.6/ 2.0	–	1.2	–			–	Bal.	–
3	ATS-6	0.10[c]	1.0/ 1.5	0.3/ 0.6	15.5/ 17.5	12.5/ 14.5	–	1.1/ 1.5	–	–	–	–	–	–	Bal.	0.6-0.8V 0.10N
4	ATS-26	0.10[c]	1.0/ 1.5	0.3/ 0.6	15.5/ 17.5	15.5/ 17.5	–	–	3.0	>10X C%	–	–	–	–	Bal.	0.10N
5	ATS-2	0.10[c]	1.5	1.0	15.5/ 17.5	15.5/ 17.5	–	1.6/ 1.8	2.0	>10X C%	–	–	0.07	–	Bal.	–
6	ATS-101	0.4	0.8	1.0	15.5/ 17.5	12.0/ 14.0	8.5/ 11.5	2.0	2.5	3.0	–	–	–	–	Bal.	–
7	ATS-105	0.10[c]	1.5	1.0	15.5/ 17.5	19.0/ 21.0	12.5/ 22.0	2.6/ 3.0	2.0	>10X C%	–	–	–	–	Bal.	0.8-1.2V 0.12N
8	ATS-113	0.4	0.8	0.5	18.5/ 22.0	18.5/ 22.0	Bal.	4.0	4.0	4.0	–	–	–	–	5[c]	–
9	MTS-1	0.22	0.6	0.3	12.5	0.4	–	1.2	–	–	–	–	–	–	Bal.	–
10	MTS-5	0.18	0.5	0.3	12.0	0.6	–	1.0	–	–	–	–	–	–	Bal.	0.25V
11	MTS-4	0.18	0.5	0.3	12.0	0.6	–	1.0	0.5	–	–	–	–	–	Bal.	0.25V
12	MTS-2	0.22	0.6	0.3	12.5	0.4	1.8	2.0	–	–	–	–	–	–	Bal.	–
13	Marwedur F 11	0.16/ 0.23	0.40/ 0.70	0.15/ 0.40	11.5/ 12.5	0.30/ 0.60	–	0.90/ 1.1	0.40/ 0.60	–	–	–	–	–	Bal.	0.25-0.35V
14	WF 100D	0.38	0.52	1.84	14.8	12.9	–	0.23	2.5	–	–	–	–	–	Bal.	–
15	Tinidur	0.04	1.0	0.73	14.7	26.1	–	–	–	–	2.26	0.15	–		Bal.	–
16	Cromadur	0.15[c]	18	–	12.5	0.2	–	–	–	–	–	–	–	–	Bal.	1.0V

a For rupture in 100 and 1000 hr. Not for design purposes.
b Cast alloy
c Maximum
e Non-current alloy–listed to provide a more complete reference.
( ) Approximate value.
lap low as possible
+ Small addition, amount unknown

Characteristic Rupture Strengths,[a] 1000 psi										Identification: Patentee, Assignee, Developer, Etc.	Alloy Designation	Ref. No.
1200F		1350F		1500F		1600F		1800F				
100	1000	100	1000	100	1000	100	1000	100	1000			
						USSR*-(Continued)						
–	–	29	–	17.8	–	10.9	–	–	–	–	VL7-45U	41
–	–	–	–	–	–	–	–	–	–	–	ZhS	42
–	–	–	–	65	–	47	–	21	–	–	ZhS6	43
–	–	–	–	68	–	53	–	23	–	–	ZhS6-K	44
–	–	–	–	–	–	–	–	–	–	–	ZhS6-KP	45
39	–	30	–	19	–	13	–	–	–	–	LK4	46
–	–	36	–	25	–	19	–	–	–	–	LK4Ya	47
–	–	–	–	33	–	25	–	–	–	–	4K66Ya	48
–	–	–	–	–	–	–	–	–	–	–	V3K	49
–	–	–	–	–	–	–	–	–	–	–	40KNKhMV	50
–	–	–	–	–	–	–	–	–	–	–	40KNKhMVTYu	51
						West Germany						
–	23	–	11	–	–	–	–	–	–	–	ATS	1
–	26	–	13	–	–	–	–	–	–	–	ATS-15	2
–	30	–	–	–	–	–	–	–	–	–	ATS-6	3
–	30	–	14	–	–	–	–	–	–	–	ATS-26	4
–	35	–	15	–	–	–	–	–	–	–	ATS-2	5
–	37	–	18	–	12	–	7	–	–	–	ATS-101	6
–	40	–	24	–	13	–	8	–	–	–	ATS-105	7
–	47	–	29	–	18	–	10	–	–	–	ATS-113	8
(Rupture in 1000 hr. at 1100F, 22 000 psi)							–	–	–	–	MTS-1	9
(Rupture in 1000 Hr. at 1100F, 27 000 psi)							–	–	–	–	MTS-5	10
(Rupture in 1000 hr. at 1100F, 30 000 psi)							–	–	–	–	MTS-4	11
–	–	–	–	–	–	–	–	–	–	–	MTS-2	12
–	–	–	–	–	–	–	–	–	–	Mannesmann	Marwedur F 11	13
–	–	–	–	–	–	–	–	–	–	Krupp	WF 100D	14
50	34	24	15	–	–	–	–	–	–	Krupp	Tinidur	15
–	–	–	–	–	–	–	–	–	–	Krupp	Cromadur	16