

CoA/M/Mat-99

ST. NO.
U.D.C. R 32166
AUTH

CoA Memo. Mat. No. 99

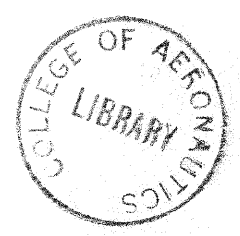
March, 1966

THE COLLEGE OF AERONAUTICS
DEPARTMENT OF MATERIALS

High temperature creep properties
of W-ThO₂ Alloy

- by -

T.E. Clifton and P. Cook



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Introduction

This memorandum reports a series of experiments to determine some tensile creep properties of W.ThO₂ alloy at elevated temperatures.

Experimental

The apparatus used for these tests is described in C. of A. memo Mat. No. 80 dated October, 1965.

The method used for gripping the specimen is shown in fig. 1. This is the only further modification carried out, the loading and strain measurement being as described in the above memo.

Results

The following six series of experiments have been completed and are shown both tabulated and plotted to a base of log time, figures 2 to 5.

In all cases the stress applied is 6.5 tons/in².

Series A. Material W-1% ThO₂.

Test No. 1 Soak for 1 hour and test at 1400°C.

Test No. 2 Soak for 1 hour and test at 1450°C.

Test No. 3 Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1450°C.

Test No. 4 Soak for 1 hour and test at 1400°C.

Test No. 5 Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1400°C.

Series B Material W-2% ThO₂

Test No. 6 Soak for 1 hour and test at 1450°C

Test No. 7 Heat treat at 1900°C for 1 hour. Test at 1450°C.

Test No. 8 Soak for 1 hour and test at 1500°C.

Test No. 9 Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1500°C.

Series C Material W-0.75% ThO₂ - Designated C.

Test No. 10 Soak for 1 hour and test at 1400°C.

Test No. 11 Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1400°C.



Series D

Material W-2% ThO₂ - Designated D.

Test No. 12

Soak for 1 hour and test at 1500°C.

Test No. 13

Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1500°C.

Series E

Material W-2% ThO₂ - Designated E.

Test No. 14

Soak for 1 hour and test at 1500°C.

Test No. 15

Heat treat at 1900°C for 2 minutes. Cool to room temperature. Soak for 1 hour and test at 1500°C.

Series F

Material Pure Tungsten - Designated F.

Test No. 16

Soak for 1 hour and test at 1400°C.

Test No. 17

Heat treat at 1900°C.

Creep Tests on W-1% ThO₂ Alloy - Series A

TEST NO. 1		TEST NO. 2		TEST NO. 3		TEST NO. 4		TEST NO. 5	
Time	Ext.	Time	Ext.	Time	Ext.	Time	Ext.	Time	Ext.
Mins	Ins	Mins	Ins	Mins	Ins	Mins	Ins	Mins	Ins
1	.0638	1	.0760	1	.0980	1	.0680	1	.0765
2	.0638	2	770	2	.1062	3	695	2	802
5	.0638	3	777	3	.1127	4	710	3	852
10	.0638	4	788	4	.1190	5	711	4	902
30	.0638	5	810	5	.1232	10	712	5	934
45	.0638	10	900	10	.1403	20	717	7	981
46	.0702	15	990	15	.1585	30	723	10	.1067
50	717	20	.1082	20	.1793	40	733	12	.1128
60	734	25	.1187	22	.1886	50	744	14	.1185
65	809	30	.1316	24	.1980	60	757	16	.1234
70	843	35	.1537	26	.2121	70	766	18	.1274
72	913	40	.1778	28	.2264	80	778	20	.1325
75	990	45	.2335	30	.2448	90	791	22	.1375
78	.1068	46	.2590	32	.2670	100	811	24	.1427
80	.1142			33	.2850	110	828	26	.1480
81	.1190			34	.3050	120	847	28	.1537
82	.1286					130	873	30	.1584
83	.1313					140	890	32	.1646
84	.1459					150	920	34	.1707
85	.1636					160	967	36	.1786
						170	.1011	38	.1849
						180	.1087	40	.1934
						190	.1195	42	.2004
								44	.2093
								46	.2203
								48	.2332
								50	.2478
								52	.2672
								54	.2978



Creep Tests on W-2% Th O₂ Alloy Series B

TEST NO. 6		TEST NO. 7		TEST NO. 8		TEST NO. 9	
Time	Ext.	Time	Ext.	Time	Ext.	Time	Ext.
Mins	Ins	Mins	Ins	Mins	Ins	Mins	Ins
1	.0426	1	.0815	1	.0609	1	.0628
2	441	2	822	2	619	2	638
3	446	3	826	3	630	3	646
4	452	4	826	5	646	5	660
5	458	5	826	10	658	10	673
10	461	10	830	15	672	15	680
15	468	15	843	20	679	20	690
20	475	20	857	30	692	30	709
25	514	25	871	45	704	45	724
30	550	30	879	60	706	60	733
35	578	40	894	90	713	90	759
40	584	50	910	120	724	120	778
45	596	60	922	150	733	150	790
50	608	75	944	180	741	180	797
55	615	90	960	210	746	210	810
60	616	105	973	240	755	240	819
70	635	120	933				
80	635	150	.1029				
90	643	180	.1054				
120	660	210	.1076				
150	678	240	.1110				
180	695						
200	705						

Creep Tests on W-0.75% ThO₂ Alloy Series C.

TEST NO. 10		TEST NO. 11		TEST NO. 12	
Time	Ext.	Time	Ext.	Time	Ext.
Mins	Ins	Mins	Ins	Mins	Ins
1	.0850	1	.0756	90	.1139
2	854	2	772	100	.1405
3	859	3	787	110	.1475
5	863	5	826	115	.1518
10	870	6	846	120	.1552
20	882	8	863	130	.1646
30	897	10	880	140	.1776
40	906	15	912	145	.1851
50	910	20	948	147	.1900
60	913	25	980	150	.1944
90	924	30	.1004	152	.2000
120	936	40	.1053	154	.2065
150	952	50	.1110	156	.2159
180	965	60	.1165		
210	974	70	.1217		
240	985	80	.1275		

Creep Tests on W2% Th O₂ Alloy - Series D

TEST NO. 13	
Time	Ext.
Mins	Ins
1	.0729
2	743
3	754
5	763
10	777
20	794
30	813
40	839
50	862
60	882
75	928
90	994
100	.1040
110	.1106
120	.1200
125	.1266
127	.1308
128	.1330
130	.1360
132	.1400
134	.1480
136	.1511
138	.1582
140	.1668
142	.1767
144	.1937
145	.2156

TEST NO. 14	
Time	Ext.
Mins	Ins
1	.0797
2	843
3	883
4	906
5	927
7	984
10	.1054
12	.1100
14	.1159
16	.1204
18	.1250
20	.1305
22	.1367
24	.1423
26	.1485
28	.1563
30	.1639
32	.1731
34	.1837
36	.1982
37	.2085
38	.2230

Creep Tests on W-2% ThO₂ Alloy - Series E

TEST No. 14	
Time	Ext.
Mins.	Ins.
1	.0721
2	.0726
3	.0735
4	.0752
5	.0765
10	.0789
15	.0818
20	.0846
25	.0852
30	.0857
40	.0883
50	.0906
60	.0945
70	.0974
85	.1052
90	.1087
100	.1168
110	.1281
115	.1353
120	.1437
125	.1545
127	.1592
130	.1650
131	.1721
132	.1763
133	.1806
134	.1878

TEST No. 15			
Time	Ext.	Time	Ext.
Mins.	Ins.	Mins.	Ins.
1	.0705	90	.2080
2	.0735	91	.2110
3	.0760	92	.2141
4	.0780	93	.2168
5	.0788	94	.2214
8	.0840	95	.2240
10	.0867	96	.2291
15	.0930	97	.2322
20	.0995	98	.2387
25	.1051	99	.2440
30	.1100		
35	.1156		
40	.1220		
45	.1280		
50	.1332		
55	.1404		
60	.1488		
65	.1557		
70	.1633		
75	.1724		
80	.1830		
82	.1868		
85	.1941		
86	.1966		
87	.1987		
88	.2020		
89	.2055		

Creep Test on Pure Tungsten. Series F.

TEST No. 16	
Time	Ext.
Mins.	Ins.
1	.0869
2	.0885
3	.0891
4	.0897
5	.0901
10	.0923
20	.0941
30	.0952
40	.0964
50	.1005
60	.1025
70	.1039
80	.1060
90	.1072
100	.1093
135	.1163
160	.1232
180	.1305
200	.1384
220	.1484
240	.1686
245	.1793
250	.1872
255	.2000
257	.2101

TEST No. 17	
Time	Ext.
Mins.	Ins.
1	.0808
2	.0870
3	.0918
4	.0950
5	.0972
7	.1001
10	.1073
13	.1130
15	.1165
17	.1191
20	.1236
25	.1307
30	.1380
35	.1478
40	.1575
43	.1635
45	.1690
47	.1751
49	.1834
50	.1880
51	.1925
52	.1995
53	.2105

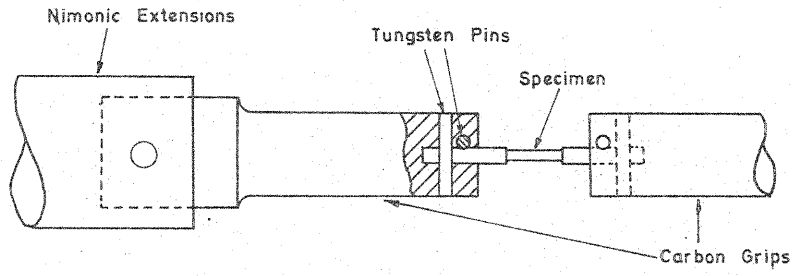


FIG 1. SPECIMEN GRIPS.

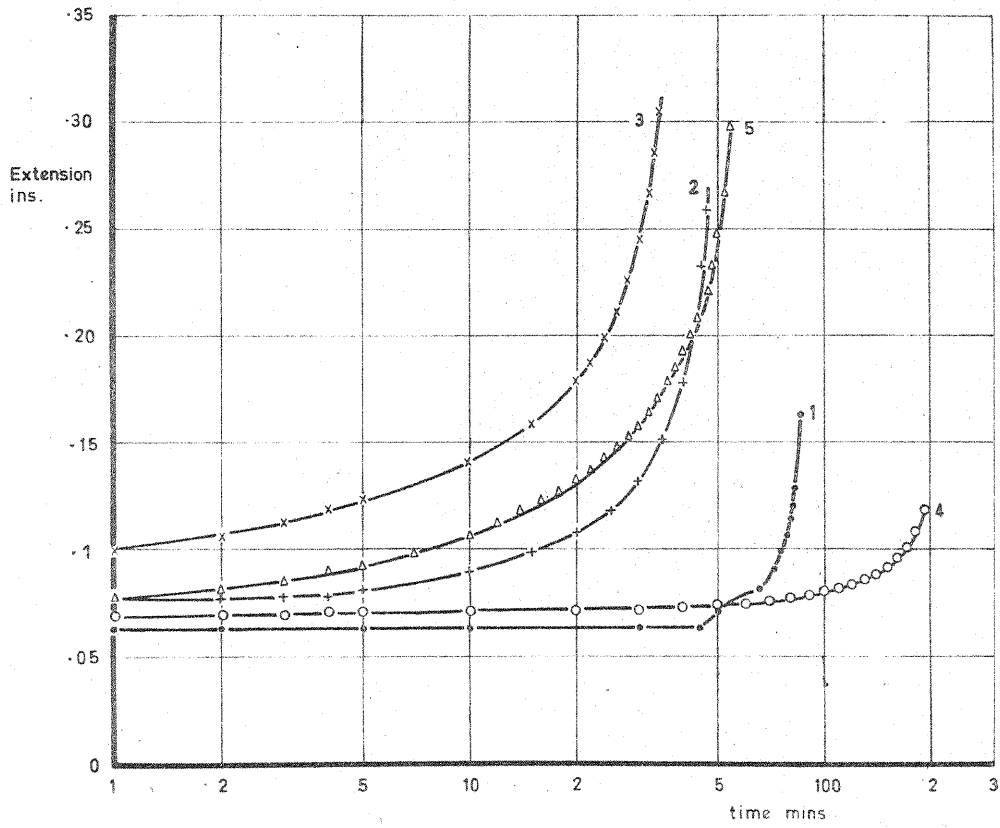


FIG 2. SERIES A.

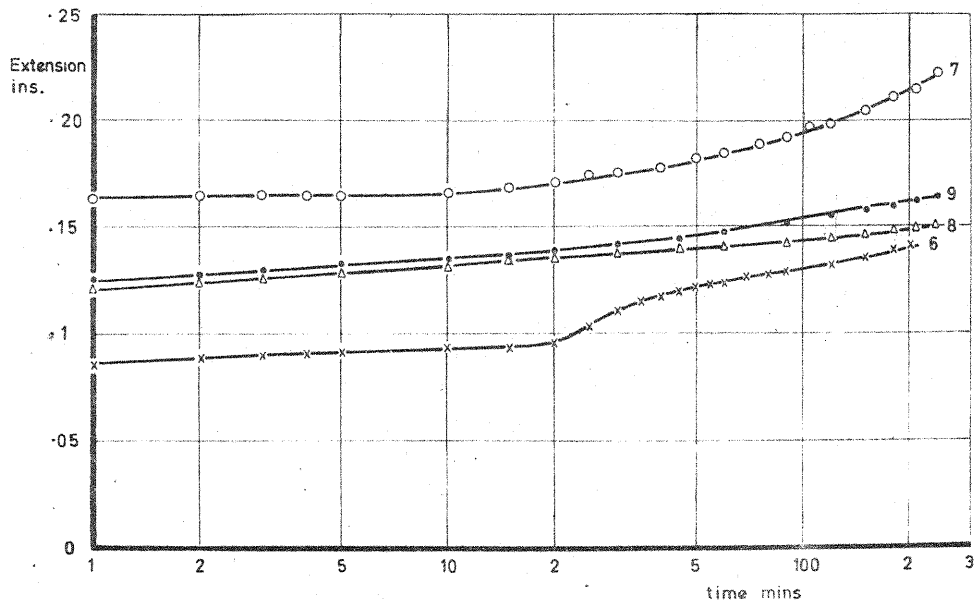


FIG 3. SERIES B.

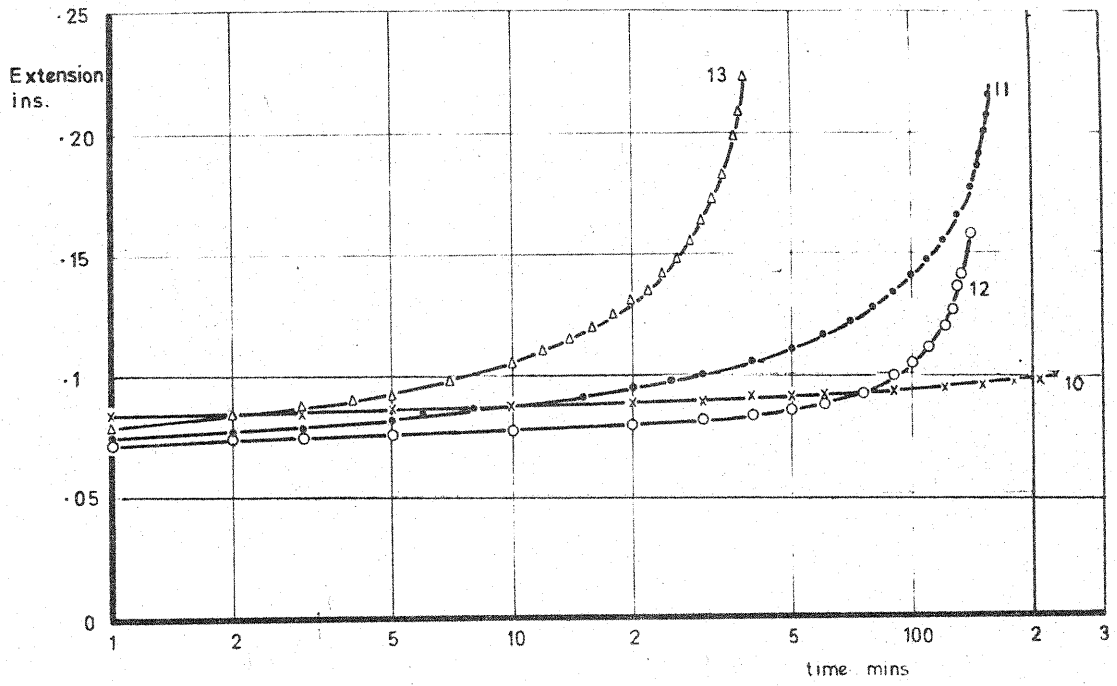


FIG. 4. SERIES C & D.

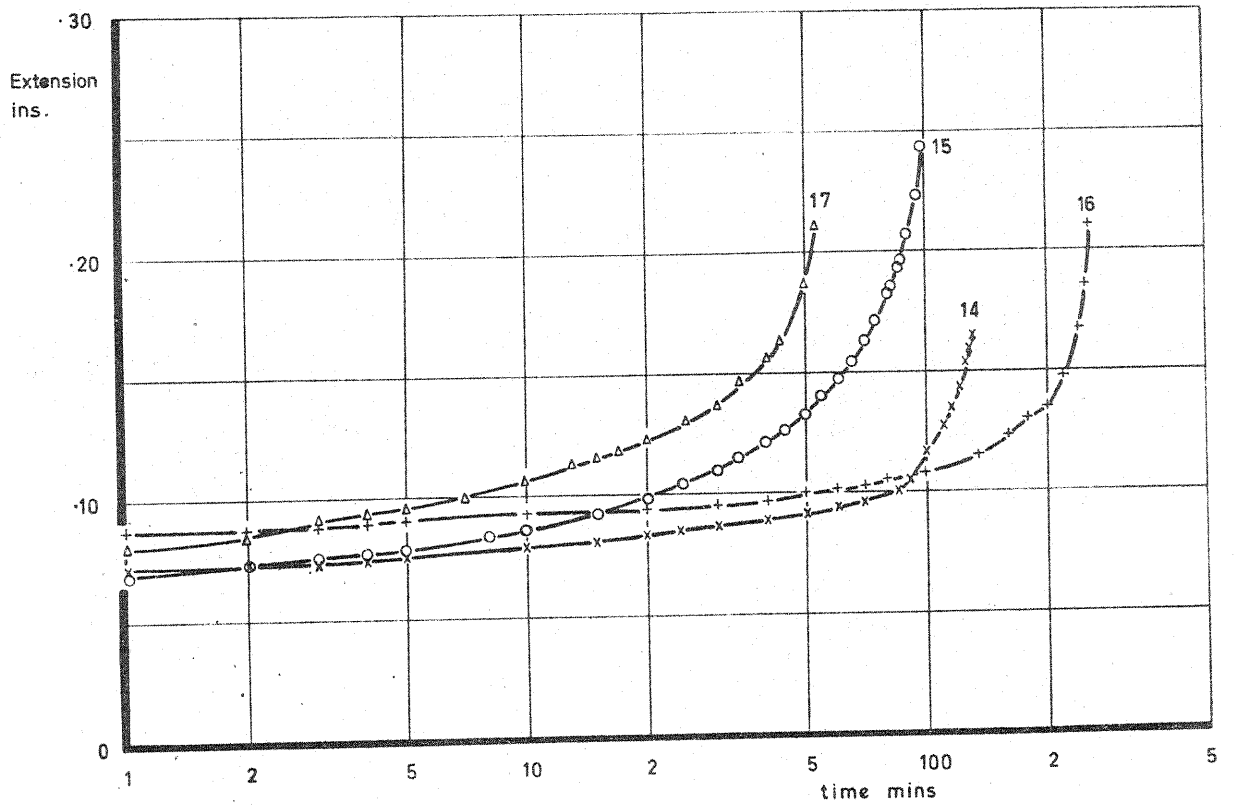


FIG. 5. SERIES E. & F.