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62D CONGRESS, 3d Session } HOUSE OF REPRESENTATIVES { DOCUMENT No. 974

REPORT

OF THE

TESTS OF METALS

AND

OTHER MATERIALS

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS, DURING THE FISCAL YEAR ENDED JUNE 30

1912

MARCH 3, 1913.—Referred to the Committee on Military Affairs and ordered to be printed, with illustrations



WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

War Department.

Document No. 425.

Office of the Chief of Ordnance.

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APR 13 1914

LETTER OF TRANSMITTAL.

War Department,
Washington, March 3, 1913.

The Speaker of the House of Representatives.

Sir: I have the honor to transmit, herewith, a letter from the Acting Chief of Ordnance, United States Army, of this date, submitting, for transmission to Congress as required by law, copy of the report of the commanding officer of Watertown Arsenal, of "Tests of iron and steel and other materials for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1912.

Very respectfully,

Henry L. Stimson,
Secretary of War.

LETTER OF SUBMITTAL.

War Department,
Office of the Chief of Ordnance,
Washington, March 3, 1913.

From: The Acting Chief of Ordnance.
To: The Secretary of War.
Subject: Annual report, tests of iron, steel, etc., 1912.

I submit herewith, for transmission to Congress as required by law, a copy of the report of the commanding officer of Watertown Arsenal, of "Tests of iron and steel and other materials for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1912.

R. Birnie.

WATERTOWN ARSENAL,
Watertown, Mass., August 16, 1912.

From: The Commanding Officer, Watertown Arsenal.
To: The Chief of Ordnance.
Subject: Annual report tests iron, steel, etc.

SIR: 1. I have the honor to submit herewith the annual report of tests of iron, steel, and other materials made at this arsenal during the fiscal year ending June 30, 1912.

2. The total number of specimens tested during the year was 3,143, classified as follows:

Gun specimens	37
For Ordnance Department	2,566
For other Government departments	25
Tests for private parties	515
Total	3,143

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received for private tests	964.33
Total received	15,964.33
Amount expended for service and labor	12,072.11
Amount expended for light, power, tools, implements, and material for tests	3,892.22
Total expended	15,964.33

3. The equipment of the laboratory has been increased by the purchase of two Ewing extensometers, one for 2-inch gauge lengths and one for 8-inch gauge lengths, with the necessary laying-off gauges; an apparatus for making either single or double shearing tests of metals; an Edelmann thermo-electric apparatus for determining the elastic limit of metals; and a Baloptican projection lantern. The Shore scleroscope has been modified to make it of the latest design.

4. Tests to determine the relative wearing qualities of bronzes have been continued, and it is hoped that definite data may soon be submitted.

5. A large number of tests on square steel wire for winding guns have been completed and data of value has been obtained. The Ordnance Department specifications for this material have been changed, as a result of these tests, so as to make them more definite and less dependent upon the personal equation of the inspector.

6. A number of reports on the metallographic examination of specimens, made by Dr. Henry Fay, of the Massachusetts Institute of Technology, are included in this report.

Respectfully,
C. B. WHEELER,
Lieutenant Colonel, Ordnance Department,
United States Army, Commanding.

CHIEF OF ORDNANCE, UNITED STATES ARMY,
Washington, D. C.

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REPORT

OF THE

TESTS OF METALS

AND

OTHER MATERIALS

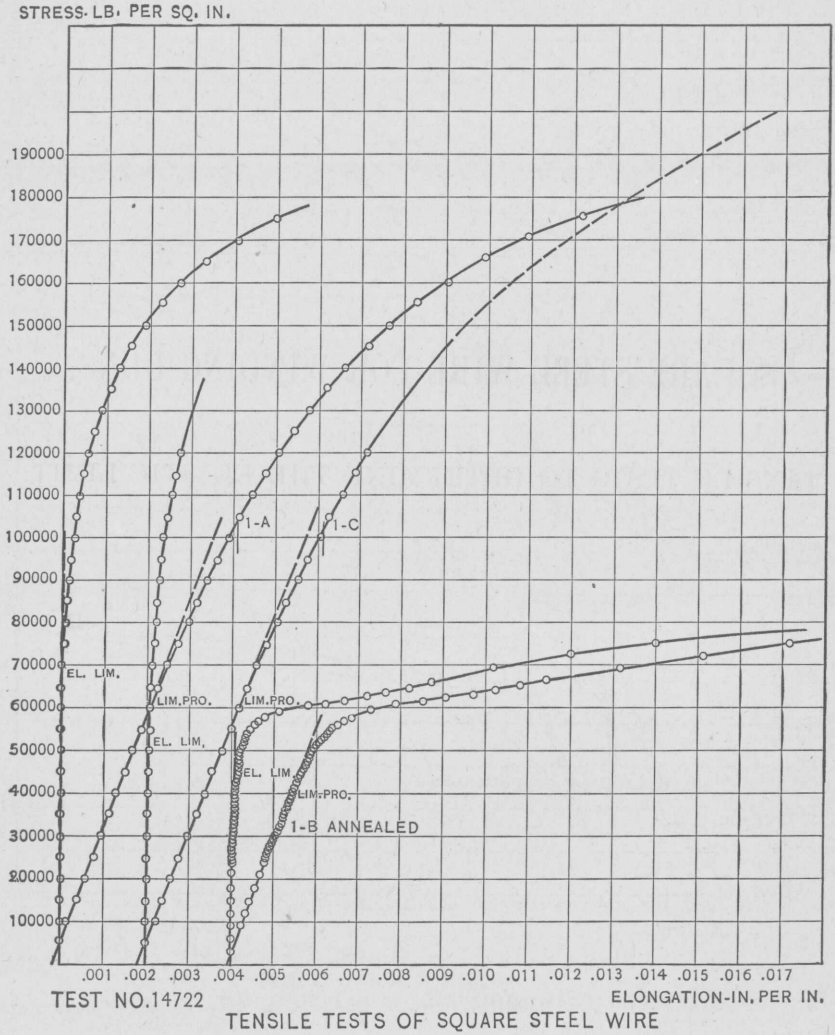
MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS, DURING THE FISCAL YEAR ENDED JUNE 30, 1912.

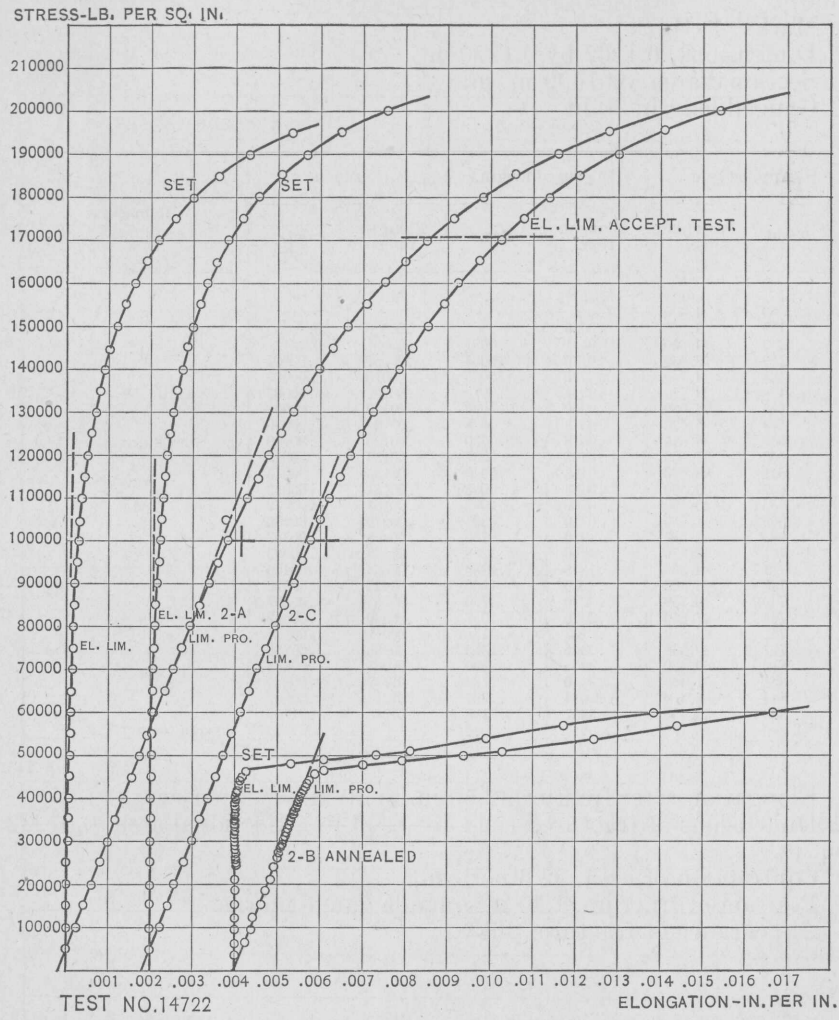
SQUARE STEEL WIRE FOR WINDING GUNS.

TENSILE TESTS TO DETERMINE THE ELASTIC LIMIT.

NOTE.—Test 14722 is continued from "Tests of Metals, etc., 1911." Curves 1–A, 1–B, 1–C, 2–A, 2–B, 2–C, and 3–A are plotted from data tabulated therein.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

TEST 14722.

From same coil as 3–A or Sample No. 3.

This sample was annealed at 1,500° F. for 1 hour and allowed to cool slowly in furnace for about 9 hours; annealed the second time at 1,500° F. for 3 hours and allowed to cool in furnace for about 9 hours.

Marks: 3–B.

Dimensions, 0.1267 by 0.1270 in.

Sectional area, 0.01609 sq. in.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
80	4,970	.0	0.	0.	0.	
159	9,880	.0059	0.	.00020	0.	
239	14,850	.0111	.0001	.00037	0.	
319	19,830	.0170	.0004	.00057	.00001	
398	24,740	.0225	.0008	.00075	.00003	
478	29,710	.0291	.0010	.00097	.00003	
558	34,680	.0360	.0023	.00120	.00008	
573	35,620	.0372	.0028	.00124	.00009	
589	36,610	.0388	.0030	.00129	.00010	
605	37,600	.0402	.0037	.00134	.00012	
621	38,600	.0413	.0040	.00138	.00013	
637	39,590	.0453	.0068	.00151	.00023	
653	40,590	.0490	.0097	.00163	.00032	
669	41,580	.0720	.0301	.00240	.00100	
685	42,580	.1210	.0760	.00403	.00253	
701	43,570	.1690	.1208	.00563	.00403	
717	44,560	.1808	.1395	.00603	.00465	
733	45,560	.2070	.1560	.00690	.00520	
749	46,550	.2290	.1760	.00763	.00587	
765	47,550	.2520	.1957	.00840	.00652	
781	48,540	.2752	.2175	.00917	.00725	
797	49,540	.2965	.2363	.00988	.00788	
812	50,470	.3205	.2590	.01068	.00863	
828	51,460	.3410	.2774	.01137	.00924	
844	52,460	.3644	.2991	.01215	.00997	
860	53,450	.3857	.3188	.01286	.01063	
1,380	85,770	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.50 in. in 30 in. = 8.3 per cent.

Dimensions at fracture, 0.111 by 0.111 in. Sectional area, 0.01232 sq. in.

Contraction of area, 22.6 per cent.

Position of fracture, 1.40 in. outside gauge marks.

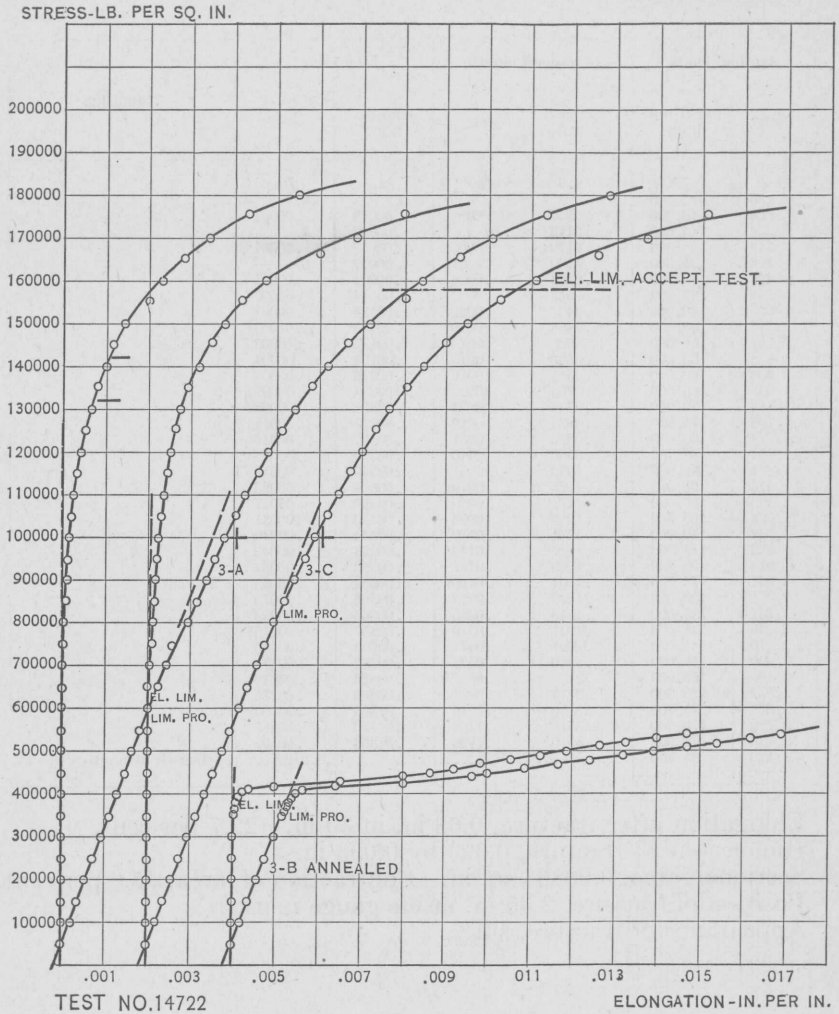
Appearance of fracture, Silky.

SQUARE STEEL WIRE FOR WINDING GUNS.

From same coil as 3–A or sample No. 3.
Marks, 3–C.
Dimensions, 0.1257 by 0.1267 in.
Sectional area, 0.01592 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
80	5,000	0.	0.	0.	0.	
159	10,000	.0057	.0002	.00019	.00001	
239	15,000	.0112	0.	.00037	0.	
319	20,000	.0170	.0002	.00057	.00001	
398	25,000	.0230	.0001	.00077	0.	
478	30,000	.0283	.0004	.00094	.00001	
558	35,000	.0342	.0005	.00114	.00002	
637	40,000	.0402	.0002	.00134	.00001	
717	45,000	.0458	.0010	.00153	.00003	
797	50,000	.0520	.0010	.00173	.00003	
876	55,000	.0582	.0013	.00194	.00004	
956	60,000	.0648	.0019	.00216	.00006	
1,035	65,000	.0703	.0021	.00234	.00007	
1,115	70,000	.0768	.0024	.00256	.00008	
1,195	75,000	.0825	.0032	.00275	.00011	
1,274	80,000	.0892	.0031	.00297	.00010	
1,354	85,000	.0960	.0046	.00320	.00015	
1,434	90,000	.1030	.0055	.00343	.00018	
1,513	95,000	.1108	.0070	.00369	.00023	
1,593	100,000	.1171	.0080	.00390	.00027	
1,673	105,000	.1260	.0093	.00420	.00031	
1,752	110,000	.1331	.0119	.00444	.00040	
1,832	115,000	.1420	.0140	.00473	.00047	
1,912	120,000	.1509	.0162	.00503	.00054	
1,991	125,000	.1594	.0190	.00531	.00063	
2,071	130,000	.1699	.0228	.00566	.00076	
2,151	135,000	.1818	.0280	.00606	.00093	
2,230	140,000	.1941	.0340	.00647	.00113	
2,310	145,000	.2098	.0421	.00699	.00140	
2,390	150,000	.2260	.0522	.00753	.00174	
2,469	155,000	.2470	.0657	.00823	.00219	
2,549	160,000	.2719	.0825	.00906	.00275	
2,628	165,000	.3190	.1210	01063	.00403	
2,708	170,000	.3510	.1462	.01170	.00487	
2,788	175,000	.3910	.1790	.01303	.00597	
3,120	196,000	.....	.....	.....	.....	=Tensile strength.

Elongation after fracture, 0.68 in. in 30 in. = 22.7 per cent.
Dimensions at fracture, 0.093 by 0.093 in.
Sectional area, 0.00865 sq. in. Contraction of area, 45.6 per cent.
Position of fracture, 2.35 in. inside gauge marks.
Appearance of fracture, silky.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 4. Reel 918. P. O. 8320. Diameter of coil in natural state: 26 in.

Marks, 4–A.

Dimensions, 0.1265 by 0.1269 in.

Sectional area, 0.01605 sq. in.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
80	5,000	0.	0.	0.	0.	
160	10,000	.0053	0.	.00018	0.	
240	15,000	.0111	— .0002	.00037	— .00001	
321	20,000	.0166	0.	.00055	0.	
401	25,000	.0219	— .0001	.00073	0.	
481	30,000	.0270	0.	.00090	0.	
561	35,000	.0320	— .0004	.00107	— .00001	
641	40,000	.0372	— .0006	.00124	— .00002	
721	45,000	.0428	— .0007	.00143	— .00002	
802	50,000	.0480	— .0007	.00160	— .00002	
882	55,000	.0539	— .0004	.00180	— .00001	
962	60,000	.0598	— .0001	.00199	0.	
1,042	65,000	.0659	0.	.00220	0.	
1,122	70,000	.0722	.0003	.00241	.00001	
1,202	75,000	.0783	.0012	.00261	.00004	
1,282	80,000	.0850	.0017	.00283	.00006	
1,363	85,000	.0915	.0027	.00305	.00009	
1,443	90,000	.0992	.0041	.00331	.00014	
1,523	95,000	.1066	.0053	.00355	.00018	
1,603	100,000	.1149	.0073	.00383	.00024	
1,683	105,000	.1230	.0100	.00410	.00033	
1,763	110,000	.1317	.0128	.00439	.00043	
1,843	115,000	.1414	.0160	.00471	.00053	
1,924	120,000	.1518	.0210	.00506	.00070	
2,003	125,000	.1640	.0261	.00547	.00087	
2,084	130,000	.1758	.0312	.00586	.00104	
2,164	135,000	.1888	.0388	.00629	.00129	
2,244	140,000	.2040	.0467	.00680	.00156	
2,324	145,000	.2252	.0593	.00751	.00198	
2,405	150,000	.2415	.0702	.00805	.00234	
2,485	155,000	.2660	.0855	.00887	.00285	
2,565	160,000	.2950	.1062	.00983	.00354	
2,645	165,000	.3260	.1307	.01087	.00436	
2,725	170,000	.3680	.1656	.01227	.00552	
3,077	191,800	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.82 in. in 30 in. = 2.2 per cent.

Dimensions at fracture, 0.095 by 0.095 in. Sectional area = 0.00902 sq. in.

Contraction of area, 43.8 per cent.

Position of fracture, 16.25 in. inside gauge marks.

Appearance of fracture, fine silky, cup shaped.

From same coil as 4–A or sample No. 4.

This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 4–B.

Dimensions, 0.1271 by 0.1279 in.

Sectional area, 0.01625 sq. in.

Sectional area used as 0.01603 sq. in., this having been the average sectional area of the unannealed wire from the same coil.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb..*	*In.*	*In.*	*In.*	*In.*	
80	5,000	0.	0.	0.	0.	
160	10,000	.0071	.0007	.00024	.00002	
240	15,000	.0130	.0012	.00043	.00004	
321	20,000	.0188	.0020	.00063	.00007	
401	25,000	.0241	.0027	.00080	.00009	
481	30,000	.0298	.0031	.00099	.00010	
561	35,000	.0360	.0040	.00120	.00013	
577	36,000	.0375	.0049	.00125	.00016	
593	37,000	.0392	.0053	.00131	.00018	
609	38,000	.0408	.0060	.00136	.00020	
625	39,000	.0424	.0064	.00141	.00021	
641	40,000	.0440	.0074	.00147	.00025	
657	41,000	.0465	.0083	.00155	.00028	
673	42,000	.0490	.0130	.00163	.00043	
689	43,000	.0530	.0130	.00177	.00043	
705	44,000	.0850	.0440	.00283	.00147	
721	45,000	.1330	.0908	.00443	.00303	
737	46,000	.1640	.1225	.00547	.00408	
753	47,000	.2110	.1652	.00703	.00551	
769	48,000	.2470	.1944	.00823	.00648	
785	49,000	.2622	.2078	.00874	.00693	
802	50,000	.2880	.2318	.00960	.00773	
818	51,000	.3070	.2488	.01023	.00829	
834	52,000	.3280	.2678	.01093	.00893	
850	53,000	.3450	.2870	.01150	.00957	
866	54,000	.3772	.3125	.01257	.01042	
1,443	88,800	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.96 in. in 30 in. = 9.9 per cent.

Dimensions at fracture, 0.111 by 0.111 in.

Sectional area, 0.01232 sq. in.

Contraction of area, 24.2 per cent.

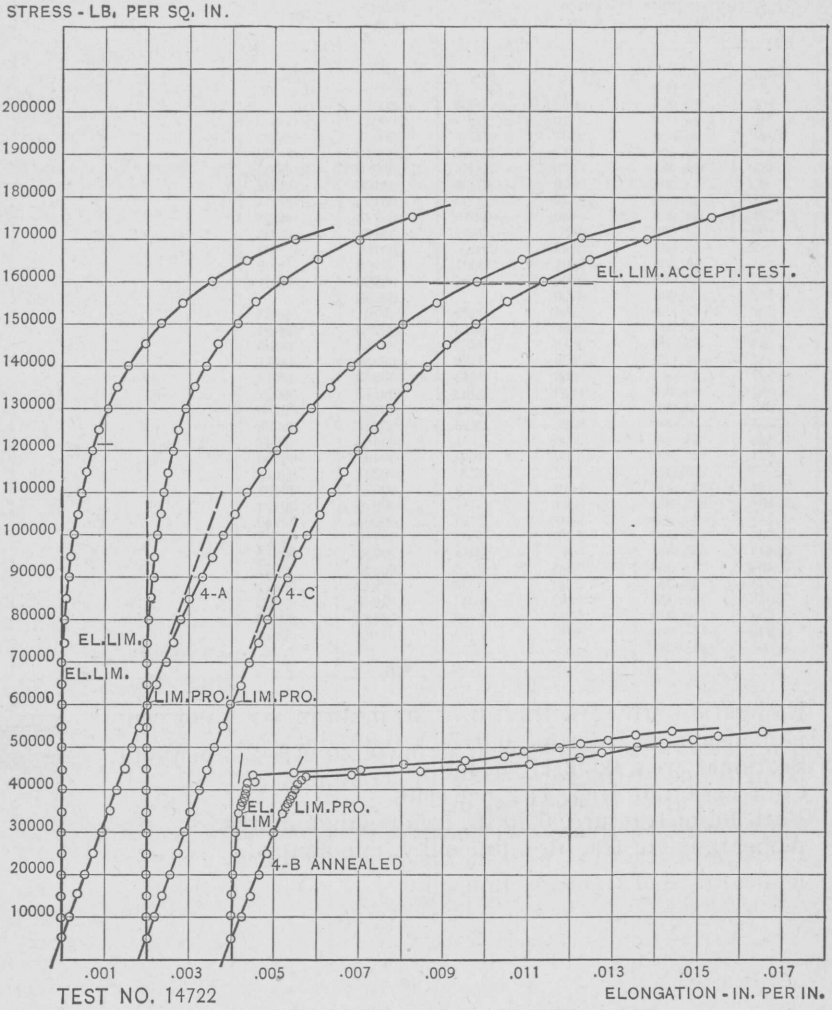
Position of fracture, 0.20 in. outside gauge marks.

Appearance of fracture, silky, trace of granulation.

Marks, 4–C. From same coil as 4–A.
Dimensions, 0.1263 by 0.1267 in.
Sectional area, 0.01600 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb..*	*In.*	*In.*	*In.*	*In.*	
80	5,000	0.	0.	0.	0.	
160	10,000	.0052	— .0001	0.00017	0.	
240	15,000	.0110	— .0005	.00037	— .00002	
321	20,000	.0162	— .0004	.00054	— .00001	
401	25,000	.0217	— .0006	.00072	— .00002	
481	30,000	.0270	— .0005	.00090	— .00002	
561	35,000	.0319	— .0006	.00106	— .00002	
641	40,000	.0372	— .0009	.00124	— .00003	
721	45,000	.0430	— .0010	.00143	— .00003	
802	50,000	.0482	— .0009	.00161	— .00003	
882	55,000	.0542	— .0010	.00181	— .00003	
962	60,000	.0601	— .0007	.00200	— .00002	
1,042	65,000	.0660	— .0004	.00220	— .00001	
1,122	70,000	.0720	0.	.00240	0.	
1,202	75,000	.0784	.0009	.00261	.00003	
1,282	80,000	.0850	.0013	.00283	.00004	
1,363	85,000	.0918	.0023	.00306	.00008	
1,443	90,000	.0990	.0032	.00330	.00011	
1,523	95,000	.1060	.0043	.00353	.00014	
1,603	100,000	.1130	.0062	.00377	.00021	
1,683	105,000	.1225	.0091	.00408	.00030	
1,763	110,000	.1305	.0113	.00435	.00038	
1,843	115,000	.1390	.0141	.00463	.00047	
1,924	120,000	.1490	.0180	.00497	.00060	
2,003	125,000	.1594	.0220	.00531	.00073	
2,084	130,000	.1719	.0279	.00573	.00093	
2,164	135,000	.1847	.0341	.00616	.00114	
2,244	140,000	.1991	.0420	.00664	.00140	
2,324	145,000	.2130	.0502	.00710	.00167	
2,405	150,000	.2345	.0635	.00782	.00212	
2,485	155,000	.2550	.0770	.00850	.00257	
2,565	160,000	.2820	.0962	.00940	.00321	
2,645	165,000	.3140	.1207	.01047	.00402	
2,725	170,000	.3550	.1518	.01183	.00506	
2,805	175,000	.3990	.1870	.01330	.00623	
3,106	194,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.71 in. in 30 in. = 2.4 per cent.
Dimensions at fracture, 0.097 by 0.097 in.
Sectional area, 0.00941 sq. in.
Contraction of area, 41.2 per cent.
Position of fracture, 0.30 in. inside gauge marks.
Appearance of fracture, fine silky, cup shaped.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 5. Reel 946. P. O. 8320. Diameter of coil in natural state, 25 inches.
Marks, 5–A.
Dimensions, 0.1268 by 0.1282 in.
Sectional area, 0.01625 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
81	5,000	0.	0.	0.	0.	
163	10,000	.0056	0.	.00019	0.	
244	15,000	.0110	−.0001	.00037	−.00001	
325	20,000	.0165	0.	.00055	0.	
406	25,000	.0220	−.0002	.00073	−.00001	
488	30,000	.0271	−.0002	.00090	−.00001	
569	35,000	.0330	0.	.00110	0.	
650	40,000	.0390	0.	.00130	0.	
731	45,000	.0450	.0003	.00150	.00001	
813	50,000	.0510	.0003	.00170	.00001	
894	55,000	.0570	.0005	.00190	.00002	
975	60,000	.0630	.0012	.00210	.00004	
1,056	65,000	.0695	.0018	.00232	.00006	
1,138	70,000	.0760	.0021	.00252	.00007	
1,219	75,000	.0822	.0032	.00274	.00011	
1,300	80,000	.0890	.0040	.00297	.00013	
1,381	85,000	.0960	.0049	.00320	.00016	
1,463	90,000	.1050	.0069	.00350	.00023	
1,544	95,000	.1120	.0080	.00373	.00027	
1,625	100,000	.1205	.0110	.00402	.00037	
1,706	105,000	.1300	.0140	.00433	.00047	
1,788	110,000	.1395	.0170	.00465	.00057	
1,869	115,000	.1500	.0208	.00500	.00069	
1,950	120,000	.1615	.0263	.00538	.00088	
2,031	125,000	.1759	.0335	.00586	.00112	
2,113	130,000	.1890	.0400	.00630	.00133	
2,194	135,000	.2060	.0500	.00687	.00167	
2,275	140,000	.2247	.0610	.00749	.00203	
2,356	145,000	.2460	.0753	.00820	.00251	
2,438	150,000	.2720	.0925	.00907	.00308	
2,519	155,000	.3000	.1141	.01000	.00380	
2,600	160,000	.3375	.1410	.01125	.00470	
2,681	165,000	.3795	.1792	.01265	.00597	
2,977	183,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.68 in. in 30 in. = 2.3 per cent.
Dimensions at fracture, 0.097 by 0.097 in.
Sectional area, 0.00941 sq. in.
Contraction of area, 42 per cent.
Position of fracture, 9.60 in. inside gauge marks.
Appearance of fracture, fine silky.

From same coil as 5–A or sample No. 5. This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 5–B.

Dimensions, 0.1270 by 0.1278 in.

Sectional area, 0.01623 sq. in.

Sectional area used, 0.01625 sq. in., this having been the sectional area of the unannealed wire from the same coil.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
81	5,000	0.	0.	0.	0.	
163	10,000	.0071	.0009	.00024	.00003	
244	15,000	.0125	.0009	.00042	.00003	
325	20,000	.0180	.0010	.00060	.00003	
406	25,000	.0232	.0012	.00077	.00004	
488	30,000	.0283	.0017	.00094	.00006	
569	35,000	.0346	.0021	.00115	.00007	
585	36,000	.0360	.0028	.00120	.00009	
601	37,000	.0374	.0029	.00125	.00010	
618	38,000	.0390	.0030	.00130	.00010	
634	39,000	.0400	.0032	.00133	.00011	
650	40,000	.0418	.0040	.00139	.00013	
666	41,000	.0439	.0050	.00146	.00017	
683	42,000	.0510	.0110	.00170	.00037	
699	43,000	.0735	.0322	.00245	.00107	
715	44,000	.1140	.0710	.00380	.00237	
731	45,000	.1460	.1030	.00487	.00343	
748	46,000	.1760	.1282	.00587	.00427	
764	47,000	.2000	.1534	.00667	.00511	
780	48,000	.2500	.1990	.00833	.00663	
796	49,000	.2900	.2370	.00967	.00790	
813	50,000	.3100	.2540	.01033	.00847	
829	51,000	.3260	.2710	.01087	.00903	
845	52,000	.3500	.2912	.01167	.00971	
861	53,000	.3800	.3230	.01267	.01077	
1,411	87,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.79 in. in 30 in. = 9.3 per cent.

Dimensions at fracture, 0.105 by 0.105 in.

Sectional area, 0.01103 sq. in.

Contraction of area, 32 per cent.

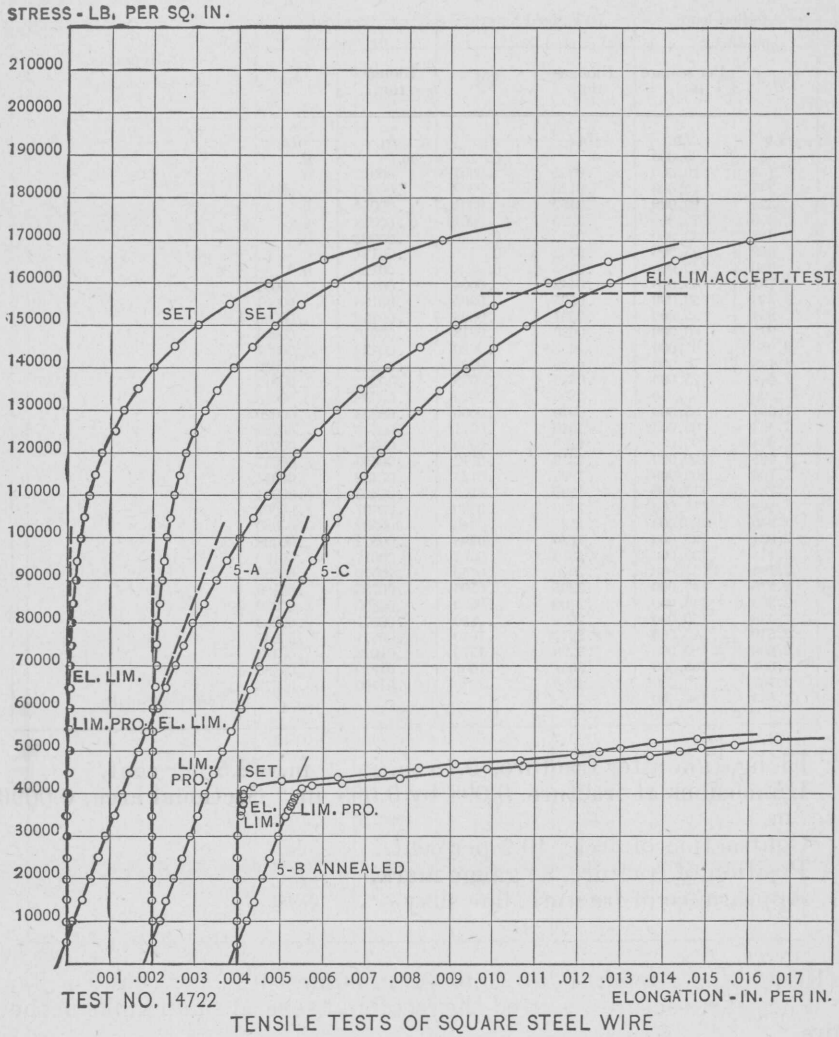
Position of fracture, at gauge mark.

Appearance of fracture, silky.

From same coil as 5–A or sample No. 5.
Marks, 5–C.
Dimensions, 0.1270 by 0.1280 in.
Sectional area, 0.01625 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
81	5,000	0.	0.	0.	0.	
163	10,000	.0051	— .0001	.00017	0.	
244	15,000	.0110	— .0002	.00037	— .00001	
325	20,000	.0162	— .0001	.00054	0.	
406	25,000	.0220	— .0001	.00073	0.	
488	30,000	.0275	0.	.00092	0.	
569	35,000	.0332	0.	.00111	0.	
650	40,000	.0385	0.	.00128	0.	
731	45,000	.0442	.0004	.00147	.00001	
813	50,000	.0505	.0004	.00168	.00001	
894	55,000	.0567	.0008	.00189	.00003	
975	60,000	.0630	.0013	.00210	.00004	
1,056	65,000	.0695	.0020	.00232	.00007	
1,138	70,000	.0759	.0028	.00253	.00009	
1,219	75,000	.0830	.0035	.00277	.00012	
1,300	80,000	.0895	.0040	.00298	.00013	
1,381	85,000	.0970	.0060	.00323	.00020	
1,463	90,000	.1040	.0071	.00347	.00024	
1,544	95,000	.1129	.0090	.00376	.00030	
1,625	100,000	.1210	.0112	.00403	.00037	
1,706	105,000	.1295	.0133	.00432	.00044	
1,788	110,000	.1390	.0163	.00463	.00054	
1,869	115,000	.1490	.0200	.00497	.00067	
1,950	120,000	.1595	.0240	.00532	.00080	
2,031	125,000	.1720	.0293	.00573	.00098	
2,113	130,000	.1850	.0361	.00617	.00120	
2,194	135,000	.2010	.0450	.00670	.00150	
2,275	140,000	.2205	.0566	.00735	.00189	
2,356	145,000	.2400	.0690	.00800	.00230	
2,438	150,000	.2630	.0850	.00877	.00283	
2,519	155,000	.2912	.1040	.00971	.00347	
2,600	160,000	.3220	.1270	.01073	.00423	
2,681	165,000	.3657	.1607	.01219	.00536	
2,762	170,000	.4200	.2033	.01400	.00678	
3,035	186,600	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.75 in. in 30 in. = 2.5 per cent.
Dimensions at fracture, 0.098 by 0.098 in. Sectional area, 0.0096 sq. in.
Contraction of area, 40.9 per cent.
Position of fracture, at gauge mark.
Appearance of fracture, fine silky.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 6. Reel 22. P. O. 8998. Diameter of coil in natural state, 21.5 in.

Marks, 6–A.

Dimensions, 0.1015 by 0.1021 in.

Sectional area, 0.01036 sq. in.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
52	5,020	0.	0.	0.	0.	
104	10,040	.0062	0.	.00021	0.	
156	15,060	.0112	0.	.00037	0.	
208	20,080	.0165	− .0004	.00055	− .00001	
260	25,100	.0215	− .0006	.00072	− .00002	
312	30,140	.0268	− .0003	.00089	− .00001	
364	35,140	.0330	− .0008	.00110	− .00003	
416	40,160	.0375	− .0008	.00125	− .00003	
468	45,180	.0430	− .0011	.00143	− .00004	
520	50,200	.0490	− .0004	.00163	− .00001	
571	55,120	.0538	− .0005	.00179	− .00002	
623	60,140	.0587	− .0005	.00199	− .00002	
675	65,160	.0658	.0002	.00219	.00001	
727	70,180	.0702	.0002	.00234	.00001	
779	75,200	.0755	0.	.00252	0.	
831	80,220	.0816	.0003	.00272	.00001	
883	85,240	.0877	.0018	.00292	.00006	
935	90,260	.0938	.0020	.00313	.00007	
987	95,280	.0995	.0029	.00332	.00010	
1,039	100,300	.1055	.0035	.00352	.00012	
1,091	105,300	.1120	.0042	.00373	.00014	
1,143	110,300	.1180	.0053	.00393	.00018	
1,195	115,300	.1238	.0057	.00413	.00019	
1,247	120,400	.1308	.0073	.00436	.00024	
1,299	125,400	.1380	.0087	.00460	.00029	
1,351	130,400	.1445	.0095	.00482	.00032	
1,403	135,400	.1510	.0105	.00503	.00035	
1,455	140,400	.1584	.0120	.00528	.00040	
1,507	145,500	.1642	.0123	.00547	.00041	
1,559	150,500	.1720	.0135	.00573	.00045	
1,610	155,400	.1792	.0150	.00597	.00050	
1,622	156,600	.1859	.0162	.00620	.00054	
1,714	165,500	.1941	.0180	.00647	.00060	
1,766	170,500	.2029	.0202	.00676	.00067	
1,818	175,500	.2100	.0230	.00700	.00077	
1,870	180,500	.2190	.0250	.00730	.00083	
1,922	185,500	.2270	.0285	.00757	.00095	
1,974	190,600	.2400	.0330	.00800	.00110	
2,026	195,600	.2493	.0369	.00831	.00123	
2,078	200,600	.2605	.0400	.00868	.00133	
2,130	205,600	.2722	.0440	.00907	.00147	
2,182	210,600	.2848	.0515	.00949	.00172	
2,234	215,700	.3010	.0600	.01003	.00200	
2,286	220,700	.3188	.0700	.01063	.00233	
2,338	225,700	.3405	.0840	.01135	.00280	
2,390	230,700	.3690	.1033	.01230	.00344	
2,523	243,500	.....	.....	.....	.....	Tensile strength.

Elongation after fracture: 0.05 in. in 30 in. = 0.17 per cent.

When the fracture occurred the recoil put several small kinks in the wire.

Dimensions at fracture: 0.099 by 0.099 in.

Sectional area: 0.0098 sq. in.

Contraction of area: 5.4 per cent.

Position of fracture: 3.50 in. inside gauge marks.

Appearance of fracture: Fine silky, serrated.

This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 6–B,—from same coil as 6–A.
Dimensions, 0.1016 by 0.1020 in.
Sectional area, 0.01036 sq. in.
Gauged length, 30 in.

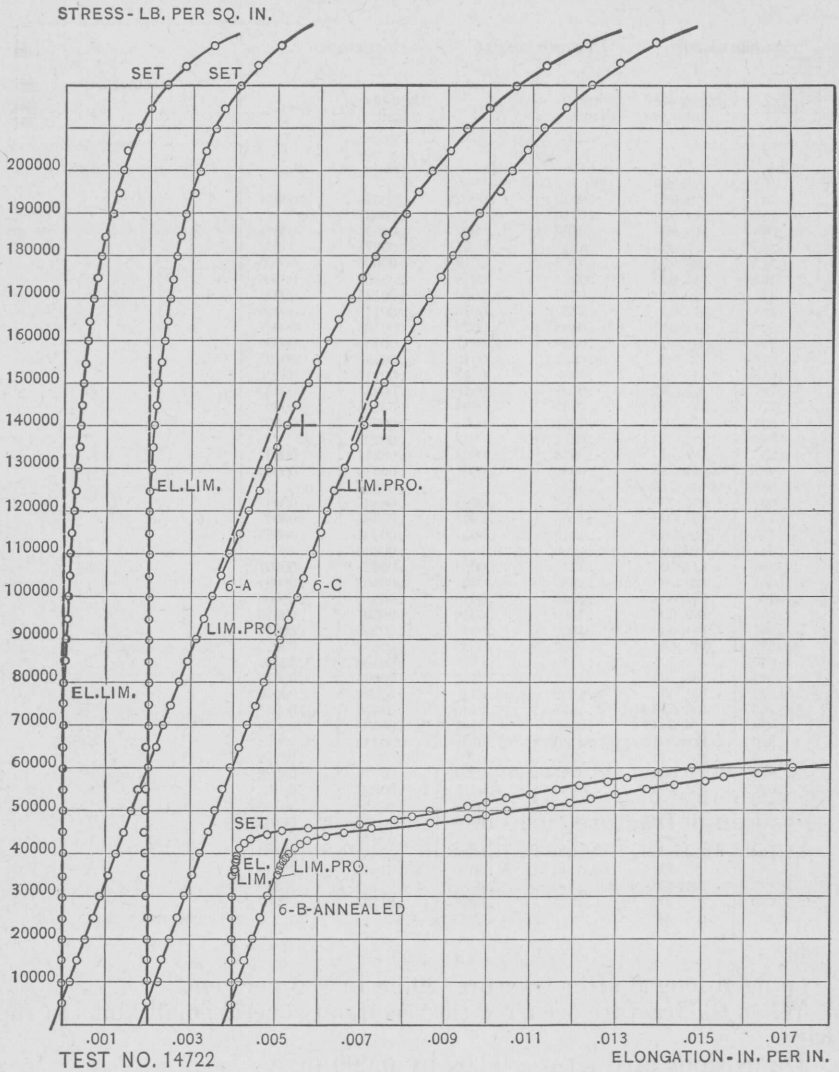
Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
52	5,020	0.	0.	0.	0.	
104	10,040	.0041	−.0001	.00014	−.000003	
156	15,060	.0091	−.0010	.00030	−.00003	
208	20,080	.0140	−.0010	.00047	−.00003	
260	25,100	.0200	−.0006	.00067	−.00002	
312	30,140	.0256	−.0001	.00085	−.000003	
364	35,140	.0322	.0005	.00107	.00002	
374	36,100	.0340	.0011	.00113	.00004	
384	37,070	.0351	.0011	.00117	.00004	
395	38,130	.0369	.0020	.00123	.00007	
405	39,100	.0387	.0025	.00129	.00008	
416	40,160	.0407	.0030	.00136	.00010	
426	41,120	.0433	.0048	.00144	.00016	
436	42,090	.0469	.0070	.00156	.00023	
447	43,150	.0510	.0100	.00170	.00033	
457	44,120	.0660	.0250	.00220	.00083	
468	45,180	.0790	.0350	.00263	.00117	
478	46,140	.0990	.0530	.00330	.00177	
488	47,110	.1400	.0910	.00467	.00303	
499	48,170	.1680	.1149	.00560	.00383	
509	49,130	.1790	.1270	.00597	.00423	
520	50,200	.1940	.1395	.00647	.00465	
530	51,130	.2250	.1670	.00750	.00557	
540	52,120	.2390	.1797	.00797	.00599	
551	53,190	.2530	.1922	.00843	.00641	
561	54,160	.2710	.2113	.00903	.00704	
571	55,120	.2920	.2288	.00973	.00763	
582	56,180	.3110	.2458	.01037	.00819	
592	57,140	.3328	.2645	.01109	.00882	
603	58,200	.3460	.2788	.01153	.00929	
613	59,170	.3710	.3015	.01237	.01005	
623	60,140	.3950	.3230	.01317	.01077	
951	91,800	----------	----------	----------	----------	Tensile strength.

Elongation after fracture, 1.85 in. in 30 in. = 6.2 per cent.
Dimensions at fracture, 0.088 by 0.090 in.
Sectional area, 0.00792 sq. in.
Contraction of area, 23.6 per cent.
Position of fracture, 0.30 in. inside gauge marks.
Appearance of fracture, silky.

From same coil as 6–A or sample No. 6.
Marks, 6–C.
Dimensions, 0.1019 by 0.1023 in.
Sectional area, 0.01042 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
52	4,990	0.	0.	0.	0.	
104	9,980	.0072	.0002	.00024	.00001	
156	14,970	.0110	0.	.00037	0.	
208	19,960	.0160	−.0002	.00053	−.00001	
260	24,950	.0215	−.0005	.00072	−.00002	
312	29,950	.0270	−.0018	.00090	−.00006	
364	34,930	.0322	−.0018	.00107	−.00006	
416	39,930	.0375	−.0020	.00125	−.00007	
468	44,920	.0430	−.0019	.00143	−.00006	
520	49,910	.0488	−.0020	.00163	−.00007	
571	54,800	.0540	−.0017	.00180	−.00006	
623	59,800	.0591	−.0010	.00197	−.00003	
675	64,780	.0650	−.0015	.00217	−.00005	
727	69,780	.0705	−.0010	.00235	−.00003	
779	74,760	.0763	−.0006	.00254	−.00002	
831	79,760	.0821	−.0004	.00274	−.00001	
883	84,740	.0879	0.	.00293	0.	
935	89,740	.0933	−.0003	.00311	−.00001	
987	94,730	.0989	.0001	.00330	.00003	
1,039	99,710	.1044	0.	.00348	0.	
1,091	104,700	.1100	.0001	.00367	.00003	
1,143	109,700	.1150	.0002	.00383	.00001	
1,195	114,700	.1210	.0001	.00403	.00003	
1,247	119,700	.1260	0.	.00420	0.	
1,299	124,700	.1315	−.0003	.00438	−.00001	
1,351	129,700	.1385	.0003	.00462	.00001	
1,403	134,600	.1455	.0019	.00485	.00006	
1,455	139,600	.1520	.0030	.00507	.00010	
1,507	144,600	.1590	.0043	.00530	.00014	
1,559	149,600	.1663	.0060	.00554	.00020	
1,610	154,500	.1740	.0079	.00580	.00026	
1,622	155,700	.1818	.0105	.00606	.00035	
1,714	164,500	.1890	.0120	.00630	.00040	
1,766	169,500	.1978	.0140	.00659	.00047	
1,818	174,500	.2060	.0161	.00687	.00054	
1,870	179,500	.2145	.0193	.00715	.00064	
1,922	184,500	.2240	.0220	.00747	.00073	
1,974	189,500	.2337	.0259	.00779	.00086	
2,026	194,400	.2480	.0325	.00827	.00108	
2,078	199,400	.2562	.0358	.00854	.00119	
2,130	204,400	.2680	.0400	.00893	.00133	
2,182	209,400	.2800	.0455	.00933	.00152	
2,234	214,400	.2950	.0530	.00983	.00177	
2,286	219,400	.3130	.0638	.01043	.00213	
2,338	224,400	.3320	.0755	.01107	.00252	
2,390	229,400	.3580	.0920	.01193	.00307	
2,452	235,300	.....	.....	.....	.....	Tensile strength.

Gauged length after fracture, 29.98 in. = 0 per cent.
When the fracture occurred the recoil put several small kinks in the wire.
Dimensions at fracture, 0.099 by 0.099 in.
Sectional area, 0.098 sq. in.
Contraction of area, 5.95 per cent.
Position of fracture, 3.95 in. inside gauge marks.
Appearance of fracture, fine silky, serrated.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT

Diameter of coil in natural state = 31.00 in.
Marks, 7–A.
Dimensions, 0.1038 by 0.1020 in.
Sectional area, 0.01058 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lbs.	*Lbs.*	*In.*	*In.*	*In.*	*In.*	
53	5,000	0.	0.	0.	0.	
106	10,000	.0053	.0015	.00018	.00005	
212	20,000	.0160	.0013	.00053	.00004	
318	30,000	.0260	.0002	.00087	.00001	
424	40,000	.0370	0.	.00123	0.	
530	50,000	.0480	0.	.00160	0.	
635	60,000	.0588	0.	.00196	0.	
741	70,000	.0708	.0002	.00236	.00001	
847	80,000	.0820	.0002	.00273	.00001	
953	90,000	.0940	.0011	.00313	.00004	
1,059	100,000	.1065	.0023	.00355	.00008	
1,112	105,000	.1125	.0031	.00375	.00010	
1,165	110,000	.1190	.0039	.00397	.00013	
1,218	115,000	.1253	.0045	.00418	.00015	
1,271	120,000	.1320	.0063	.00440	.00021	
1,324	125,000	.1385	.0065	.00462	.00022	
1,377	130,000	.1460	.0075	.00487	.00025	
1,430	135,000	.1528	.0085	.00509	.00028	
1,483	140,000	.1600	.0098	.00533	.00033	
1,536	145,000	.1673	.0110	.00558	.00037	
1,589	150,000	.1750	.0129	.00583	.00043	
1,641	155,000	.1828	.0140	.00609	.00047	
1,694	160,000	.1905	.0165	.00635	.00055	
1,747	165,000	.1990	.0185	.00663	.00062	
1,800	170,000	.2077	.0208	.00692	.00069	
1,906	180,000	.2268	.0277	.00756	.00092	
2,012	190,000	.2480	.0340	.00827	.00113	
2,118	200,000	.2700	.0442	.00900	.00147	
2,224	210,000	.3065	.0650	.01022	.00217	
2,445	231,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.21 in. in 30 in. = 0.7 per cent.
Dimensions at fracture, 0.079 by 0.079 in.
Sectional area: 0.00625 sq. in.
Contraction of area, 41 per cent.
Position of fracture, 9.40 in. inside gauge marks.
Appearance of fracture, fine silky, cup shaped.

This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in the furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 7–B,—from same coil as 7–A.
Dimensions, 0.1031 by 0.1021 in.
Sectional area, 0.010526 sq. in.
Gauged length, 30 in.

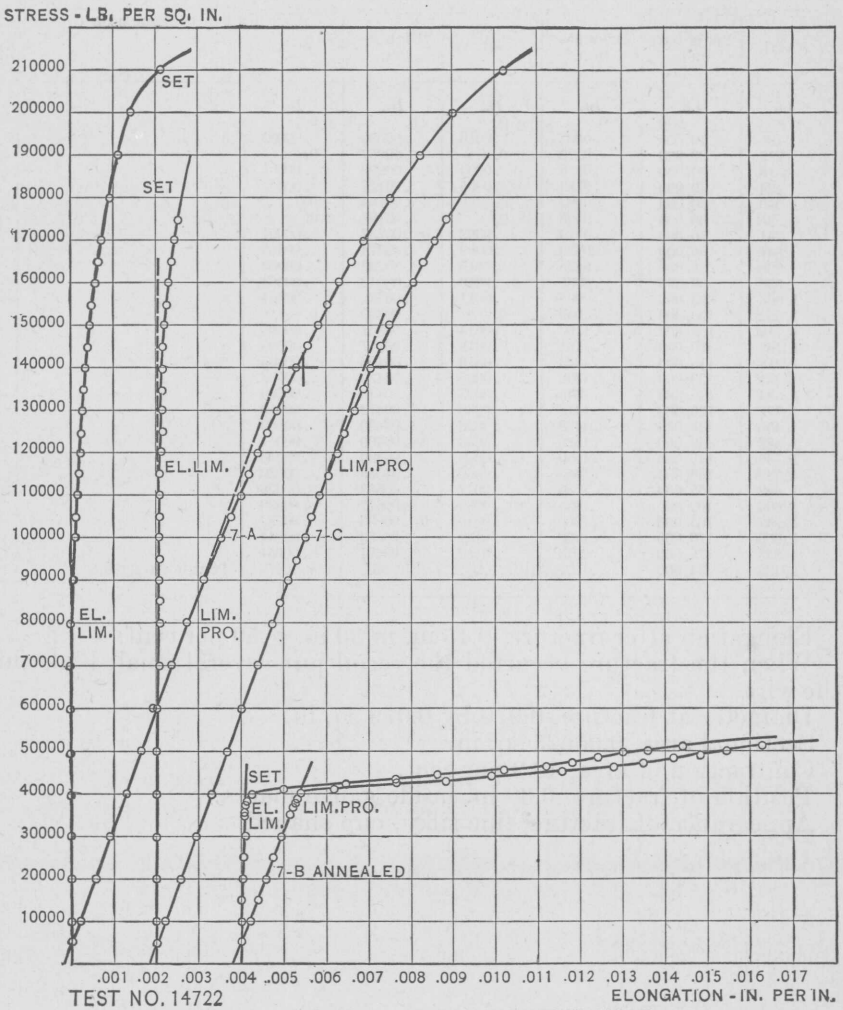
Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
53	5,036	0.	0.	0.	0.	
106	10,070	.0059	0.	.00020	0.	
159	15,110	.0110	−.0002	.00037	−.00001	
212	20,140	.0165	0.	.00055	0.	
265	25,180	.0220	0.	.00073	0.	
318	30,210	.0280	.0010	.00093	.00003	
371	35,250	.0342	.0022	.00114	.00007	
381	36,200	.0360	.0030	.00120	.00010	
392	37,240	.0380	.0031	.00127	.00010	
402	38,200	.0390	.0042	.00130	.00014	
413	39,240	.0412	.0056	.00137	.00019	
424	40,280	.0450	.0083	.00150	.00028	
434	41,230	.0660	.0304	.00220	.00101	
445	42,280	.1100	.0729	.00367	.00243	
455	43,230	.1450	.1100	.00483	.00367	
466	44,270	.1780	.1382	.00593	.00461	
477	45,320	.2280	.1865	.00760	.00622	
487	46,270	.2650	.2162	.00883	.00721	
498	47,320	.2860	.2350	.00953	.00783	
508	48,270	.3070	.2540	.01023	.00847	
519	49,310	.3260	.2710	.01087	.00903	
530	50,360	.3450	.2892	.01150	.00964	
540	51,300	.3700	.3140	.01230	.01047	
889	84,460	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.62 in. in 30 in. = 8.7 per cent.
Diameter at fracture, 0.085 by 0.085 in.
Sectional area, 0.00723 sq. in.
Contraction of area, 31.3 per cent.
Position of fracture, 1.65 in. inside gauge marks.
Appearance of fracture, dull silky.

Marks, 7–C,—from same coil as 7–A.
Dimensions, 0.1038 by 0.1021 in.
Sectional area, 0.0105979 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
53	5,000	0.	0.	0.	0.	
106	10,000	.0061	.0010	.00020	.00003	
212	20,000	.0170	0.	.00057	0.	
318	30,000	.0270	.0004	.00090	.00001	
424	40,000	.0382	.0005	.00127	.00002	
530	50,000	.0492	0.	.00164	0.	
635	60,000	.0595	0.	.00198	0.	
741	70,000	.0710	.0002	.00237	.00001	
847	80,000	.0820	.0009	.00273	.00003	
900	85,000	.0875	.0010	.00292	.00003	
953	90,000	.0935	.0010	.00312	.00003	
1,006	95,000	.0995	.0011	.00332	.00004	
1,059	100,000	.1050	0.	.00350	0.	
1,112	105,000	.1102	.0015	.00367	.00005	
1,165	110,000	.1161	.0018	.00387	.00006	
1,218	115,000	.1223	.0016	.00408	.00005	
1,271	120,000	.1290	.0025	.00430	.00008	
1,324	125,000	.1345	.0028	.00448	.00009	
1,377	130,000	.1415	.0030	.00472	.00010	
1,430	135,000	.1470	.0028	.00490	.00009	
1,483	140,000	.1528	.0033	.00509	.00011	
1,536	145,000	.1600	.0048	.00533	.00016	
1,589	150,000	.1665	.0060	.00555	.00020	
1,642	155,000	.1750	.0077	.00583	.00026	
1,694	160,000	.1835	.0089	.00612	.00030	
1,747	165,000	.1900	.0110	.00633	.00037	
1,800	170,000	.1990	.0132	.00663	.00044	
1,853	175,000	.2073	.0152	.00691	.00051	
2,484	234,600	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.15 in. in 30 in. = .50 per cent.
When the fracture occurred the recoil put several small kinks in the wire.
Diameter at fracture, 0.079 by 0.079 sq. in.
Sectional area, 0.00625 sq. in.
Contraction of area, 40.9 per cent.
Position of fracture, 0.30 in. inside gauge marks.
Appearance of fracture, fine silky, cup shaped.



TENSILE TESTS OF SQUARE STEEL WIRE FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 8. Reel 33. P. O. 8025. Diam. of coil in natural state, 43.50 in.
Marks, 8–A.
Dimensions, 0.1013 by 0.1013 in.
Sectional area, 0.01026 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
51	5,000	0.	0.	0.	0.	
103	10,000	.0059	0.	.00020	0.	
205	20,000	.0167	0.	.00056	0.	
308	30,000	.0285	0.	.00095	0.	
411	40,000	.0392	.0005	.00131	.00002	
514	50,000	.0508	.0010	.00169	.00003	
616	60,000	.0645	.0018	.00215	.00006	
719	70,000	.0750	.0027	.00250	.00009	
822	80,000	.0875	.0040	.00292	.00013	
873	85,000	.0950	.0052	.00317	.00017	
924	90,000	.1030	.0060	.00343	.00020	
976	95,000	.1112	.0085	.00371	.00028	
1,027	100,000	.1180	.0100	.00393	.00033	
1,078	105,000	.1273	.0121	.00424	.00040	
1,130	110,000	.1350	.0150	.00450	.00050	
1,181	115,000	.1445	.0180	.00482	.00060	
1,232	120,000	.1537	.0210	.00512	.00070	
1,284	125,000	.1647	.0251	.00549	.00084	
1,335	130,000	.1748	.0292	.00583	.00097	
1,386	135,000	.1880	.0365	.00627	.00122	
1,438	140,000	.2032	.0440	.00677	.00147	
1,489	145,000	.2180	.0525	.00727	.00175	
1,541	150,000	.2342	.0605	.00781	.00202	
1,592	155,000	.2542	.0722	.00847	.00241	
1,643	160,000	.2730	.0870	.00910	.00290	
1,695	165,000	.2960	.1050	.00987	.00350	
1,746	170,000	.3300	.1300	.01100	.00433	
1,797	175,000	.3670	.1580	.01223	.00527	
1,991	194,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.61 in. in 30 in. = 2 per cent.
Dimensions at fracture, 0.075 by 0.075 in.
Sectional area, 0.00563 sq. in.
Contraction of area, 45.1 per cent.
Position of fracture, 13.35 in. inside gauge marks.
Appearance of fracture, fine silky, cup shaped.

From same coil as 8–A, or sample No. 8. This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in furnace for about nine hours, annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 8–B.

Dimensions, 0.1015 by 0.1014 in.

Sectional area, 0.01029 sq. in.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
51	5,000	0.	0.	0.	0.	
103	10,000	.0062	0.	.00021	0.	
205	20,000	.0181	0.	.00060	0.	
308	30,000	.0306	.0032	.00102	.00011	
359	35,000	.0410	.0091	.00137	.00030	
370	36,000	.0490	.0165	.00163	.00055	
380	37,000	.0650	.0318	.00217	.00106	
390	38,000	.0870	.0509	.00290	.00170	
401	39,000	.1070	.0730	.00357	.00243	
411	40,000	.1300	.0973	.00433	.00324	
421	41,000	.1910	.1540	.00637	.00513	
431	42,000	.2450	.2022	.00817	.00674	
442	43,000	.2940	.2530	.00980	.00843	
452	44,000	.3270	.2810	.01090	.00937	
462	45,000	.3550	.3070	.01183	.01023	
472	46,000	.3760	.3245	.01253	.01082	
483	47,000	.4100	.3655	.01367	.01218	
797	77,400	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 3.09 in. in 30 in. = 10.3 per cent.

Dimensions at fracture, 0.084 by 0.084 in.

Sectional area, 0.00706 sq. in.

Contraction of area, 31.4 per cent.

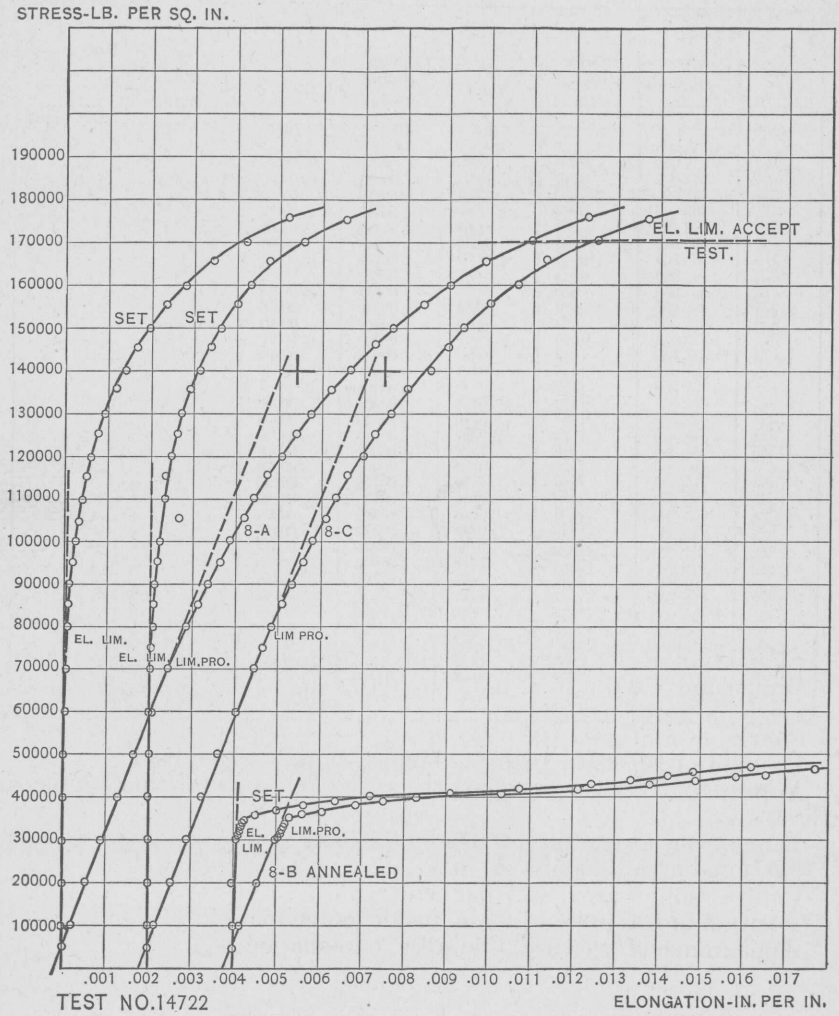
Position of fracture, 1.10 in. inside gauge marks.

Appearance of fracture, dull silky.

Marks, 8–C,—from same coil as 8–A.
Dimensions, 0.1013 by 0.1014 in.
Sectional area, 0.01027 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
51	5,000	0.	0.	0.	0.	
103	10,000	.0060	.0003	.00020	.00001	
205	20,000	.0170	.0002	.00057	.00001	
308	30,000	.0282	.0001	.00094	0.	
411	40,000	.0392	.0009	.00131	.00003	
514	50,000	.0510	.0009	.00170	.00003	
616	60,000	.0630	.0018	.00210	.00006	
719	70,000	.0759	.0025	.00253	.00008	
822	80,000	.0882	.0040	.00294	.00013	
873	85,000	.0950	.0050	.00317	.00017	
924	90,000	.1020	.0061	.00340	.00020	
976	95,000	.1092	.0073	.00364	.00024	
1,027	100,000	.1165	.0089	.00388	.00030	
1,078	105,000	.1242	(?)	.00414	(?)	
1,130	110,000	.1323	.0125	.00441	.00042	
1,181	115,000	.1400	.0140	.00467	.00047	
1,232	120,000	.1510	.0178	.00503	.00059	
1,284	125,000	.1595	.0210	.00532	.00070	
1,335	130,000	.1720	.0250	.00573	.00083	
1,386	135,000	.1825	.0300	.00608	.00100	
1,438	140,000	.1980	.0378	.00660	.00126	
1,489	145,000	.2105	.0440	.00702	.00147	
1,541	150,000	.2250	.0515	.00750	.00172	
1,592	155,000	.2400	.0620	.00800	.00207	
1,643	160,000	.2620	.0735	.00873	.00245	
1,695	165,000	.2800	.0860	.00933	.00287	
1,746	170,000	.3150	.1119	.01050	.00373	
1,797	175,000	.3500	.1391	.01167	.00464	
1,998	194,500	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.70 in. in 30 in. = 2.3 per cent.
Dimensions at fracture, 0.073 by 0.073 in.
Sectional area, 0.00533 sq. in.
Contraction of area, 48.1 per cent.
Position of fracture, 13.40 in. inside gauge marks.
Appearance of fracture, fine silky.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 9. Reel 38. P. O. 8998. Diameter of coil in natural state, 19-in.

Marks, 9–A.

Dimensions, 0.1000 by 0.1000 in.

Sectional area, 0.01000 sq. in.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
50	5,000	0.	0.	0.	0.	
100	10,000	.0060	0.	.00020	0.	
200	20,000	.0168	−.0005	.00056	−.00002	
300	30,000	.0270	0.	.00090	0.	
400	40,000	.0372	−.0004	.00124	−.00001	
500	50,000	.0480	.0003	.00160	.00001	
600	60,000	.0590	0.	.00197	0.	
700	70,000	.0700	0.	.00233	0.	
800	80,000	.0800	0.	.00267	0.	
850	85,000	.0858	.0005	.00286	.00002	
900	90,000	.0910	−.0002	.00303	−.00001	
950	95,000	.0970	0.	.00323	0.	
1,000	100,000	.1020	.0005	.00340	.00002	
1,050	105,000	.1070	0.	.00357	0.	
1,100	110,000	.1125	0.	.00375	0.	
1,150	115,000	.1182	.0007	.00394	.00002	
1,200	120,000	.1252	.0010	.00417	.00003	
1,250	125,000	.1318	.0025	.00439	.00008	
1,300	130,000	.1390	.0031	.00463	.00010	
1,350	135,000	.1452	.0042	.00484	.00014	
1,400	140,000	.1528	.0060	.00509	.00020	
1,450	145,000	.1605	.0075	.00535	.00025	
1,500	150,000	.1670	.0095	.00557	.00032	
1,550	155,000	.1745	.0110	.00582	.00037	
1,600	160,000	.1830	.0130	.00610	.00043	
1,650	165,000	.1908	.0150	.00636	.00050	
1,700	170,000	.2010	.0181	.00670	.00060	
1,750	175,000	.2087	.0203	.00696	.00068	
1,800	180,000	.2175	.0240	.00725	.00080	
1,900	190,000	.2380	.0310	.00793	.00103	
2,000	200,000	.2650	.0440	.00883	.00147	
2,100	210,000	.2970	.0642	.00990	.00214	
2,200	220,000	.3540	.1030	.01180	.00310	
2,374	237,400	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.25 in. in 30 in. = .8 per cent.

When the fracture occurred the recoil put several small kinks in the wire.

Dimensions at fracture, 0.075 by 0.075 in

Sectional area, 0.00563 sq. in.

Contraction of area, 43.7 per cent.

Position of fracture, 11.65 in. inside gauge mark.

Appearance of fracture, fine silky, cup-shaped.

This sample was annealed at 1,500° F. for one hour and allowed to cool slowly in furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 9–B,—from same coil as 9–A.

Dimensions, 0.1020 by 0.1030 in.

Sectional area, 0.01050 sq. in.

Sectional area used, 0.01000 sq. in., this being the sectional area of the unannealed wire from the same coil.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
50	5,000	0.	0.	0.	0.	
100	10,000	.0062	.0003	.00021	.00001	
150	15,000	.0110	.0003	.00037	.00001	
200	20,000	.0172	.0003	.00057	.00001	
250	25,000	.0220	.0009	.00073	.00003	
300	30,000	.0285	.0015	.00095	.00005	
310	31,000	.0300	.0025	.00100	.00008	
320	32,000	.0310	.0027	.00103	.00009	
330	33,000	.0326	.0032	.00109	.00011	
340	34,000	.0337	.0025	.00112	.00008	
350	35,000	.0350	.0038	.00117	.00013	
360	36,000	.0370	.0040	.00123	.00013	
370	37,000	.0380	.0049	.00127	.00016	
380	38,000	.0400	.0052	.00133	.00017	
390	39,000	.0418	.0063	.00139	.00021	
400	40,000	.0440	.0075	.00147	.00025	
410	41,000	.0470	.0095	.00157	.00032	
420	42,000	.0500	.0128	.00167	.00043	
430	43,000	.0610	.0215	.00203	.00072	
440	44,000	.0730	.0342	.00243	.00114	
450	45,000	.0865	.0445	.00288	.00148	
460	46,000	.1180	.0772	.00393	.00257	
470	47,000	.1570	.1140	.00523	.00380	
480	48,000	.1800	.1350	.00600	.00450	
490	49,000	.2380	.1890	.00793	.00630	
500	50,000	.2640	.2122	.00880	.00707	
510	51,000	.2780	.2245	.00927	.00748	
520	52,000	.3010	.2462	.01003	.00821	
530	53,000	.3170	.2612	.01057	.00871	
540	54,000	.3420	.2842	.01140	.00947	
550	55,000	.3690	.3087	.01230	.01029	
560	56,000	.3940	.3310	.01313	.01103	
903	90,300	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.20 in. in 30 in. = 7.3 per cent.

When the fracture occurred the recoil put several small kinks in the wire.

Dimensions at fracture, 0.082 by 0.082 in.

Sectional area, 0.00673 sq. in.

Contraction of area, 35.9 per cent.

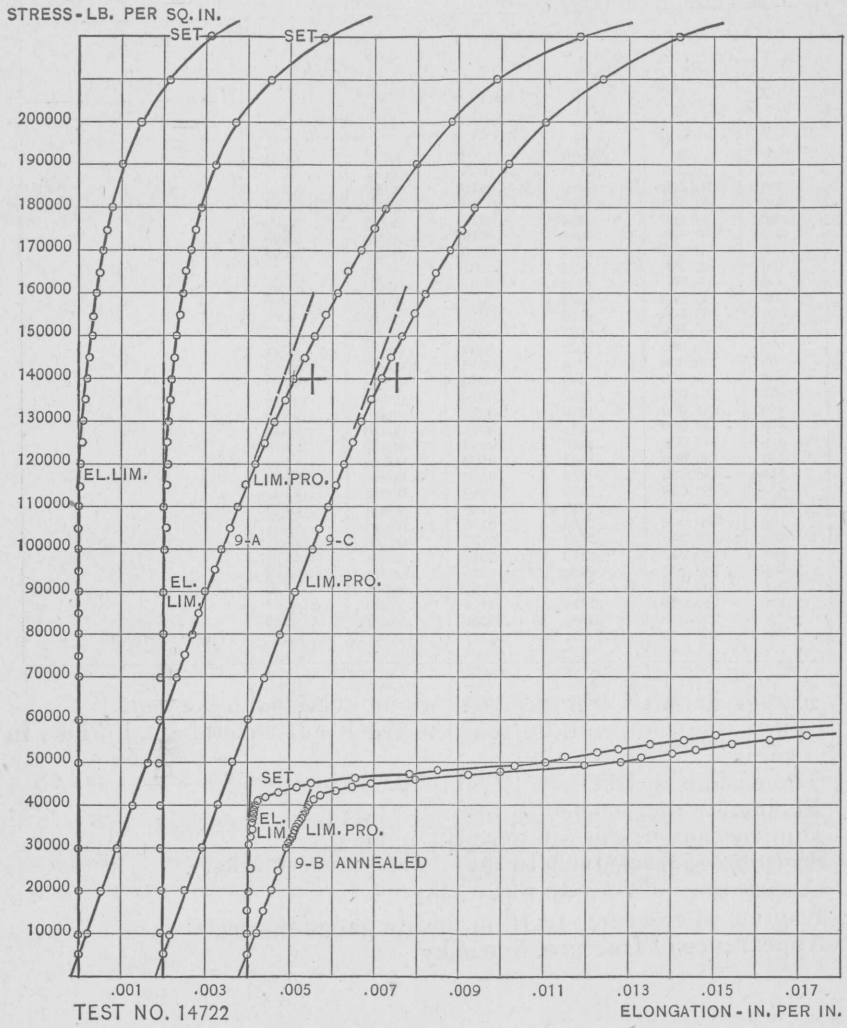
Position of fracture, 0.50 in. outside gauge marks.

Appearance of fracture, dull, silky.

From same coil as 9–A, or sample No. 9.
Marks, 9–C.
Dimensions, 0.1000 by 0.1000 in.
Sectional area, 0.01000 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
50	5,000	0.	0.	0.	0.	
100	10,000	.0050	−.0010	.00017	−.00003	
200	20,000	.0155	−.0008	.00052	−.00003	
300	30,000	.0279	−.0010	.00093	−.00003	
400	40,000	.0380	−.0010	.00127	−.00003	
500	50,000	.0493	−.0017	.00164	−.00006	
600	60,000	.0600	−.0010	.00200	−.00003	
700	70,000	.0710	−.0015	.00237	−.00005	
800	80,000	.0822	.0001	.00274	0.	
900	90,000	.0930	.0007	.00310	.00002	
1,000	100,000	.1050	.0017	.00350	.00006	
1,050	105,000	.1110	.0022	.00370	.00007	
1,100	110,000	.1170	.0020	.00390	.00007	
1,150	115,000	.1220	.0020	.00407	.00007	
1,200	120,000	.1280	.0030	.00427	.00010	
1,250	125,000	.1348	.0026	.00449	.00009	
1,300	130,000	.1405	.0040	.00468	.00013	
1,350	135,000	.1469	.0050	.00490	.00017	
1,400	140,000	.1545	.0061	.00515	.00020	
1,450	145,000	.1610	.0084	.00537	.00028	
1,500	150,000	.1695	.0100	.00565	.00033	
1,550	155,000	.1773	.0120	.00591	.00040	
1,600	160,000	.1855	.0140	.00618	.00047	
1,650	165,000	.1930	.0160	.00643	.00053	
1,700	170,000	.2035	.0200	.00678	.00067	
1,750	175,000	.2112	.0225	.00704	.00075	
1,800	180,000	.2210	.0270	.00737	.00090	
1,900	190,000	.2438	.0365	.00813	.00122	
2,000	200,000	.2720	.0510	.00907	.00170	
2,100	210,000	.3120	.0760	.01040	.00253	
2,200	220,000	.3650	.1140	.01217	.00380	
2,358	235,800	----------	----------	----------	----------	Tensile strength.

Elongation after fracture, 0.15 in. in 30 in. = 0.5 per cent.
When the fracture occurred, the recoil put several small kinks in the wire.
Dimensions at fracture, 0.080 by 0.080 in.
Sectional area, 0.00640 sq. in.
Contraction of area, 36 per cent.
Position of fracture, 1.10 in. outside gauge marks.
Appearance of fracture, fine silky.



TENSILE TESTS OF SQUARE STEEL WIRE FOR WINDING GUNS.
DETERMINATION OF ELASTIC LIMIT.

Sample No. 10, Reel 42. P. O. 8998. Diameter of coil in natural state, 17–in.
Marks, 10–A.
Dimensions, 0.1030 by 0.1030 in.
Sectional area, 0.01061 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
53	5,000	0.	0.	0.	0.	
106	10,000	.0068	.0008	.00023	.00003	
212	20,000	.0180	0.	.00060	0.	
318	30,000	.0285	.0003	.00095	.00001	
424	40,000	.0400	.0005	.00133	.00002	
531	50,000	.0500	.0003	.00167	.00001	
637	60,000	.0610	.0010	.00203	.00003	
743	70,000	.0722	.0010	.00241	.00003	
849	80,000	.0841	.0015	.00280	.00005	
902	85,000	.0892	.....	.00297	.....	
955	90,000	.0948	.0019	.00316	.00006	
1,008	95,000	.1000	.0014	.00333	.00005	
1,061	100,000	.1053	.0015	.00351	.00005	
1,114	105,000	.1110	.0020	.00370	.00007	
1,167	110,000	.1162	.0020	.00387	.00007	
1,220	115,000	.1230	.0025	.00410	.00008	
1,273	120,000	.1291	.0035	.00430	.00012	
1,326	125,000	.1355	.0050	.00452	.00017	
1,379	130,000	.1437	.0060	.00479	.00020	
1,432	135,000	.1490	.0067	.00497	.00026	
1,485	140,000	.1568	.0080	.00523	.00027	
1,538	145,000	.1638	.0102	.00546	.00034	
1,592	150,000	.1710	.0120	.00570	.00040	
1,645	155,000	.1772	.0125	.00591	.00042	
1,698	160,000	.1849	.0149	.00616	.00050	
1,751	165,000	.1943	.0170	.00648	.00057	
1,804	170,000	.2020	.0190	.00673	.00063	
1,857	175,000	.2100	.0215	.00700	.00072	
1,910	180,000	.2190	.0240	.00730	.00080	
1,963	185,000	.2270	.0273	.00757	.00091	
2,016	190,000	.2360	.0300	.00787	.00100	
2,069	195,000	.2470	.0342	.00823	.00114	
2,122	200,000	.2580	.0388	.00860	.00129	
2,228	210,000	.2830	.0500	.00943	.00167	
2,334	220,000	.3190	.0710	.01063	.00237	
2,440	230,000	.3580	.0980	.01193	.00327	
2,623	247,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.29 in. in 30 in. = 1 per cent.
Dimensions at fracture, 0.082 by 0.082 in.
Sectional area, 0.00673 sq. in.
Contraction of area, 36.5 per cent.
Position of fracture, 12.10 in. inside gauge marks.
Appearance of fracture, fine silky.

This sample was annealed at 1,500° F. for one hour, and allowed to cool slowly in furnace for about nine hours; annealed the second time at 1,500° F. for three hours and allowed to cool in furnace for about nine hours.

Marks, 10–B, from same coil as 10–A.

Dimensions, 0.1040 by 0.1040 in.

Sectional area, 0.01081 sq. in.

Sectional area used, 0.01061, this being the sectional area of the unannealed wire from the same coil.

Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
53	5,000	0.	0.	0.	0.	
106	10,000	.0060	.0005	.00020	.00002	
159	15,000	.0120	0.	.00040	0.	
212	20,000	.0170	0.	.00057	0.	
265	25,000	.0225	.0005	.00075	.00002	
318	30,000	.0275	.0009	.00092	.00003	
371	35,000	.0332	.0017	.00111	.00006	
382	36,000	.0341	.0020	.00114	.00007	
393	37,000	.0360	.0024	.00120	.00008	
403	38,000	.0370	.0032	.00123	.00011	
414	39,000	.0385	.0035	.00128	.00012	
424	40,000	.0400	.0041	.00133	.00014	
435	41,000	.0450	.0068	.00150	.00023	
446	42,000	.0470	.0088	.00157	.00029	
456	43,000	.0518	.0139	.00173	.00046	
467	44,000	.0820	.0430	.00273	.00143	
477	45,000	.1150	.0740	.00383	.00247	
488	46,000	.1620	.1210	.00540	.00403	
499	47,000	.2200	.1740	.00733	.00580	
509	48,000	.2470	.1960	.00823	.00653	
520	49,000	.2650	.2119	.00883	.00706	
531	50,000	.2810	.2275	.00937	.00758	
541	51,000	.3050	.2481	.01017	.00827	
552	52,000	.3290	.2710	.01097	.00903	
562	53,000	.3520	.2915	.01173	.00972	
573	54,000	.3772	.3133	.01257	.01044	
584	55,000	.3970	.3340	.01323	.01113	
941	87,000	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 2.50 in. in 30 in. = 8.4 per cent.

When the fracture occurred the recoil put several small kinks in the wire.

Dimensions at fracture, 0.089 by 0.089 in.

Sectional area, 0.00792 sq. in.

Contraction of area, 26.8 per cent.

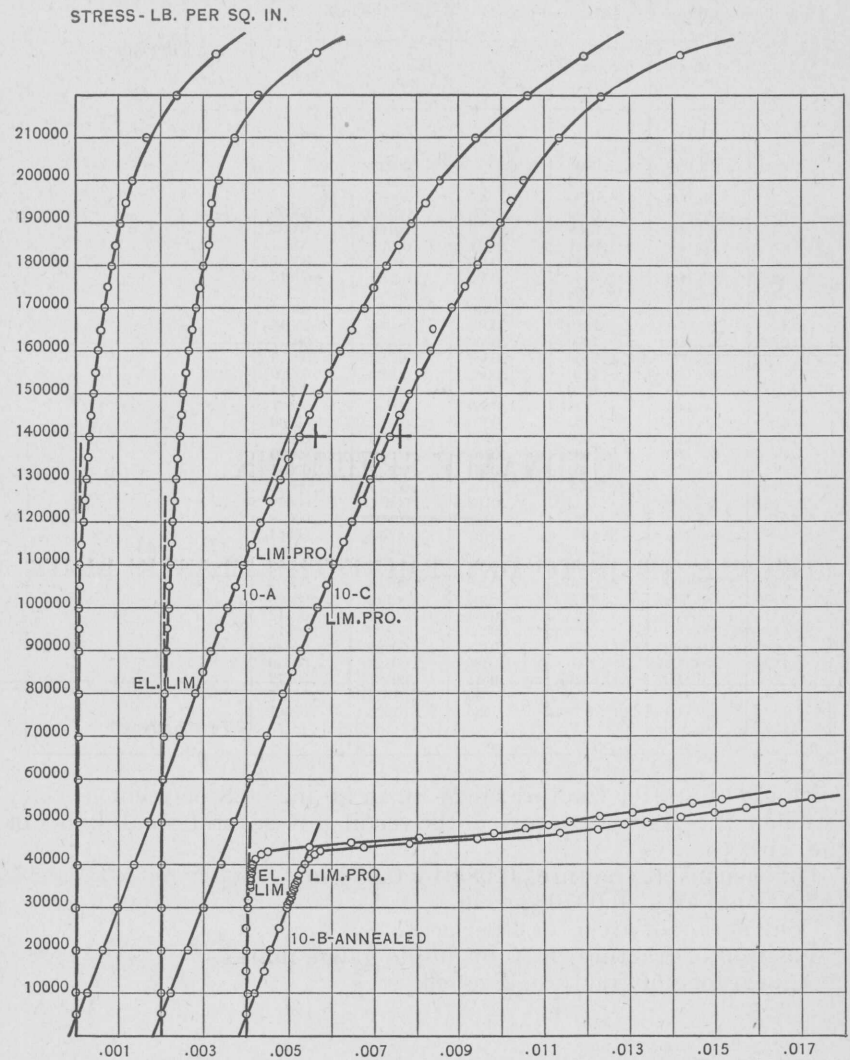
Position of fracture, 7.80 in. inside gauge marks.

Appearance of fracture, silky.

Marks, 10–C, from same coil as 10–A.
Dimensions, 0.1030 by 0.1030 in.
Sectional area, 0.01061 sq. in.
Gauged length, 30 in.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
53	5,000	0.	0.	0.	0.	
106	10,000	.0060	0.	.00020	0.	
212	20,000	.0170	0.	.00057	0.	
318	30,000	.0290	0.	.00097	0.	
424	40,000	.0399	.0003	.00133	.00001	
531	50,000	.0508	.0010	.00169	.00003	
637	60,000	.0611	.0011	.00204	.00004	
743	70,000	.0739	.0020	.00246	.00007	
849	80,000	.0848	.0030	.00283	.00010	
902	85,000	.0908	.....	.00303	.....	
955	90,000	.0965	.0040	.00322	.00013	
1,008	95,000	.1020	.0048	.00340	.00016	
1,061	100,000	.1090	.0050	.00363	.00017	
1,114	105,000	.1150	.0054	.00383	.00018	
1,167	110,000	.1210	.0061	.00403	.00020	
1,220	115,000	.1270	.0071	.00423	.00024	
1,273	120,000	.1338	.0080	.00446	.00027	
1,326	125,000	.1400	.0090	.00467	.00030	
1,379	130,000	.1470	.0100	.00490	.00033	
1,432	135,000	.1532	.0107	.00511	.00036	
1,485	140,000	.1603	.0124	.00531	.00041	
1,538	145,000	.1678	.0138	.00559	.00046	
1,592	150,000	.1743	.0150	.00581	.00050	
1,645	155,000	.1822	.0175	.00607	.00058	
1,698	160,000	.1905	.0191	.00635	.00064	
1,751	165,000	.1907	.0225	.00636	.00075	
1,804	170,000	.2060	.0245	.00687	.00082	
1,857	175,000	.2140	.0270	.00713	.00090	
1,910	180,000	.2225	.0300	.00742	.00100	
1,963	185,000	.2323	.0335	.00774	.00112	
2,016	190,000	.2405	.0352	.00802	.00117	
2,069	195,000	.2475	.0358	.00825	.00119	
2,122	200,000	.2560	.0390	.00853	.00130	
2,228	210,000	.2810	.0515	.00937	.00172	
2,334	220,000	.3100	.0680	.01033	.00227	
2,440	230,000	.3670	.1083	.01223	.00361	
2,637	248,100	.....	.....	.....	.....	Tensile strength.

Elongation after fracture, 0.24 in. in 30 in. = 0.8 per cent.
When the fracture occurred the recoil put several small kinks in the wire.
Dimensions at fracture, 0.084 by 0.084 in.
Sectional area, 0.00706 sq. in.
Contraction of area, 33.4 per cent.
Position of fracture, 0.70 in. inside gauge marks.
Appearance of fracture, fine silky.



TENSILE TESTS OF SQUARE STEEL WIRE
FOR WINDING GUNS
DETERMINATION OF ELASTIC LIMIT

ORDNANCE SPECIMENS.

TENSILE TESTS TO DETERMINE THE ELASTIC LIMIT.

TEST 14886.

TENSILE TESTS TO DETERMINE THE ELASTIC LIMIT.

CAST STEEL NO. 1. HEAT NO. 3372 AND 3373. ARSENAL STEEL.

Marks, 9119.
Diameter, 0.503 in.
Sectional area, 0.1987 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
199	1,000	0.	0.	
993	5,000	.00028	.00014	
1,987	10,000	.00066	.00033	
2,980	15,000	.00100	.00050	
3,973	20,000	.00135	.00068	
4,965	25,000	.00172	.00086	
5,960	30,000	.00209	.00105	Limit of proportionality.
6,950	35,000	.00284	.00142	
7,150	36,000	.00307	.00154	
7,350	37,000	.00332	.00166	
7,550	38,000	.00374	.00187	Yield point.
		.00424	.00212	
7,750	39,000	.00556	.00278	
7,940	40,000	.01577	.00789	

Extensometer reset to zero.

199	1,000	0.	0.	
993	5,000	.00025	.00013	
1,987	10,000	.00061	.00030	
2,980	15,000	.00098	.00049	
3,973	20,000	.00137	.00069	Limit of proportionality.
4,965	25,000	.00181	.00091	
5,960	30,000	.00227	.00113	
6,950	35,000	.00267	.00133	
7,150	36,000	.00281	.00140	
7,350	37,000	.00294	.00147	
7,550	38,000	.00310	.00155	
7,750	39,000	.00331	.00165	
7,940	40,000	.00365	.00183	Yield point.
8,140	41,000	.00581	.00291	
8,340	42,000	.00789	.00394	
8,540	43,000	.00946	.00473	
8,740	44,000	.01246	.00623	
8,940	45,000	.01470	.00735	
15,400	77,000	.....	.....	Tensile strength.

Elongation after fracture: 0.44 in. in 2 in. = 22 per cent.
Elongation of inch sections: 0.25* 0.19 in.
Diameter at fracture: 0.43 in. Contraction of area: 27.4 per cent.
Position of fracture: 1.20 in. from the neck.
Appearance of fracture: Amorphous, trace of granulation.

TEST 14887.

CAST STEEL NO. 2. HEAT NO. 3374. ARSENAL STEEL.

Marks, 9121.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. gauge length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00024	.00013	
2,000	10,000	.00058	.00029	
3,000	15,000	.00094	.00047	
4,000	20,000	.00130	.00065	
5,000	25,000	.00165	.00083	
6,000	30,000	.00202	.00101	Limit of proportionality.
7,000	35,000	.00247	.00123	
7,200	36,000	.00257	.00128	
7,400	37,000	.00265	.00133	
7,600	38,000	.00272	.00136	
7,800	39,000	.00282	.00141	
8,000	40,000	.00298	.00149	
8,200	41,000	.00306	.00153	
8,400	42,000	.00320	.00160	
8,600	43,000	.00331	.00166	
8,800	44,000	.00347	.00174	
9,000	45,000	.00365	.00182	
9,200	46,000	.00379	.00189	
9,400	47,000	.00404	.00202	
9,600	48,000	.00432	.00216	Yield point.
9,700	48,500	.00565	.00282	
9,800	49,000	.00980	.00490	
200	1,000	.00967	.00484	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00027	.00014	
2,000	10,000	.00063	.00032	
3,000	15,000	.00101	.00051	
4,000	20,000	.00141	.00071	Limit of proportionality.
5,000	25,000	.00180	.00090	
6,000	30,000	.00224	.00112	
7,000	35,000	.00267	.00134	
7,200	36,000	.00276	.00138	
7,400	37,000	.00285	.00143	
7,600	38,000	.00293	.00147	
7,800	39,000	.00304	.00152	
8,000	40,000	.00317	.00159	
8,200	41,000	.00321	.00160	
8,400	42,000	.00332	.00166	
8,600	43,000	.00342	.00171	
8,800	44,000	.00351	.00175	
9,000	45,000	.00363	.00182	
9,200	46,000	.00374	.00187	
9,400	47,000	.00387	.00194	
9,600	48,000	.00405	.00203	
9,800	49,000	.00439	.00220	
10,000	50,000	.00490	.00245	Yield point.
10,200	51,000	.00681	.00341	
10,400	52,000	.00872	.00436	
10,600	53,000	.01105	.00553	
10,800	54,000	.01304	.00652	
10,900	54,500	.01478	.00739	
15,300	76,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.06* 0.06 in.
Diameter at fracture, 0.49 in.
Position of fracture, 0.30 in. from the neck.
Appearance of fracture, amorphous 80 per cent, fine granular 20 per cent.

SUMMARY.

Limit of proportionality	30,000 lb. per sq. in.
Yield point	48,000 lb. per sq. in.
Tensile strength	76,500 lb. per sq. in.
Modulus of elasticity	29,000,000 lb. per sq. in.
Elongation in 2 in	6.0 per cent.
Contraction of area	5.7 per cent.
After stressing to 49,000 lb. per sq. in.:	
Limit of proportionality	20,000 lb. per sq. in.
Yield point	50,000 lb. per sq. in.
Modulus of elasticity	27,600,000 lb. per sq. in.

TEST 14890.

CAST STEEL NO. 2 AND 3. HEAT NO. 3350. ARSENAL STEEL.

Marks, 8754.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Berry's extensometer used, K2.
Edelmann's thermo-electric apparatus for determining elastic limit used.

Applied loads.		Elongations.		Galvanometer—Deflections.	Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.		
Lb.	*Lb.*	*In.*	*In.*	*Mm.*	
200	1,000	0.	0.	0	When readings were started the galvanometer was swinging very slowly in the cooling or negative direction.
1,000	5,000	.0002	.00010	− 1	
2,000	10,000	.0006	.00030	− 2	
3,000	15,000	.0009	.00045	− 4	
4,000	20,000	.0013	.00065	− 5	
5,000	25,000	.0016	.00080	− 5	
6,000	30,000	.0020	.00100	− 6	
7,000	35,000	.0024	.00120	− 7	
7,200	36,000	.0025	.00125	− 8	Limit of proportionality.
7,400	37,000	.0026	.00130	− 8	
7,600	38,000	.0026	.00130	− 8	
7,800	39,000	.0027	.00135	− 9	
8,000	40,000	.0028	.00140	− 9	
8,200	41,000	.0030	.00150	−10	
8,400	42,000	.0030	.00150	−10	
8,600	43,000	.0031	.00155	−11	
8,800	44,000	.0033	.00165	−11	
9,000	45,000	.0036	.00180	−11	Yield point, elastic limit by galvanometer.
9,200	46,000	.0174	.00870	− 8	
9,400	47,000	.0187	.00935	− 8	
9,600	48,000	.0200	.01000	− 8	
9,800	49,000	.0220	.01100	− 9	
10,000	50,000	.0240	.01200	− 9	
11,000	55,000	.0330	.01650	− 8	
12,000	60,000	.0460	.02300	− 5	
13,000	65,000	.....	.....	− 2	
14,000	70,000	.....	.....	+ 3, +6	
17,000	85,000	.....	.....	.....	Tensile strength.

Elongations of inch sections, 0.20*, 0.25* in.
Diameter at fracture, 0.44 in.
Position of fracture, 1.30 in. from the neck.
Appearance of fracture, amorphous 85 per cent, granular 15 per cent.

SUMMARY.

Limit of proportionality	36,000-lb. per sq. in.
Elastic limit by galvanometer	45,000-lb. per sq. in.
Yield point	45,000-lb. per sq. in.
Tensile strength	85,000-lb. per sq. in.
Elongation	22.5 per cent.
Contraction of area	24.0 per cent.

TEST 14891.

CAST STEEL NO. 2 AND 3. HEAT NO. 3369. ARSENAL STEEL.

Marks, 9085.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Berry extensometer used, K2.
Edelmann's thermo-electric apparatus for determining elastic limit used.

Applied loads.		Elongations.		Galvanometer readings.	Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.		
Lb.	*Lb.*	*In.*	*In.*	*Mm.*	
200	1,000	0.	0.	0	When readings were started the galvanometer was swinging slowly in a heating or positive direction.
1,000	5,000	.0002	.00010	1	
2,000	10,000	.0004	.00020	1	
3,000	15,000	.0008	.00040	2	
4,000	20,000	.0012	.00060	3	
5,000	25,000	.0016	.00080	3	
6,000	**30,000	.0020	.00100	2	Limit of proportionality.
7,000	35,000	.0036	.00180	3	Yield point.
7,200	36,000	.0064	.00320	4	
7,400	37,000	.0096	.00480	5	
7,600	38,000	.0133	.00665	5	
7,800	39,000	.0156	.00780	5	
8,000	40,000	.0174	.00870	5	
8,200	41,000	.0195	.00975	5	
8,400	42,000	.0213	.01065	5	
8,600	43,000	.0236	.01180	5	
8,800	44,000	.0258	.01290	5	
9,000	45,000	.0280	.01400	6	
9,200	46,000	.0316	.01580	6	
9,400	47,000	.0330	.01650	6	
9,600	48,000	.0354	.01770	6	
9,800	49,000	.0374	.01870	6	
10,000	50,000	.0410	.02050	6	
11,000	55,000	.....	.....	5	
12,000	60,000	.....	.....	9	
13,000	65,000	.....	.....	17	
14,000	70,000	.....	.....	25	
15,400	77,000	.....	.....	.....	Tensile strength.

Elongation of inch sections: 0.29*, 0.16 in.
Diameter at fracture: 0.43 in.
Position of fracture: 0.90 in. from the neck.
Appearance of fracture: Amorphous 60 per cent, granular 40 per cent.

SUMMARY.

Limit of proportionality	30,000 lb. per sq. in.
**Elastic limit by galvanometer	30,000 lb. per sq. in.
Yield point	35,000 lb. per sq. in.
Tensile strength	77,000 lb. per sq. in.
Elongation in 2 in	22.5 per cent.
Contraction of area	27.4 per cent.

TEST 14888.

CAST STEEL NO. 3. HEAT NO. 3356 A2 TI. ARSENAL STEEL.

Marks, 8864–2.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00026	.00013	
2,000	10,000	.00058	.00029	
3,000	15,000	.00093	.00047	
4,000	20,000	.00131	.00066	
5,000	25,000	.00166	.00083	
6,000	30,000	.00201	.00101	
7,000	35,000	.00236	.00118	
7,200	36,000	.00244	.00122	
7,400	37,000	.00251	.00125	
7,600	38,000	.00259	.00130	Limit of proportionality.
7,800	39,000	.00266	.00133	
8,000	40,000	.00277	.00138	
8,200	41,000	.00284	.00142	
8,400	42,000	.00293	.00147	
8,600	43,000	.00302	.00151	
8,800	44,000	.00314	.00157	
9,000	45,000	.00330	.00165	Yield point.
Load fell to—				
8,486	42,430	.00464	.00232	
8,486	42,430	.00504	.00252	
8,600	43,000	.00514	.00257	
8,800	44,000	.00540	.00270	
9,000	45,000	.00739	.00370	
9,200	46,000	{.01495 {.01944	.00748 .00972	
200	1,000	.01572	.00786	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00026	.00013	
2,000	10,000	.00063	.00032	
3,000	15,000	.00099	.00049	
	17,000	.....	.....	Limit of proportionality.
4,000	20,000	.00140	.00070	
5,000	25,000	.00180	.00090	
6,000	30,000	.00223	.00112	
7,000	35,000	.00268	.00134	
7,200	36,000	.00278	.00139	
7,400	37,000	.00285	.00143	
7,600	38,000	.00294	.00147	
7,800	39,000	.00303	.00151	
8,000	40,000	.00315	.00158	
8,200	41,000	.00329	.00165	
8,400	42,000	.00335	.00168	
8,600	43,000	.00349	.00175	
8,800	44,000	.00360	.00180	
9,000	45,000	.00381	.00191	
9,200	46,000	.00409	.00204	
200	1,000	.....	.....	Set.
9,400	47,000	.00472	.00236	Yield point.
9,600	48,000	.00648	.00324	
9,800	49,000	.00880	.00440	
10,000	50,000	.01114	.00557	
10,200	51,000	.01371	.00686	
10,400	52,000	.01615	.00808	
10,600	53,000	.01869	.00935	
16,600	83,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.12 0.18* in.
Diameter at fracture, 0.46 in.
Position of fracture, 0.50 in. from the neck.
Appearance of fracture, amorphous.

SUMMARY.

Limit of proportionality	38,000 lb. per sq. in.
Yield point	45,000 lb. per sq. in.
Tensile strength	83,000 lb. per sq. in.
Modulus of elasticity	28,800,000 lb. per sq. in.
Elongation in 2 in.	15.0 per cent.
Contraction of area	16.9 per cent.
After stressing to 46,000 lb. per sq. in.:	
Limit of proportionality	17,000 lb. per sq. in.
Yield point	47,000 lb. per sq. in.
Modulus of elasticity	28,500,000 lb. per sq. in.

TEST 14889.

CAST STEEL NO. 3. HEAT NO. 3359 A2 TI. ARSENAL STEEL.

Marks, 8937–2.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2 in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00023	.00012	
2,000	10,000	.00061	.00031	
3,000	15,000	.00098	.00049	
4,000	20,000	.00133	.00067	
5,000	25,000	.00168	.00084	
6,000	30,000	.00204	.00102	
7,000	35,000	.00240	.00120	
7,200	36,000	.00248	.00124	
7,400	37,000	.00258	.00129	
7,600	38,000	.00263	.00132	
7,800	39,000	.00268	.00134	
8,000	40,000	.00277	.00139	
8,200	41,000	.00286	.00143	
8,400	42,000	.00292	.00146	
8,600	43,000	.00301	.00150	
8,800	44,000	.00311	.00155	
9,000	45,000	.00316	.00158	
9,200	46,000	.00331	.00166	
9,400	47,000	.00332	.00166	
9,600	48,000	.00339	.00170	Limit of proportionality.
9,800	49,000	.00346	.00173	
10,000	50,000	.00356	.00178	
10,200	51,000	.00371	.00186	Yield point.
9,372	46,860	.00608	.00304	
9,400	47,000	.00612	.00306	
9,600	48,000	.00624	.00312	
9,800	49,000	.00697	.00349	
9,900	49,500	.01436	.00718	
9,600	48,000	.01471	.00736	
9,800	49,000	.01992	.00996	

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00026	.00013	
2,000	10,000	.00064	.00032	
3,000	15,000	.00101	.00050	Limit of proportionality.
4,000	20,000	.00141	.00071	
5,000	25,000	.00180	.00090	
6,000	30,000	.00223	.00112	
7,000	35,000	.00263	.00131	
7,200	36,000	.00273	.00137	
7,400	37,000	.00281	.00140	
7,600	38,000	.00288	.00144	
7,800	39,000	.00298	.00149	
8,000	40,000	.00307	.00153	
8,200	41,000	.00318	.00159	
8,400	42,000	.00339	.00170	
8,600	43,000	.00342	.00171	
8,800	44,000	.00351	.00175	
9,000	45,000	.00364	.00182	
9,200	46,000	.00372	.00186	
9,400	47,000	.00408	.00204	Yield point.
		.00689	.00345	
9,600	48,000	.00750	.00375	
9,800	49,000	.00829	.00415	
10,000	50,000	.00946	.00473	
10,200	51,000	.01204	.00602	
10,400	52,000	.01428	.00714	
10,600	53,000	.01685	.00843	
10,800	54,000	.01950	.00975	
16,100	80,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.21, 0.25* in.
Diameter at fracture, 0.43 in.
Position of fracture, 1.20 in. from the neck.
Appearance of fracture, amorphous.

SUMMARY.

Limit of proportionality	48,000 lb. per sq. in.
Yield point	51,000 lb. per sq. in.
Tensile strength	80,500 lb. per sq. in.
Modulus of elasticity	28,300,000 lb. per sq. in.
Elongation in 2 in	23.0 per cent.
Contraction of area	27.4 per cent.
After stressing to 49,000 lb. per sq. in.:	
Limit of proportionality	15,000 lb. per sq. in.
Yield point	47,000 lb. per sq. in.
Modulus of elasticity	27,500,000 lb. per sq. in.

TEST 14881.

FORGED STEEL "D." ARSENAL STEEL.

Marks, 163 F–3.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00027	.00014	
2,000	10,000	.00061	.00031	
3,000	15,000	.00096	.00048	
4,000	20,000	.00134	.00067	
5,000	25,000	.00169	.00085	
6,000	30,000	.00204	.00102	
7,000	35,000	.00241	.00121	
8,000	40,000	.00276	.00138	
8,200	41,000	.00289	.00145	
8,400	42,000	.00293	.00147	
8,600	43,000	.00302	.00151	
8,800	44,000	.00310	.00155	
9,000	45,000	.00316	.00158	
9,200	46,000	.00324	.00162	
9,400	47,000	.00330	.00165	
9,600	48,000	.00336	.00168	
9,800	49,000	.00345	.00173	
10,000	50,000	.00350	.00175	
10,200	51,000	.00360	.00180	
10,400	52,000	.00367	.00184	
10,600	53,000	.00372	.00186	
10,800	54,000	.00374	.00187	
11,000	55,000	.00388	.00194	
11,200	56,000	.00397	.00199	
11,400	57,000	.00407	.00203	
11,600	58,000	.00410	.00205	
11,800	59,000	.00417	.00208	
12,000	60,000	.00428	.00214	
12,200	61,000	.00432	.00216	
12,400	62,000	.00438	.00219	
12,600	63,000	.00448	.00224	
12,800	64,000	.00453	.00227	
13,000	65,000	.00468	.00234	
13,200	66,000	.00467	.00233	
13,400	67,000	.00473	.00237	
13,600	68,000	.00482	.00241	
13,800	69,000	.00492	.00246	
14,000	70,000	.00498	.00249	
14,200	71,000	.00506	.00253	
14,400	72,000	.00512	.00256	
14,600	73,000	.00520	.00260	
14,800	74,000	.00527	.00265	
15,000	75,000	.00532	.00266	
15,200	76,000	.00542	.00271	
15,400	77,000	.00550	.00275	
15,600	78,000	.00556	.00278	
15,800	79,000	.00563	.00282	
16,000	80,000	.00574	.00287	
16,200	81,000	.00581	.00290	
16,400	82,000	.00582	.00291	
16,600	83,000	.00596	.00298	
16,800	84,000	.00600	.00300	
17,000	85,000	.00612	.00306	
17,200	86,000	.00616	.00308	
17,400	87,000	.00623	.00312	
17,600	88,000	.00635	.00318	
17,800	89,000	.00643	.00322	
18,000	90,000	.00650	.00325	
18,200	91,000	.00657	.00328	
18,400	92,000	.00667	.00333	Limit of proportionality.
18,600	93,000	.00674	.00337	

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
18,800	94,000	.00684	.00342	
19,000	95,000	.00694	.00347	
19,200	96,000	.00708	.00354	
19,400	97,000	.00717	.00358	
19,600	98,000	.00724	.00362	
19,800	99,000	.00738	.00369	
20,000	100,000	.00749	.00375	
20,200	101,000	.00799	.00399	
20,400	102,000	.00800	.00400	
20,600	103,000	.00814	.00407	
20,800	104,000	.00824	.00412	
21,000	105,000	.00844	.00422	
21,200	106,000	.00877	.00439	
21,400	107,000	.00896	.00448	
21,600	108,000	.00922	.00461	
28,700	143,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.24*, 0.05 in.
Diameter at fracture, 0.37 in.
Position of fracture, 0.60 in. from the neck.
Appearance of fracture, fine silky.

SUMMARY.

Limit of proportionality	92,000 lb. per sq. in.
Tensile strength	143,500 lb. per sq. in.
Modulus of elasticity	27,700,000 lb. per sq. in.
Elongation in 2 in	14.5 per cent.
Contraction of area	46.2 per cent.

TEST 14884.

FORGED STEEL "D." ARSENAL STEEL.

Marks, 226 F–2.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00023	.00012	
2,000	10,000	.00061	.00030	
3,000	15,000	.00101	.00051	
4,000	20,000	.00133	.00066	
5,000	25,000	.00169	.00084	
6,000	30,000	.00204	.00102	
7,000	35,000	.00240	.00120	
8,000	40,000	.00276	.00138	
9,000	45,000	.00319	.00160	
10,000	50,000	.00346	.00173	
11,000	55,000	.00383	.00192	
12,000	60,000	.00421	.00211	
13,000	65,000	.00454	.00227	
14,000	70,000	.00490	.00245	
14,400	72,000	.00505	.00252	
14,800	74,000	.00520	.00260	
15,200	76,000	.00535	.00267	
15,600	78,000	.00548	.00274	
16,000	80,000	.00565	.00282	
16,400	82,000	.00580	.00290	
16,800	84,000	.00592	.00296	
17,200	86,000	.00606	.00303	
17,600	88,000	.00622	.00311	
18,000	90,000	.00637	.00318	
18,400	92,000	.00654	.00327	
18,800	94,000	.00664	.00332	
19,200	96,000	.00679	.00340	
19,600	98,000	.00693	.00346	
20,000	100,000	.00707	.00354	
20,400	102,000	.00722	.00361	
20,800	104,000	.00738	.00369	
21,200	106,000	.00756	.00378	
21,600	108,000	.00769	.00384	
22,000	110,000	.00783	.00392	
22,400	112,000	.00800	.00400	
22,800	114,000	.00814	.00407	
23,200	116,000	.00828	.00414	
23,600	118,000	.00842	.00421	
24,000	120,000	.00859	.00430	
24,400	122,000	.00874	.00437	
24,800	124,000	.00889	.00445	Limit of proportionality.
25,200	126,000	.00905	.00453	
25,600	128,000	.00922	.00461	
26,000	130,000	.00939	.00470	
26,400	132,000	.00962	.00481	
26,800	134,000	.00981	.00491	
27,200	136,000	.01005	.00503	
27,600	138,000	.01044	.00522	
28,000	140,000	.01066	.00533	
28,400	142,000	.01131	.00566	
200	1,000	.00118	.00059	Set.

Extensometer set to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00033	.00017	
2,000	10,000	.00065	.00032	
3,000	15,000	.00101	.00051	
4,000	20,000	.00135	.00067	
5,000	25,000	.00173	.00086	
6,000	30,000	.00209	.00105	
7,000	35,000	.00243	.00121	
8,000	40,000	.00281	.00141	
9,000	45,000	.00318	.00160	
10,000	50,000	.00360	.00180	
11,000	55,000	.00384	.00192	
12,000	60,000	.00424	.00212	
13,000	65,000	.00465	.00233	
14,000	70,000	.00500	.00250	
14,800	74,000	.00523	.00262	
15,600	78,000	.00555	.00277	
16,400	82,000	.00581	.00291	
17,200	86,000	.00612	.00306	
18,000	90,000	.00645	.00323	
18,800	94,000	.00670	.00335	
19,600	98,000	.00698	.00349	
20,400	102,000	.00728	.00364	
21,200	106,000	.00758	.00379	
22,000	110,000	.00787	.00394	
22,800	114,000	.00820	.00410	
23,600	118,000	.00847	.00423	
24,400	122,000	.00878	.00439	Limit of proportionality.
25,200	126,000	.00910	.00455	
26,000	130,000	.00940	.00470	
26,800	134,000	.00970	.00485	
27,600	138,000	.01004	.00502	
28,400	142,000	.01406	.00523	
29,200	146,000	.01204	.00602	
200	1,000	.00148	.00074	Set.
33,300	166,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.05, 0.22* in.
Diameter at fracture, 0.39 in. from the neck.
Position of fracture, 0.80 in. from the neck.
Appearance of fracture, fine silky.

SUMMARY.

Limit of proportionality	124,000 lb. per sq. in.
Modulus of elasticity	28,000,000 lb. per sq. in.
Tensile strength	166,500 lb. per sq. in.
Elongation in 2 in	13.5 per cent.
Contraction of area	40.3 per cent.
After stressing to 142,000 lb. per sq. in.:	
Limit of proportionality	122,000 lb. per sq. in
Modulus of elasticity	27,800,000 lb. per sq. in

TEST 14868.

FORGED STEEL NO. 5, NAVY. ARSENAL STEEL.

Marks, 247 F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Berry extensometer used.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.0002	.00010	
2,000	10,000	.0006	.00030	
3,000	15,000	.0009	.00045	
4,000	20,000	.0012	.00060	
5,000	25,000	.0016	.00080	
6,000	30,000	.0020	.00100	
7,000	35,000	.0023	.00115	
8,000	40,000	.0026	.00130	
8,200	41,000	.0027	.00135	
8,400	42,000	.0028	.00140	
8,600	43,000	.0028	.00140	
8,800	44,000	.0029	.00145	
9,000	45,000	.0030	.00150	Limit of proportionality.
		.0042	.00210	Yield point.
16,600	83,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.36*, 0.15 in.
Diameter at fracture, 0.36 in.
Position of fracture, 0.60 in. from the neck.
Appearance of fracture, silky.

SUMMARY.

Limit of proportionality	45,000 lb. per sq. in.
Yield point	45,000 lb. per sq. in.
Tensile strength	83,000 lb. per sq. in.
Elongation in 2 in	25.5 per cent.
Contraction of area	49.1 per cent.

TEST 14871.

FORGED STEEL NO. 5, NAVY. ARSENAL STEEL.

Marks, 240–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00028	.00014	
2,000	10,000	.00063	.00032	
3,000	15,000	.00097	.00049	
4,000	20,000	.00132	.00066	
5,000	25,000	.00166	.00083	
6,000	30,000	.00202	.00101	
7,000	35,000	.00239	.00120	
	37,000	.....	.....	Limit of proportionality.
8,000	40,000	.00285	.00143	
8,200	41,000	.00308	.00154	
8,400	42,000	.00548	.00274	Yield point.
8,600	43,000	.00830	.00415	
18,200	91,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.25, 0.28* in.
Diameter at fracture, 0.38 in.
Position of fracture, 1.35 in. from the neck.
Appearance of fracture, dull silky.

SUMMARY.

Limit of proportionality	37,000 lb. per sq. in.
Yield point	42,000 lb. per sq. in.
Tensile strength	91,000 lb. per sq. in.
Modulus of elasticity	28,500,000 lb. per sq. in.
Elongation in 2 in	26.5 per cent.
Contraction of area	43.3 per cent.

TEST 14882.

FORGED STEEL NO. 5 NAVY. ARSENAL STEEL.

Marks, 211 F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2 in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*In.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00028	.00014	
2,000	10,000	.00065	.00033	
3,000	15,000	.00101	.00051	
4,000	20,000	.00135	.00067	
5,000	25,000	.00168	.00084	
6,000	30,000	.00206	.00103	
7,000	35,000	.00251	.00125	
7,200	36,000	.00254	.00127	
7,400	37,000	.00251	.00126	
7,600	38,000	.00270	.00135	
7,800	39,000	.00872	.00436	Limit of proportionality.
		.01495	.00748	Yield point.

Extensometer set to zero.

200	1,000	0.	0.	
1,000	5,000	.00027	.00014	
2,000	10,000	.00068	.00034	
3,000	15,000	.00106	.00053	
4,000	20,000	.00145	.00072	Limit of proportionality.
5,000	25,000	.00189	.00094	
6,000	30,000	.00236	.00118	
7,000	35,000	.00281	.00140	
7,200	36,000	.00296	.00148	
7,400	37,000	.00310	.00155	
7,600	38,000	.00323	.00162	
7,800	39,000	.00349	.00174	
8,000	40,000	.00403	.00201	Yield point.
8,200	41,000	.00590	.00295	
8,400	42,000	.00739	.00370	
8,600	43,000	.00914	.00457	
8,800	44,000	.01046	.00523	
16,400	82,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.25, 0.12 in.
Diameter at fracture, 0.43 in.
Position of fracture, 0.65 in. from the neck.
Appearance of fracture, lamellar.

SUMMARY.

Limit of proportionality	39,000 lb. per sq. in.
Yield point	39,000 lb. per sq. in.
Tensile strength	82,000 lb. per sq. in.
Modulus of elasticity	27,600,000 lb. per sq. in.
Elongation in 2 in.	18.5 per cent.
Contraction of area	27.4 per cent.
After stressing to 39,000 lb. per sq. in.:	
Limit of proportionality	20,000 lb. per sq. in.
Yield point	40,000 lb. per sq. in.
Modulus of elasticity	26,600,000 lb. per sq. in.

TEST 14883.

FORGED STEEL NO. 5 NAVY. ARSENAL STEEL.

Marks, 212 F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gaged length, 2 in.
Berry extensometer used, K2.
Edelmann thermo-electric apparatus for determining elastic limit used.

Applied loads.		Elongations.		Galvanometer.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	Reading.	Deflection.	
Lb.	*Lb.*	*In.*	*In.*	*Mm.*	*In.*	
200	1,000	0.	0.	70	0	
1,000	5,000	.0003	.00015	67	3	
2,000	10,000	.0009	.00045	64	6	
3,000	15,000	.0013	.00065	64	6	
4,000	20,000	.0016	.00080	66	4	
5,000	25,000	.0020	.00100	68	2	
6,000	30,000	.0023	.00115	69	1	
7,000	35,000	.0026	.00130	71	−1	
7,200	36,000	.0028	.00140	73	−3	
7,400	37,000	.0028	.00140	74	−4	
7,600	38,000	.0029	.00145	75	−5	
7,800	39,000	.0029	.00145	75	−5	Limit of proportionality.
8,000	40,000	.0031	.00155	77	−7	Yield point.
8,200	41,000	.0280	.01400	73	−3	
8,400	42,000	.0288	.01440	75	−5	
8,600	43,000	.0297	.01485	76	−6	
8,800	44,000	.0317	.01585	77	−7	
9,000	45,000	.0340	.01700	79	−9	Elastic limit by galvanometer.
10,000	50,000	.0442	.0221	78	−8	
11,000	55,000	.....	.....	75	−5	
12,000	60,000	.....	.....	72	−2	
13,000	65,000	.....	.....	62	8	
14,000	70,000	.....	.....	39	31	
15,200	76,000	.....	.....	.....	.....	Tensile strength.

Elongation of inch sections, 0.10, 0.37* in.
Diameter at fracture, 0.37 in.
Position of fracture, 0.70 in. from the neck.
Appearance of fracture, Silky.

SUMMARY.

Limit of proportionality	39,000 lb. per sq. in.
Elastic limit by galvanometer	45,000 lb. per sq. in.
Yield point	40,000 lb. per sq. in.
Tensile strength	76,000 lb. per sq. in.
Elongation in 2 in	23.5 per cent.
Contraction of area	46.2 per cent.

TEST 14899.

FORGED STEEL NO. 5 NAVY. ARSENAL STEEL.

Marks, 1526 F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00026	.00013	
2,000	10,000	.00060	.00030	
3,000	15,000	.00094	.00047	
4,000	20,000	.00127	.00064	
5,000	25,000	.00164	.00082	
6,000	30,000	.00198	.00099	
6,200	31,000	.00207	.00104	
6,400	32,000	.00213	.00107	
6,600	33,000	.00219	.00110	
6,800	34,000	.00227	.00113	
7,000	35,000	.00235	.00118	
7,200	36,000	.00243	.00122	
7,400	37,000	.00247	.00124	
7,600	38,000	.00256	.00128	
7,800	39,000	.00262	.00131	
8,000	40,000	.00269	.00135	
8,200	41,000	.00277	.00139	
8,400	42,000	.00285	.00143	
8,600	43,000	.00290	.00145	
8,800	44,000	.00298	.00149	
9,000	45,000	.00306	.00153	
9,200	46,000	.00314	.00157	Limit of proportionality.
9,400	47,000	.00321	.00161	
9,600	48,000	.00335	.00167	
9,800	49,000	.00372	.00186	Yield point.
9,282	46,410	.01826	.00913	
200	1,000	.01614	.00807	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00022	.00011	
2,000	10,000	.00057	.00028	
3,000	15,000	.00094	.00047	
4,000	20,000	.00128	.00064	
5,000	25,000	.00164	.00082	Limit of proportionality.
6,000	30,000	.00203	.00101	
6,400	32,000	.00217	.00108	
6,800	34,000	.00233	.00117	
7,200	36,000	.00252	.00126	
7,600	38,000	.00263	.00132	
8,000	40,000	.00279	.00140	
8,400	42,000	.00297	.00149	
8,800	44,000	.00315	.00157	
9,000	45,000	.00326	.00163	
9,200	46,000	.00355	.00177	
9,400	47,000	.00540	.00270	Yield point.
16,200	81,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.34*, 0.22 in.

Diameter at fracture, 0.37 in.

Position of fracture, 1.10 in. from the neck.

Appearance of fracture, fine silky, open longitudinal seam in the stem.

SUMMARY.

Limit of proportionality	46,000 lb. per sq. in.
Yield point	49,000 lb. per sq. in.
Tensile strength	81,000 lb. per sq. in.
Modulus of elasticity	28,800,000 lb. per sq. in.
Elongation in 2 in	28.0 per cent.
Contraction of area	46.2 per cent.
After stressing to 49,000 lb. per sq. in.:	
Limit of proportionality	25,000 lb. per sq. in.
Yield point	47,000 lb. per sq. in.
Modulus of elasticity	28,400,000 lb. per sq. in.

TEST 14900.

FORGED STEEL NO. 5 NAVY. ARSENAL STEEL.

Marks, 1540 F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00027	.00013	
2,000	10,000	.00061	.00030	
3,000	15,000	.00098	.00048	
4,000	20,000	.00130	.00065	
5,000	25,000	.00164	.00082	
6,000	30,000	.00201	.00101	
6,200	31,000	.00209	.00105	
6,400	32,000	.00214	.00107	
6,600	33,000	.00222	.00111	
6,800	34,000	.00228	.00114	
7,000	35,000	.00237	.00118	
7,200	36,000	.00244	.00122	
7,400	37,000	.00251	.00125	
7,600	38,000	.00257	.00128	
7,800	39,000	.00264	.00132	
8,000	40,000	.00272	.00136	
8,200	41,000	.00280	.00140	
8,400	42,000	.00285	.00143	
8,600	43,000	.00293	.00147	
8,800	44,000	.00302	.00151	
9,000	45,000	.00309	.00155	
9,200	46,000	.00318	.00159	
9,400	47,000	.00323	.00162	Limit of proportionality.
9,546	47,730	.....	.....	Yield point.
9,200	46,000	.00663	.00331	
9,400	47,000	.00805	.00403	
9,600	48,000	.01536	.00768	
200	1,000	.01452	.00726	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00019	.00010	
2,000	10,000	.00055	.00027	
3,000	15,000	.00090	.00045	
4,000	20,000	.00128	.00064	
5,000	25,000	.00165	.00083	Limit of proportionality.
6,000	30,000	.00210	.00105	
6,400	32,000	.00223	.00111	
6,800	34,000	.00238	.00119	
7,200	36,000	.00256	.00128	
7,600	38,000	.00271	.00135	
8,000	40,000	.00288	.00144	
8,400	42,000	.00308	.00154	
8,600	43,000	.00317	.00159	
8,800	44,000	.00326	.00163	
9,000	45,000	.00340	.00170	
9,200	46,000	.00415	.00208	Yield point.
9,400	47,000	.00697	.00349	
9,600	48,000	.00872	.00436	
17,000	85,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.26*, 0.31* in.
Diameter at fracture, 0.35 in.
Position of fracture, 1.20 in. from the neck.
Appearance of fracture, fine silky, cup-shaped.

SUMMARY.

Limit of proportionality	47,000 lb. per sq. in.
Yield point	47,730 lb. per sq. in.
Tensile strength	85,000 lb. per sq. in.
Modulus of elasticity	28,200,000 lb. per sq. in.
Elongation in 2 in	28.5 per cent.
Contraction of area	51.9 per cent.
After stressing to 47,730 lb. per sq. in.:	
Limit of proportionality	25,000 lb. per sq. in.
Yield point	46,000 lb. per sq. in.
Modulus of elasticity	27,500,000 lb. per sq. in.

TEST 14885.

FORGED STEEL NO. 3. ARSENAL STEEL.

Marks, 273–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Berry's extensometer used, K2.
Edelmann thermo-electric apparatus for determining elastic limit used.

Applied loads.		Elongation.		Galvanometer reading.	Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.		
Lb.	*Lb.*	*In.*	*In.*	*In.*	
200	1,000				
1,000	5,000	0.	0.	0	
2,000	10,000	.0004	.00020	− 1	
3,000	15,000	.0009	.00045	− 2	
4,000	20,000	.0013	.00065	− 3	
5,000	25,000	.0017	.00085	− 4	
6,000	30,000	.0021	.00105	− 5	
6,400	32,000	.0022	.00110	− 5	
6,800	34,000	.0023	.00115	− 6	
7,200	36,000	.0025	.00125	− 6	
7,600	38,000	.0026	.00130	− 7	
7,800	39,000	.0027	.00135	− 8	
8,000	40,000	.0028	.00140	− 9	
8,200	41,000	.0028	.00140	− 9	
8,600	43,000	.0030	.00150	− 9	
8,800	44,000	.0031	.00155	− 9	
9,000	45,000	.0032	.00160	− 9	
9,200	46,000	.0032	.00160	− 9	
9,400	47,000	.0034	.00170	−10	
9,800	49,000	.0034	.00170	−11	
10,000	50,000	.0035	.00175	−12	
10,200	51,000	.0036	.00180	−12	
10,600	53,000	.0037	.00185	−13	
10,800	54,000	.0038	.00190	−13	
11,000	55,000	.0039	.00195	−13	
11,300	56,500	.0050	.00250	−13	Limit of proportionality. Yield point. Elastic limit by galvanometer.
11,800	59,000	.0190	.00950	−10	
13,000	65,000	.0350	.01750	− 6	
15,000	75,000	.0430	.02150	− 4	
16,000	80,000	.....	.....	− 2	
17,000	85,000	.....	.....	+ 2	
18,000	90,000	.....	.....	+ 9	
21,200	106,000	.....	.....	.....	Tensile strength.

Elongation of inch sections, 0.10, 0.26* in.
Diameter at fracture, 0.38 in.
Position of fracture, 0.60 in. from the neck.
Appearance of fracture, silky.

SUMMARY.

Limit of proportionality	56,500 lb. per sq. in.
Elastic limit by galvanometer	56,500 lb. per sq. in.
Yield point	56,500 lb. per sq. in.
Tensile strength	106,000 lb. per sq. in.
Elongation in 2 in	18.0 per cent.
Contraction of area	43.3 per cent.

TEST 14866.

FORGED STEEL NO. 2.

Marks, 255–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Inspectors' extensometer used on 2-in. length.

Applied loads.		In gauged length.		Per inch.		Remarks.
Total.	Per square inch.	Elongation.	Set.	Elongation.	Set.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*	
200	1,000	0.	0.	0.	.....	
1,000	5,000	.0002	.....	.00010	.....	
2,000	10,000	.0005	.....	.00025	.....	
3,000	15,000	.0008	.....	.00040	.....	
4,000	20,000	.0011	.0001	.00055	.00005	
5,000	25,000	.0014	.....	.00070	.....	
6,000	30,000	.0017	.0001	.00085	.00005	Limit of proportionality.
7,000	35,000	.0021	.....	.00105	.....	
8,000	40,000	.0025	.0002	.00125	.0001	
8,200	41,000	.0026	.....	.00130	.....	
8,400	42,000	.0027	.....	.00135	.....	
8,600	43,000	.0033–.0200	.....	.00165–.0100	.....	Yield point.
8,800	44,000	.0260	.....	.0130	.....	
9,000	45,000	.0280	.....	.0140	.....	
16,000	80,000	.....	.....	.....	.....	Tensile strength.

Elongation of inch sections, 0.16, 0.39* in.
Diameter at fracture, 0.36 in.
Position of fracture, 0.85 in. from the neck.
Appearance of fracture, silky.

SUMMARY.

Limit of proportionality	30,000 lb. per sq. in.
Elastic limit	30,000 lb. per sq. in.
Yield point	43,000 lb. per sq. in.
Tensile strength	80,000 lb. per sq. in.
Elongation in 2 in	27.5 per cent.
Contraction of area	49.1 per cent.

TEST 14894.

FORGED STEEL NO. 2. ARSENAL STEEL.

Marks, 234–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00025	.00013	
2,000	10,000	.00060	.00030	
3,000	15,000	.00093	.00047	
4,000	20,000	.00127	.00064	
5,000	25,000	.00165	.00083	Limit of proportionality.
6,000	30,000	.00201	.00101	
6,200	31,000	.00206	.00103	
6,400	32,000	.00213	.00107	
6,600	33,000	.00221	.00111	
6,800	34,000	.00229	.00115	
7,000	35,000	.00236	.00118	
7,200	36,000	.00248	.00124	
7,400	37,000	.00262	.00131	
7,600	38,000	.00272	.00136	Yield point.
7,800	39,000	.00399	.00199	
8,000	40,000	.00631	.00316	
8,200	41,000	.00839	.00419	
8,400	42,000	.01046	.00523	
8,600	43,000	.01588	.00794	
200	1,000	.01272	.00636	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00023	.00012	
2,000	10,000	.00057	.00029	
3,000	15,000	.00095	.00047	
.....	17,000	.....	.....	Limit of proportionality.
4,000	20,000	.00132	.00066	
5,000	25,000	.00169	.00085	
6,000	30,000	.00212	.00106	
6,200	31,000	.00221	.00111	
6,400	32,000	.00226	.00113	
6,600	33,000	.00235	.00118	
6,800	34,000	.00242	.00121	
7,000	35,000	.00251	.00125	
7,200	36,000	.00259	.00130	
7,400	37,000	.00266	.00133	
7,600	38,000	.00276	.00138	
7,800	39,000	.00285	.00143	
8,000	40,000	.00298	.00149	
8,200	41,000	.00312	.00156	
8,400	42,000	.00323	.00162	
8,600	43,000	.00341	.00171	
8,800	44,000	.00388	.00194	Yield point.
9,000	45,000	.00577	.00289	
9,200	46,000	.00747	.00374	
9,400	47,000	.00967	.00484	
200	1,000	.00612	.00306	Set.
16,500	82,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.19, 0.36* in.
Diameter at fracture, 0.33 in.
Position of fracture, 1.25 in. from the neck.
Appearance of fracture, fine silky.

SUMMARY.

Limit of proportionality	25,000 lb. per sq. in.
Yield point	38,000 lb. per sq. in.
Tensile strength	82,500 lb. per sq. in.
Modulus of elasticity	29,700,000 lb. per sq. in.
Elongation in 2 in	27.5 per cent.
Contraction of area	57.2 per cent.
After stressing to 43,000 lb. per sq. in.:	
Limit of proportionality	17,000 lb. per sq. in.
Yield point	44,000 lb. per sq. in.
Modulus of elasticity	28,700,000 lb. per sq. in.

TEST 14869.

GUN STEEL. TRUNNION HOOP 6-IN. GUN.

Marks, 1743 F–C.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	0.	0.	
2,000	10,000	.0002	.00010	
3,000	15,000	.0006	.00030	
4,000	20,000	.0010	.00050	
5,000	25,000	.0014	.00070	
6,000	30,000	.0018	.00090	
7,000	35,000	.0022	.00110	
8,000	40,000	.0025	.00125	
8,200	41,000	.0026	.00130	
8,400	42,000	.0027	.00135	
8,600	43,000	.0028	.00140	Limit of proportionality.
8,800	44,000	.0029	.00145	
9,000	45,000	.0030	.00150	
9,200	46,000	.0032	.00160	Yield point.
		.0068	.00340	
9,400	47,000	.0135	.00675	
9,600	48,000	.0190	.00950	
10,000	50,000	.0218	.01090	
10,400	52,000	.0240	.01200	
10,800	54,000	.0270	.01350	
11,200	56,000	.0315	.01575	
12,000	60,000	.0380	.01900	
18,500	92,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.29*, 0.24 in.
Diameter at fracture, 0.38 in.
Position of fracture, at middle of length.
Appearance of fracture, silky.

SUMMARY.

Limit of proportionality	43,000 lb. per sq. in.
Yield point	46,000 lb. per sq. in.
Tensile strength	92,500 lb. per sq. in.
Elongation in 2 in	26.5 per cent.
Contraction of area	43.3 per cent.

TEST 14872.

STUDENT OFFICERS' TEST. ARSENAL STEEL.

Marks, INGOT 26.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00022	.00011	
2,000	10,000	.00058	.00029	
3,000	15,000	.00098	.00049	
4,000	20,000	.00130	.00065	
5,000	25,000	.00163	.00081	
6,000	30,000	.00200	.00100	
7,000	35,000	.00240	.00120	
8,000	40,000	.00277	.00138	
8,200	41,000	.00288	.00144	
8,400	42,000	.00294	.00147	
8,600	43,000	.00308	.00154	
8,800	44,000	.00309	.00155	Limit of proportionality
9,000	45,000	.00317	.00159	
9,200	46,000	.00332	.00166	Yield point.
9,400	47,000	.00548	.00274	
16,400	82,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.32*, 0.19 in.
Diameter at fracture, 0.41 in.
Position of fracture, 1 in. from the neck
Appearance of fracture, dull silky.

SUMMARY.

Limit of proportionality	44,000 lb. per sq. in.
Yield point	46,000 lb. per sq. in.
Tensile strength	82,000 lb. per sq. in.
Modulus of elasticity	27,500,000 lb. per sq. in.
Elongation in 2 in	25.5 per cent.
Contraction of area	34.0 per cent.

TEST 14870.

STUDENT OFFICERS' TEST. EX. 25. ARSENAL STEEL.

Marks, 1450F–25.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged lengths, 2 in.
Berry's extensometer used, K2.
Edelmann's thermo-electric apparatus for determining elastic limit used.

Applied loads.		Elongations.		Galvanometer.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	Reading.	Deflection.	
Lb.	*Lb.*	*In.*	*In.*	*Mm.*	*Mm.*	
200	1,000	0.	0.	57	0	
1,000	5,000	.0001	.00005	57	0	
2,000	10,000	.0003	.00015	57	0	
3,000	15,000	.0007	.00035	58	−1	
4,000	20,000	.0011	.00055	58	−1	
5,000	25,000	.0014	.00070	59	−2	
6,000	30,000	.0018	.00090	59	−2	
7,000	35,000	.0021	.00105	59	−2	Elastic limit by galvanometer.
8,000	40,000	.0025	.00125	58	−1	Limit of proportionality.
8,200	41,000	.0026	.00130	57	0	
8,400	42,000	.0028	.00140	57	0	
8,600	43,000	.0030	.00150	56	1	
8,800	44,000	.0042	.00210	56	1	Yield point.
9,000	45,000	.0102	.00510	53	4	
9,200	46,000	.0114	.00570	52	5	
9,400	47,000	.0126	.00630	52	5	
9,600	48,000	.0135	.00675	52	5	
9,800	49,000	.0150	.00750	51	6	
10,000	50,000	.0184	.00920	50	7	
11,000	55,000	.0240	.01200	48	9	
12,000	60,000	.0335	.01675	45	12	
18,300	91,500	.....	.....	.....	.....	Tensile strength.

Elongation of inch sections, 0.17, 0.33* in.
Diameter of fracture, 0.40 in.
Position of fracture, 1.35 in. from the neck.
Appearance of fracture. dull silky 70 per cent; fine granular 30 per cent.

SUMMARY.

Limit of proportionality	40,000 lb. per sq. in
Elastic limit by galvanometer	35,000 lb. per sq. in.
Yield point	44,000 lb. per sq. in.
Tensile strength	91,500 lb. per sq. in.
Elongation in 2 in	25.0 per cent.
Contraction of area	37.2 per cent.

TEST 14865.

NICKEL STEEL NO. 2 NAVY. ARSENAL STEEL.

Marks, 86F.
Diameter, 0.505 in.
Sectional area, 0.20 in.
Gauged length, 2 in.
Inspectors' extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.0002	.00010	
2,000	10,000	.0006	.00030	
3,000	15,000	.0010	.00050	
4,000	20,000	.0014	.00070	
5,000	25,000	.0018	.00090	
6,000	30,000	.0021	.00105	
7,000	35,000	.0025	.00125	
8,000	40,000	.0028	.00140	
.....	43,000	.....	.....	Limit of proportionality.
9,000	45,000	.0032	.00160	
10,000	50,000	.0038	.00190	
.....	51,000	.....	.....	Yield point.
10,400	52,000	.0068	.00340	
10,800	54,000	.0158	.00790	
11,200	56,000	.0192	.00960	
11,600	58,000	.0235	.01175	
19,100	95,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.12, 0.38* in.
Diameter at fracture, 0.34 in.
Position of fracture, 0.90 in. from the neck.
Appearance of fracture, silky.

SUMMARY.

Limit of proportionality	43,000 lb. per sq. in.
Yield point	51,000 lb. per sq. in.
Tensile strength	95,500 lb. per sq. in.
Elongation in 2 in.	25 per cent.
Contraction of area	54.6 per cent.

TEST 14892.

NICKEL STEEL NO. 2. ARSENAL STEEL.

Marks, 204–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00027	.00013	
2,000	10,000	.00062	.00031	
3,000	15,000	.00098	.00049	
4,000	20,000	.00133	.00066	
5,000	25,000	.00171	.00086	
6,000	30,000	.00205	.00103	
7,000	35,000	.00239	.00120	
7,200	36,000	.00251	.00126	
7,400	37,000	.00260	.00130	
7,600	38,000	.00261	.00130	
7,800	39,000	.00268	.00134	
8,000	40,000	.00281	.00140	
8,200	41,000	.00287	.00144	
8,400	42,000	.00289	.00145	
8,600	43,000	.00299	.00150	
8,800	44,000	.00305	.00153	
9,000	45.000	.00313	.00157	
9,200	46,000	.00317	.00159	
9,400	47,000	.00327	.00163	
9,600	48,000	.00332	.00166	
9,800	49,000	.00339	.00170	
10,000	50,000	.00348	.00174	
10,200	51,000	.00355	.00177	
10,400	52,000	.00362	.00181	
10,600	53,000	.00372	.00186	
10,800	54,000	.00375	.00188	
11,000	55,000	.00389	.00194	
11,200	56,000	.00390	.00195	
11,400	57,000	.00394	.00197	
11,600	58,000	.00405	.00202	Limit of proportionality.
11,800	59,000	.00414	.00207	
12,000	60,000	.00429	.00214	
12,200	61,000	.00430	.00215	
12,400	62,000	.00447	.00224	
12,600	63,000	.00455	.00228	
12,800	64,000	.00464	.00232	
12,900	64,500	.00759	.00380	Yield point.
12,000	60,000	.00799	.00399	
12,200	61,000	.00880	.00440	
11,474	57,370	.01925	.00963	
200	1,000	.01478	.00739	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00027	.00014	
2,000	10,000	.00061	.00030	
3,000	15,000	.00094	.00047	
4,000	20,000	.00135	.00067	
5,000	25,000	.00177	.00089	
6,000	30,000	.00210	.00105	Limit of proportionality.
7,000	35,000	.00250	.00125	
7,200	36,000	.00264	.00132	
7,400	37,000	.00271	.00136	
7,600	38,000	.00273	.00137	
7,800	39,000	.00282	.00141	
8,000	40,000	.00290	.00145	
8,200	41,000	.00302	.00151	
8,400	42,000	.00307	.00154	
8,600	43,000	.00316	.00158	
8,800	44,000	.00326	.00163	
9,000	45,000	.00331	.00165	
9,200	46,000	.00341	.00171	
9,400	47,000	.00347	.00174	
9,600	48,000	.00356	.00178	
9,800	49,000	.00364	.00182	
10,000	50,000	.00375	.00188	
10,200	51,000	.00385	.00193	
10,400	52,000	.00392	.00196	
10,600	53,000	.00402	.00201	
10,800	54,000	.00412	.00206	
11,000	55,000	.00421	.00211	
11,200	56,000	.00434	.00217	
11,400	57,000	.00446	.00223	
11,600	58,000	.00462	.00231	
11,800	59,000	.00515	.00258	
12,000	60,000	.00665	.00332	Yield point.
12,200	61,000	.01520	.00760	
19,300	96,500	.....	.....	Tensile strength.

Elongation of inch sections, 0.17, 0.35* in.
Diameter at fracture, 0.37 in.
Position of fracture, 1.10 in. from the neck.
Appearance of fracture, fine, silky.

Summary.

Limit of proportionality	58,000 lb. per sq. in.
Yield point	64,500 lb. per sq. in.
Tensile strength	96,500 lb. per sq. in.
Modulus of elasticity	28,000,000 lb. per sq. in.
Elongation in 2 in	26.0 per cent.
Contraction of area	46.2 per cent.
After stressing to 64,500 lb. per sq. in.:	
Limit of proportionality	30,000 lb. per sq. in.
Yield point	60,000 lb. per sq. in.
Modulus of elasticity	26,700,000 lb. per sq. in.

TEST 14893.

NICKEL STEEL NO. 2. ARSENAL STEEL.

Marks, 206–F.
Diameter, 0.505 in.
Sectional area, 0.20 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00026	.00013	
2,000	10,000	.00061	.00031	
3,000	15,000	.00097	.00049	
4,000	20,000	.00131	.00066	
5,000	25,000	.00167	.00084	
6,000	30,000	.00203	.00101	
7,000	35,000	.00239	.00120	
7,200	36,000	.00248	.00124	
7,400	37,000	.00253	.00126	
7,600	38,000	.00261	.00130	
7,800	39,000	.00267	.00133	
8,000	40,000	.00276	.00138	
8,200	41,000	.00284	.00142	
8,400	42,000	.00290	.00145	
8,600	43,000	.00297	.00149	
8,800	44,000	.00306	.00153	
9,000	45,000	.00313	.00157	
9,200	46,000	.00321	.00160	
9,400	47,000	.00326	.00163	
9,600	48,000	.00332	.00166	
9,800	49,000	.00341	.00170	
10,000	50,000	.00347	.00174	
10,200	51,000	.00355	.00178	
10,400	52,000	.00362	.00181	
10,600	53,000	.00372	.00186	
10,800	54,000	.00377	.00189	
11,000	55,000	.00388	.00194	
11,200	56,000	.00394	.00197	Limit of proportionality.
11,400	57,000	.00401	.00201	
11,600	58,000	.00410	.00205	
11,800	59,000	.00426	.00213	
12,000	60,000	----------	----------	Yield point.
11,076	55,380	.00835	.00417	
200	1,000	.01536	.00768	Set.

Extensometer reset to zero.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
200	1,000	0.	0.	
1,000	5,000	.00028	.00014	
2,000	10,000	.00062	.00031	
3,000	15,000	.00097	.00049	
3,600	18,000	.....	.....	Limit of proportionality.
4,000	20,000	.00135	.00068	
5,000	25,000	.00174	.00087	
6,000	30,000	.00213	.00107	
7,000	35,000	.00251	.00125	
7,200	36,000	.00262	.00131	
7,400	37,000	.00267	.00134	
7,600	38,000	.00277	.00138	
7,800	39,000	.00284	.00142	
8,000	40,000	.00292	.00146	
8,200	41,000	.00302	.00151	
8,400	42,000	.00309	.00155	
8,600	43,000	.00316	.00158	
8,800	44,000	.00326	.00163	
9,000	45,000	.00331	.00166	
9,200	46,000	.00346	.00173	
9,400	47,000	.00350	.00175	
9,600	48,000	.00359	.00179	
9,800	49,000	.00367	.00184	
10,000	50,000	.00379	.00189	
10,200	51,000	.00389	.00195	
10,400	52,000	.00399	.00199	
10,600	53,000	.00410	.00205	
10,800	54,000	.00426	.00213	
11,000	55,000	.00450	.00225	
11,200	56,000	.....	.....	Yield point.
10,506	52,530	.00570	.00285	
18,000	90,000	.....	.....	Tensile strength.

Elongation of inch sections, 0.38*, 0.20 in.
Diameter at fracture, 0.33 in.
Position of fracture, 1.35 in. from the neck.
Appearance of fracture, fine silky, cup shaped.

SUMMARY.

Limit of proportionality	56,000 lb. per sq. in.
Yield point	60,000 lb. per sq. in.
Tensile strength	90,000 lb. per sq. in.
Modulus of elasticity	28,200,000 lb. per sq. in.
Elongation in 2 in	29.0 per cent.
Contraction of area	57.2 per cent.
After stressing to 60,000 lb. per sq. in.:	
Limit of proportionality	18,000 lb. per sq. in.
Yield point	56,000 lb. per sq. in.
Modulus of elasticity	28,000,000 lb. per sq. in.

TEST 14903.

BRONZE NO. 3. ARSENAL BRONZE.

Marks, 4324.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,000	2,000	0.	0.	
2,000	4,000	.00031	.00015	
3,000	6,000	.00060	.00030	
4,000	8,000	.00091	.00045	
5,000	10,000	.00121	.00061	Limit of proportionality.
6,000	12,000	.00155	.00077	
7,000	14,000	.00186	.00093	
8,000	16,000	.00227	.00113	
9,000	18,000	.00279	.00140	
10,000	20,000	.00331	.00166	
11,000	22,000	.00414	.00207	
12,000	24,000	.00497	.00248	
13,000	26,000	.00626	.00313	
14,000	28,000	.00823	.00411	
15,000	30,000	.01096	.00548	
16,000	32,000	.01528	.00764	
1,000	2,000	.01138	.00569	Set.

Extensometer reset to zero.

1,000	2,000	0.	0.	
2,000	4,000	.00033	.00017	
3,000	6,000	.00064	.00032	
4,000	8,000	.00095	.00047	
5,000	10,000	.00128	.00064	
6,000	12,000	.00164	.00082	
7,000	14,000	.00198	.00099	
8,000	16,000	.00232	.00116	
9,000	18,000	.00269	.00135	
10,000	20,000	.00309	.00155	
11,000	22,000	.00346	.00173	
12,000	24,000	.00389	.00195	
13,000	26,000	.00430	.00215	
14,000	28,000	.00476	.00238	
15,000	30,000	.00526	.00263	
16,000	32,000	.00592	.00296	
17,000	34,000	.01158	.00579	
34,400	68,800	.....	.....	Tensile strength.

Elongation of inch sections, 0.26*, 0.20 in.
Diameter at fracture, 0.69 in.
Position of fracture, 1.20 in. from the neck.
Appearance of fracture, light yellow.

SUMMARY.

Limit of proportionality	10,000 lb. per sq. in.
Tensile strength	68,800 lb. per sq. in.
Modulus of elasticity	13,400,000 lb. per sq. in.
Elongation in 2 in.	23.0 per cent.
Contraction of area	25.2 per cent.
After a set of 0.00569 in. per in. elongation:	
Limit of proportionality	10,000 lb. per sq. in.
Modulus of elasticity	12,600,000 lb. per sq. in.

TEST 14867.

BRONZE NO. 4. ARSENAL BRONZE.

Marks, 4218.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Inspectors' extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
500	1,000	0.	0.	
2,500	5,000	.0006	.00030	
5,000	10,000	.0014	.00070	Limit of proportionality.
7,500	15,000	.0025	.00125	
10,000	20,000	.0042	.00210	
12,500	25,000	.0075	.00375	
15,000	30,000	.0159	.00795	
15,500	31,000	.0185	.00925	
16,000	32,000	.0217	.01085	
16,500	33,000	.0256	.01280	
17,000	34,000	.0300	.01500	
17,500	35,000	.0348	.01740	
18,000	36,000	.0385	.01925	
18,500	37,000	.0453	.02265	
19,000	38,000	.0515	.02575	
19,500	39,000	.0570	.02850	
20,000	40,000	.0658	.03290	
20,500	41,000	.0694	.03470	
21,000	42,000	.0840	.04200	
32,900	65,800	.....	.....	Tensile strength.

Elongation of inch sections: 0.42, 0.43 in.
Diameter at fracture, 0.62 in.
Position of fracture, 1.40 in. from the neck.
Appearance of fracture, light yellow

SUMMARY.

Limit of proportionality	10,000 lb. per sq. in.
Tensile strength	65,800 lb. per sq. in.
Elongation in 2 in	42 5 per cent.
Contraction of area	39.6 per cent.

TEST 14901.

BRONZE NO. 4. ARSENAL BRONZE.

Marks, 4308.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,000	2,000	0.	0.	
2,000	4,000	.00025	.00013	
3,000	6,000	.00053	.00027	Limit of proportionality.
4,000	8,000	.00085	.00042	
5,000	10,000	.00115	.00058	
6,000	12,000	.00152	.00076	
7,000	14,000	.00197	.00098	
8,000	16,000	.00247	.00124	
9,000	18,000	.00316	.00158	
10,000	20,000	.00395	.00198	
11,000	22,000	.00485	.00243	
12,000	24,000	.00615	.00307	
13,000	26,000	.00755	.00377	
14,000	28,000	.00982	.00491	
15,000	30,000	.01305	.00653	
1,000	2,000	.01116	.00558	Set.

Extensometer reset to zero.

1,000	2,000	0.	0.	
2,000	4,000	.00030	.00015	
3,000	6,000	.00059	.00030	
4,000	8,000	.00091	.00045	
5,000	10,000	.00123	.00061	Limit of proportionality.
6,000	12,000	.00157	.00079	
7,000	14,000	.00193	.00096	
8,000	16,000	.00227	.00113	
9,000	18,000	.00264	.00132	
10,000	20,000	.00308	.00154	
11,000	22,000	.00340	.00170	
12,000	24,000	.00383	.00191	
13,000	26,000	.00424	.00212	
14,000	28,000	.00473	.00236	
15,000	30,000	.00527	.00263	
16,000	32,000	.00600	.00300	
34,600	69,200	.....	.....	Tensile strength.

Elongation after fracture: 0.76 in. in 2 in. =38 per cent.
Elongation of inch sections: 0.38*, 0.38* in.
Diameter at fracture, 0.64 in.
Contraction of area, 35.7 per cent.
Position of fracture, 1.40 in. from the neck.
Appearance of fracture, light yellow, oblique.

SUMMARY.

Limit of proportionality	6,000 lb. per sq.in.
Tensile strength	69,200 lb. per sq.in.
Modulus of elasticity	14,600,000 lb. per sq.in.
After a set of 0.00558 in. per in. elongation:	
Limit of proportionality	10,000 lb. per sq.in.
Modulus of elasticity	13,000,000 lb. per sq.in.

TEST 14902.

BRONZE NO. 4. ARSENAL BRONZE.

Marks, 4317.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongation.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,000	2,000	0.	0.	
2,000	4,000	.00026	.00013	
3,000	6,000	.00057	.00029	
4,000	8,000	.00085	.00042	Limit of proportionality.
5,000	10,000	.00118	.00059	
6,000	12,000	.00151	.00076	
7,000	14,000	.00197	.00098	
8,000	16,000	.00260	.00130	
9,000	18,000	.00351	.00176	
10,000	20,000	.00468	.00234	
11,000	22,000	.00618	.00309	
12,000	24,000	.00829	.00415	
13,000	26,000	.01146	.00573	
14,000	28,000	.01536	.00768	
1,000	2,000	.01032	.00516	Set

Extensometer reset to zero.

1,000	2,000	0.	0.	
2,000	4,000	.00029	.00015	
3,000	6,000	.00059	.00030	
4,000	8,000	.00088	.00044	
5,000	10,000	.00123	.00062	
6,000	12,000	.00153	.00076	
7,000	14,000	.00185	.00093	
8,000	16,000	.00224	.00112	
9,000	18,000	.00261	.00130	
10,000	20,000	.00301	.00150	
11,000	22,000	.00342	.00171	
12,000	24,000	.00389	.00194	
13,000	26,000	.00438	.00219	
14,000	28,000	.00506	.00253	
15,000	30,000	.01137	.00569	
31,900	63,800	.....	.....	Tensile strength.

Elongation of inch sections, 0.46*, 0.43* in.
Diameter at fracture, 0.61 in.
Position of fracture, 1.6 in. from the neck. Appearance of fracture, light yellow.

SUMMARY.

Limit of proportionality	8,000 lb. per sq. in.
Tensile strength	63,800 lb. per sq. in.
Modulus of elasticity	14,000,000 lb. per sq. in.
Elongation in 2 in	44.5 per cent.
Contraction of area	41.6 per cent.
After a set of 0.00516 in. per in. elongation:	
Limit of proportionality	8000 lb. per sq. in.
Modulus of elasticity	13,700,000 lb. per sq. in.

TEST 14904.

BRONZE NO. 4. ARSENAL BRONZE.

Marks, 4354.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongation.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,000	2,000	0.	0.	
2,000	4,000	.00031	.00015	
3,000	6,000	.00053	.00027	Limit of proportionality.
4,000	8,000	.00085	.00042	
5,000	10,000	.00119	.00059	
6,000	12,000	.00161	.00081	
7,000	14,000	.00212	.00106	
8,000	16,000	.00277	.00139	
9,000	18,000	.00369	.00185	
10,000	20,000	.00469	.00234	
11,000	22,000	.00579	.00289	
12,000	24,000	.00726	.00363	
13,000	26,000	.00947	.00474	
14,000	28,000	.01290	.00645	
1,000	2,000	.00789	.00394	Set.
33,300	66,600	.....	.....	Tensile strength.

Elongation of inch sections, 0.39, 0.43* in.
Diameter at fracture, 0.63 in.
Position of fracture, at middle of stem.
Appearance of fracture, light yellow, oblique.

SUMMARY.

Limit of proportionality	6,000 lb. per sq. in.
Tensile strength	66,600 lb. per sq. in.
Modulus of elasticity	15,000,000 lb. per sq. in.
Elongation in 2 in	41.0 per cent.
Contraction of area	37.7 per cent.

TEST 14905.

BRONZE NO. 4. ARSENAL BRONZE.

Marks, 4357.
Diameter, 0.798 in.
Sectional area, 0.50 sq. in.
Gauged length, 2 in.
Ewing extensometer used on 2-in. length.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,000	2,000	0.	0.	
2,000	4,000	.00030	.00015	
3,000	6,000	.00056	.00028	
4,000	8,000	.00083	.00042	
5,000	10,000	.00115	.00057	Limit of proportionality.
6,000	12,000	.00150	.00075	
7,000	14,000	.00192	.00096	
8,000	16,000	.00249	.00125	
9,000	18,000	.00340	.00170	
10,000	20,000	.00452	.00226	
11,000	22,000	.00598	.00299	
12,000	24,000	.00775	.00388	
13,000	26,000	.01040	.00520	
14,000	28,000	.01423	.00712	
		.01443	.00722	
1,000	2,000	.00944	.00472	Set.
32,100	64,200	.....	.....	Tensile strength.

Elongation of inch sections, 0.42, 0.48* in.
Diameter at fracture, 0.61 in.
Position of fracture, 1.30 in. from the neck.
Appearance of fracture, light yellow, oblique.

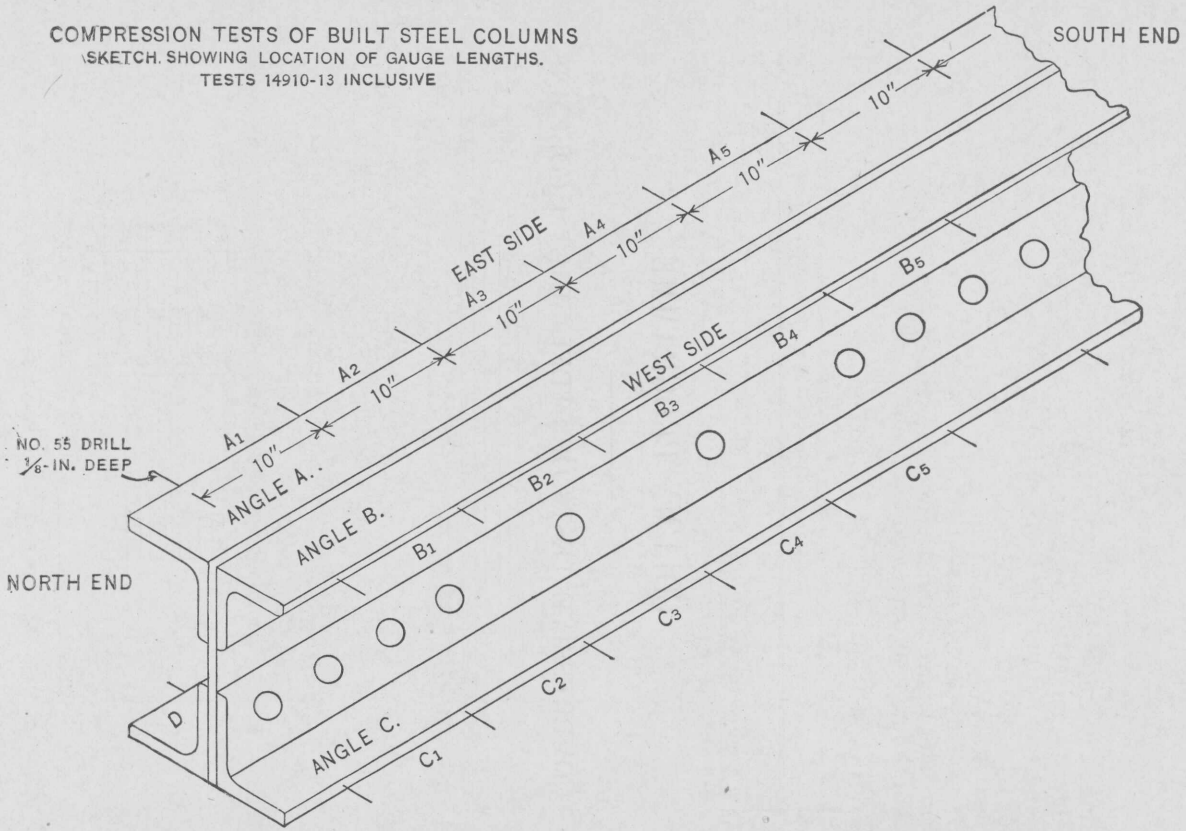
SUMMARY.

Limit of proportionality	10,000 lb. per sq. in.
Tensile strength	64,200 lb. per sq. in.
Modulus of elasticity	14,000,000 lb. per sq. in.
Elongation in 2 in	45.0 per cent.
Contraction of area	41.6 per cent.

COLUMN PROGRAMME.

COMPRESSIVE TESTS OF STEEL-BUILT I COLUMNS.

COMPRESSION TESTS OF BUILT STEEL COLUMNS
SKETCH SHOWING LOCATION OF GAUGE LENGTHS.
TESTS 14910-13 INCLUSIVE



No. 14910.

Built **I** column.
Figure 1, 60,000-lb. carbon steel.
Length of column, 12 ft. 10.80 in.
Weight, 413 lbs.
Sectional area, 9.018 sq. in.
Gauge lengths as per sketch.
Pin ends, figure 3, pins vertical in plane of web.
Length from center to center of pins, 13 ft. 7.50 in.

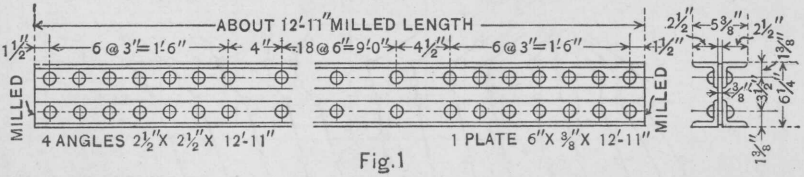


Fig.1

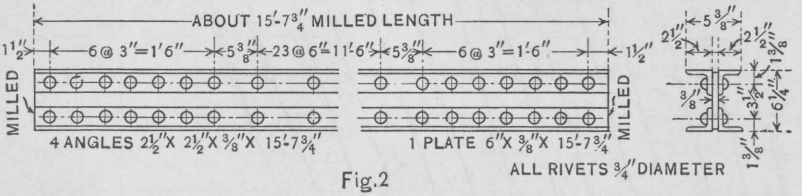
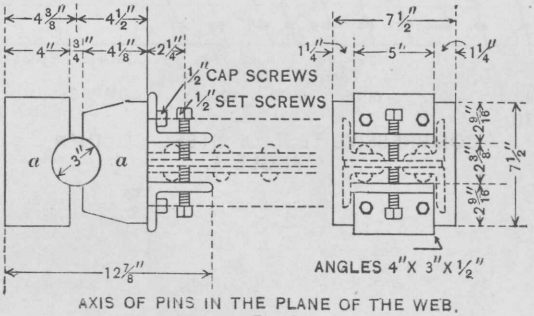
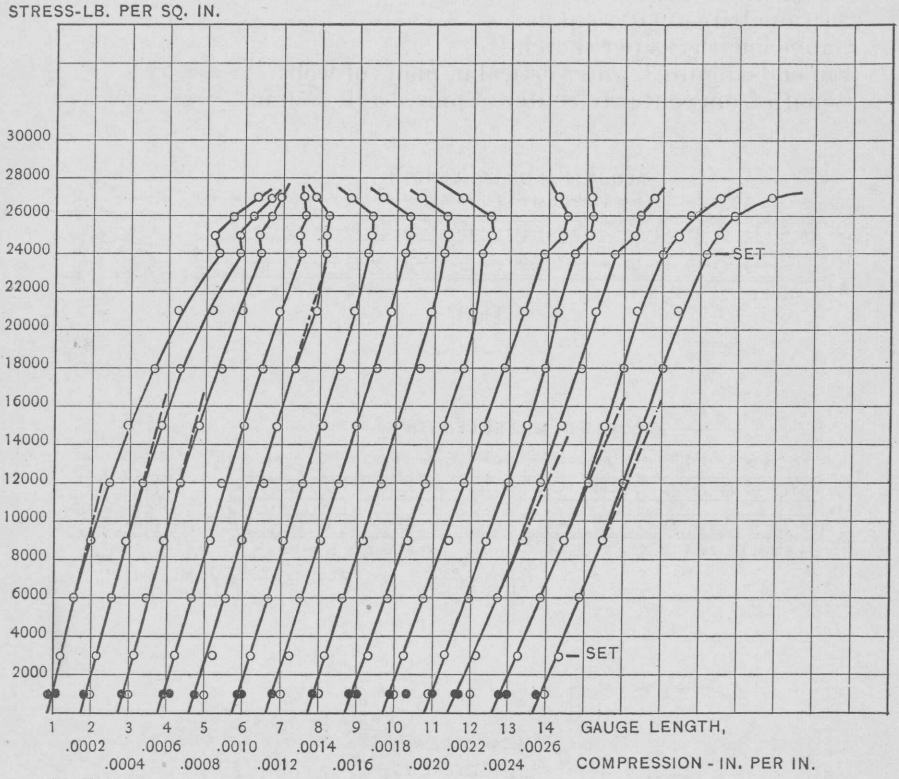


Fig.2



AXIS OF PINS IN THE PLANE OF THE WEB.

Fig.3



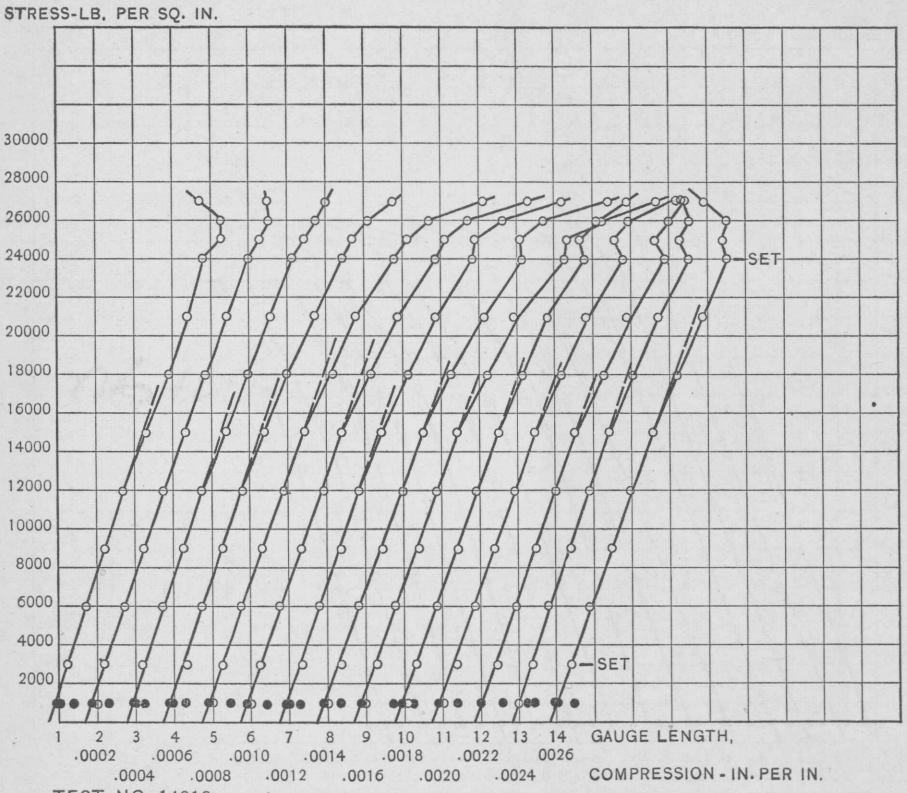
TEST NO. 14910.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE A.

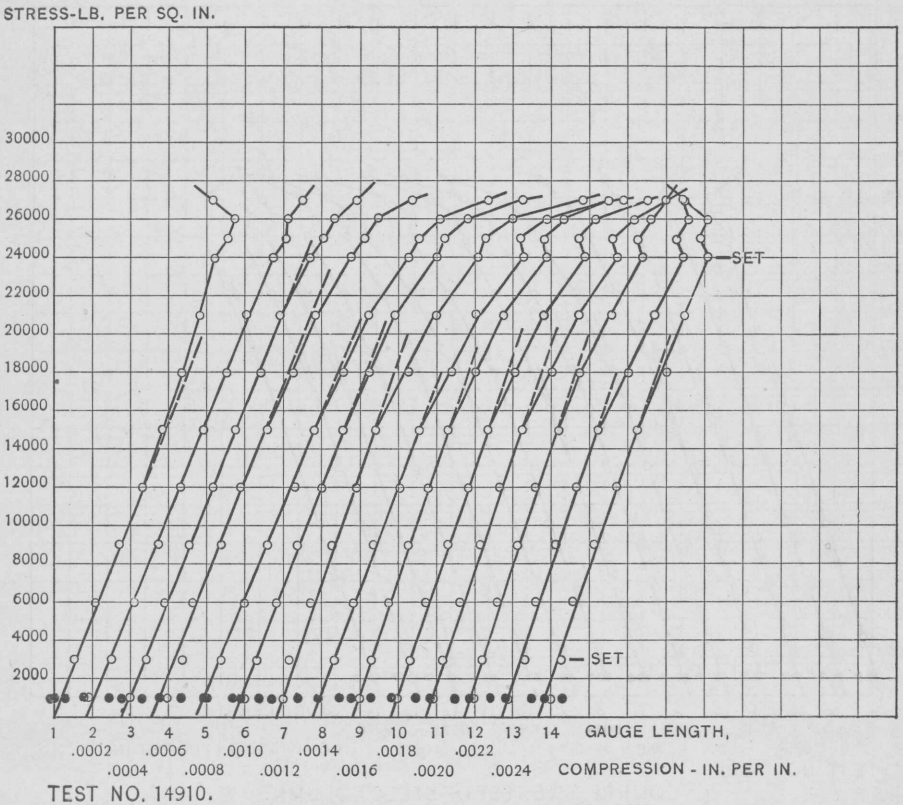
Gauge lengths.

Total load.	Stress per square inch.		1		2		3		4		5		6		7		8		9		10		11		12		13		14		Deflections.	
			Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Horizontal.	Vertical.
Lb.	*Lb.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
9,018	1,000	A	0.0046	0.	0.0057	0.	0.0072	0.	.0055	0.	0.0039	0.	0.0052	0.	0.0075	0.	.0047	0.	0.0040	0.	0.0042	0.	0.0046	0.	0.0041	0.	0.0078	0.	0.0063	0.		
		B	.0050	0.	.0083	0.	.0058	0.	.0052	0.	.0057	0.	.0059	0.	.0051	0.	.0042	0.	.0096	0.	.0093	0.	.0096	0.	.0063	0.	.0093	0.	.0080	0.		
		C	.0084	0.	.0104	0.	.0067	0.	.0075	0.	.0105	0.	.0076	0.	.0068	0.	.0112	0.	.0094	0.	.0090	0.	.0072	0.	.0084	0.	.0086	0.	.0124	0.		
		D	.0024	0.	.0021	0.	.0039	0.	.0069	0.	.0082	0.	.0029	0.	.0037	0.	.0050	0.	.0064	0.	.0033	0.	.0074	0.	.0052	0.	.0027	0.	.0070	0.	0.	0.
27,052	3,000	A	.0050	.00004	.0060	.00003	.0075	.00003	.0060	.00005	.0044	.00005	.0057	.00005	.0080	.00005	.0052	.00005	.0047	.00007	.0048	.00006	.0053	.00007	.0045	.00004	.0084	.00006	.0071	.00008		
		B	.0054	.00004	.0086	.00003	.0062	.00004	.0057	.00005	.0062	.00005	.0064	.00005	.0057	.00006	.0047	.00005	.0101	.00005	.0099	.00006	.0102	.00006	.0071	.00008	.0099	.00006	.0087	.00007		
		C	.0095	.00011	.0114	.00010	.0075	.00008	.0083	.00008	.0113	.00008	.0083	.00007	.0074	.00006	.0120	.00008	.0101	.00007	.0097	.00007	.0077	.00005	.0089	.00005	.0092	.00006	.0130	.00006		
		D	.0033	.00009	.0028	.00007	.0046	.00007	.0077	.00008	.0089	.00007	.0036	.00007	.0045	.00008	.0059	.00009	.0071	.00007	.0040	.00007	.0080	.00006	.0058	.00006	.0033	.00006	.0074	.00004	0.	0.
9,018	1,000	A	.0045	−.00001	.0055	−.00002	.0070	−.00002	.0054	−.00001	.0036	−.00003	.0050	−.00002	.0072	−.00003	.0045	−.00002	.0040	0.	.0041	−.00001	.0045	−.00001	.0036	−.00005	.0075	−.00003	.0060	−.00003		
		B	.0047	−.00003	.0080	−.00003	.0056	−.00002	.0050	−.00002	.0055	−.00002	.0057	−.00002	.0049	−.00002	.0040	−.00002	.0093	−.00003	.0091	−.00002	.0094	−.00002	.0063	0.	.0089	−.00004	.0078	−.00002		
		C	.0083	−.00001	.0102	−.00002	.0064	−.00003	.0072	−.00003	.0102	−.00003	.0074	−.00002	.0064	−.00004	.0111	−.00001	.0091	−.00003	.0088	−.00002	.0070	−.00002	.0082	−.00002	.0084	−.00002	.0122	−.00002		
		D	.0024	0.	.0020	−.00001	.0038	−.00001	.0069	0.	.0082	0.	.0027	−.00002	.0036	−.00001	.0050	0.	.0063	−.00001	.0032	−.00001	.0073	−.00001	.0051	−.00001	.0026	−.00001	.0068	−.00002	0.	0.
54,105	6,000	A	.0057	.00011	.0068	.00011	.0082	.00010	.0068	.00013	.0051	.00012	.0066	.00014	.0086	.00011	.0060	.00013	.0057	.00017	.0058	.00016	.0065	.00019	.0056	.00015	.0096	.00018	.0081	.00018		
		B	.0064	.00014	.0097	.00014	.0072	.00014	.0067	.00015	.0072	.00015	.0075	.00016	.0067	.00016	.0058	.00016	.0111	.00015	.0110	.00017	.0112	.00016	.0081	.00018	.0108	.00015	.0097	.00017		
		C	.0106	.00022	.0126	.00022	.0086	.00019	.0088	.00013	.0125	.00020	.0094	.00018	.0084	.00016	.0130	.00018	.0111	.00017	.0106	.00016	.0086	.00014	.0098	.00014	.0100	.00014	.0138	.00014		
		D	.0044	.00020	.0037	.00016	.0055	.00016	.0085	.00016	.0099	.00017	.0045	.00016	.0053	.00016	.0068	.00018	.0080	.00016	.0048	.00015	.0088	.00014	.0067	.00015	.0042	.00015	.0083	.00013	0.01	0.
81,150	9,000	A	.0066	.00020	.0076	.00019	.0091	.00019	.0078	.00023	.0059	.00020	.0074	.00022	.0097	.00022	.0071	.00024	.0067	.00027	.0070	.00028	.0075	.00029	.0069	.00028	.0108	.00030	.0093	.00030		
		B	.0074	.00024	.0107	.00024	.0083	.00025	.0077	.00025	.0083	.00026	.0085	.00026	.0078	.00027	.0070	.00028	.0123	.00027	.0121	.00028	.0123	.00027	.0092	.00029	.0120	.00027	.0108	.00028		
		C	.0119	.00035	.0139	.00035	.0099	.00032	.0104	.00029	.0138	.00033	.0105	.00029	.0096	.00028	.0141	.00029	.0121	.00027	.0117	.00027	.0096	.00024	.0108	.00024	.0110	.00024	.0148	.00024		
		D	.0054	.00030	.0048	.00027	.0066	.00027	.0096	.00027	.0110	.00028	.0055	.00026	.0064	.00027	.0078	.00028	.0090	.00026	.0059	.00026	.0100	.00026	.0077	.00025	.0052	.00025	.0095	.00025	0.02	0.01
108,200	12,000	A	.0076	.00030	.0084	.00027	.0099	.00027	.0084	.00029	.0070	.00031	.0084	.00032	.0106	.00031	.0080	.00033	.0076	.00036	.0079	.00037	.0085	.00039	.0078	.00037	.0120	.00042	.0103	.00040		
		B	.0084	.00034	.0118	.00035	.0093	.00035	.0088	.00036	.0094	.00037	.0097	.00038	.0088	.00037	.0081	.00039	.0133	.00037	.0131	.00038	.0134	.00038	.0103	.00040	.0130	.00037	.0119	.00039		
		C	.0131	.00047	.0151	.00047	.0111	.00044	.0115	.00040	.0151	.00046	.9117	.00041	.0107	.00039	.0154	.00042	.0131	.00037	.0128	.00038	.0107	.00035	.0118	.00034	.0121	.00035	.0159	.00035		
		D	.0066	.00042	.0058	.00037	.0075	.00036	.0106	.00037	.0120	.00038	.0065	.00036	.0074	.00037	.0087	.00037	.0100	.00036	.0070	.00037	.0110	.00036	.0087	.00035	.0062	.00035	.0106	.00036	0.02	0.01
135,260	15,000	A	.0085	.00039	.0094	.00037	.0109	.00037	.0096	.00041	.0077	.00038	.0094	.00042	.0115	.00040	.0088	.00041	.0086	.00046	.0089	.00047	.0096	.00050	.0089	.00048	.0129	.00051	.0114	.00051		
		B	.0096	.00046	.0129	.00046	.0105	.00047	.0100	.00048	.0105	.00048	.0107	.00048	.0100	.00049	.0092	.00050	.0143	.00047	.0142	.00049	.0144	.00048	.0113	.00050	.0140	.00047	.0130	.00050		
		C	.0141	.00057	.0163	.00059	.0123	.00056	.0127	.00052	.0162	.00057	.0128	.00052	.0117	.00049	.0164	.00052	.0141	.00047	.0138	.00048	.0118	.00046	.0129	.00045	.0132	.00046	.0170	.00046		
		D	.0077	.00053	.0069	.00048	.0084	.00045	.0115	.00046	.0130	.00048	.0074	.00045	.0083	.00046	.0098	.00048	.0111	.00047	.0079	.00046	.0122	.00048	.0099	.00047	.0074	.00047	.0119	.00049	0.03	0.02
162,300	18,000	A	.0099	.00053	.0106	.00049	.0120	.00048	.0105	.00050	.0086	.00047	.0103	.00051	.0125	.00050	.0100	.00053	.0096	.00056	.0100	.00058	.0105	.00059	.0099	.00058	.0138	.00060	.0124	.00061		
		B	.0108	.00058	.0140	.00057	.0117	.00059	.0112	.00060	.0120	.00063	.0122	.00063	.0113	.00062	.0106	.00064	.0159	.00063	.0155	.00062	.0158	.00062	.0128	.00065	.0153	.00060	.0142	.00062		
		C	.0152	.00068	.0175	.00071	.0136	.00069	.0141	.00066	.0177	.00072	.0142	.00066	.0134	.00066	.0180	.00068	.0155	.00061	.0153	.00063	.0133	.00061	.0142	.00056	.0146	.00060	.0183	.00059		
		D	.0090	.00066	.0081	.00060	.0096	.00057	.0128	.00059	.0141	.00059	.0085	.00056	.0094	.00057	.0109	.00059	.0122	.00058	.0090	.00057	.0133	.00059	.0110	.00058	.0086	.00059	.0134	.00064	0.04	0.02
189,360	21,000	A	.0112	.00066	.0120	.00063	.0131	.00059	.0114	.00059	.0097	.00058	.0111	.00059	.0133	.00058	.0105	.00058	.0101	.00061	.0110	.00068	.0111	.00065	.0107	.00066	.0146	.00068	.0132	.00069		
		B	.0118	.00068	.0151	.00068	.0129	.00071	.0126	.00074	.0133	.00076	.0136	.00077	.0128	.00077	.0124	.00082	.0174	.00078	.0169	.00076	.0172	.00076	.0140	.00077	.0166	.00073	.0156	.00076		
		C	.0161	.00077	.0186	.00082	.0147	.00080	.0154	.00079	.0191	.00086	.0156	.00080	.0148	.00080	.0194	.00082	.0170	.00076	.0168	.00078	.0148	.00076	.0156	.00072	.0161	.00075	.0194	.00070		
		D	.0104	.00080	.0094	.00073	.0107	.00068	.0137	.00068	.0151	.00069	.0094	.00065	.0102	.00065	.0118	.00068	.0129	.00065	.0099	.00066	.0143	.00069	.0123	.00071	.0101	.00074	.0149	.00079	0.07	0.02
216,400	24,000	A	.0133	.00087	.0135	.00078	.0141	.00069	.0125	.00070	.0102	.00063	.0117	.00065	.0139	.00064	.0111	.00064	.0165	.00065	.0120	.00078	.0120	.00074	.0117	.00076	.0158	.00080	.0146	.00083		
		B	.0126	.00076	.0162	.00079	.0140	.00082	.0141	.00089	.0152	.00095	.0156	.00097	.0147	.00096	.0144	.00102	.0201	.00105	.0188	.00095	.0191	.00095	.0159	.00096	.0181	.00088	.0168	.00088		
		C	.0168	.00084	.0199	.00095	.0162	.00095	.0171	.00096	.0211	.00106	.0177	.00101	.0171	.00103	.0218	.00106	.0192	.00098	.0189	.00099	.0167	.00095	.0172	.00088	.0176	.00090	.0206	.00082		
		D	.0123	.00099	.0111	.00090	.0120	.00081	.0147	.00078	.0158	.00076	.0100	.00071	.0108	.00071	.0123	.00073	.0134	.00070	.0105	.00072	.0152	.00078	.0133	.00081	.0118	.00091	.0167	.00097	0.13	0.02
9,018	1,000	A	.0047	.00001	.0057	0.	.0072	0.	.0056	.00001	.0035	−.00004	.0051	−.00001	.0075	0.	.0046	−.00001	.0037	−.00003	.0048	.00006	.0045	−.00001	.0035	−.00006	.0077	−.00001	.0061	−.00002		
		B	.0057	.00007	.0088	.00005	.0062	.00004	.0057	.00005	.0066	.00009	.0067	.00008	.0055	.00004	.0049	.00007	.0111	.00015	.0096	.00003	.0103	.00007	.0074	.00011	.0099	.00006	.0088	.00008		
		C	.0089	.00005	.0114	.00010	.0074	.00007	.0082	.00007	.0120	.00015	.0085	.00009	.0077	.00009	.0124	.00012	.0100	.00006	.0100	.00010	.0083	.00011	.0093	.00009	.0098	.00012	.0131	.00007		
		D	.0028	.00004	.0026	.00005	.0042	.00003	.0073	.00004	.0086	.00004	.0031	.00002	.0042	.00005	.0056	.00006	.0067	.00003	.0036	.00003	.0080	.00006	.0058	.00006	.0039	.00012	.0080	.00010	0.02	0.02
225,418	25,000	A	.0130	.00084	.0134	.00077	.0140	.00068	.0124	.00069	.0102	.00063	.0119	.00067	.0142	.00067	.0114	.00067	.0111	.00071	.0130	.00088	.0128	.00082	.0127	.00086	.0167	.00089	.0153	.00090		
		B	.0134	.00084	.0168	.00085	.0146	.00088	.0146	.00094	.0158	.00101	.0161	.00102	.0149	.00098	.0143	.00101	.0202	.00106	.0184	.00091	.0186	.00090	.0155	.00092	.0177	.00084	.0166	.00086		
		C	.0175	.00091	.0206	.00102	.0168	.00101	.0178	.00103	.0217	.00112	.0181	.00105	.0174	.00106	.0217	.00105	.0191	.00097	.0186	.00096	.0165	.00093	.0169	.00085	.0172	.00086	.0203	.00079		
		D	.0121	.00097	.0110	.00089	.0119	.00080	.0147	.00078	.0159	.00077	.0102	.00073	.0113	.00076	.0129	.00079	.0141	.00077	.0114	.00081	.0162	.00088	.0141	.00089	.0133	.00106	.0177	.00107	0.11	0.02
234,436	26,000	A	.0140	.00094	.0141	.00084	.0146	.00074	.0127	.00072	.0103	.00064	.0119	.00067	.0142	.00067	.0113	.00066	.0110	.00070	.0133	.00091	.0130	.00084	.0130	.00089	.0174	.00096	.0162	.00099		
		B	.0135	.00085	.0173	.00090	.0153	.00095	.0154	.00102	.0171	.00114	.0173	.00114	.0163	.00112	.0156	.00114	.0219	.00123	.0194	.00101	.0194	.00098	.0163	.00100	.0181	.00088	.0168	.00088		
		C	.0177	.00093	.0212	.00103	.0176	.00109	.0186	.00111	.0228	.00123	.0193	.00117	.0188	.00120	.0232	.00120	.0203	.00109	.0197	.00107	.0175	.00103	.0176	.00092	.0178	.00092	.0206	.00082		
		D	.0130	.00106	.0117	.00096	.0123	.00084	.0150	.00081	.0160	.00078	.0101	.00072	.0112	.00075	.0126	.00076	.0140	.00076	.0114	.00081	.0165	.00091	.0146	.00094	.0142	.00115	.0188	.00118	0.16	0.02
243,450	27,000	A	.0154	.00108	.0152	.00095	.0151	.00079	.0126	.00071	.0096	.00057	.0108	.00056	.0128	.00053	.0100	.00053	.0095	.00055	.0128	.00086	.0129	.00083	.0137	.00096	.0189	.00111	.0181	.00118		
		B	.0124	.00074	.0172	.00089	.0158	.00100	.0167	.00115	.0198	.00141	.9204	.00145	.0194	.00143	.0189	.00147	.0264	.00168	.0210	.00117	.0208	.00112	.0169	.00106	.0177	.00084	.0157	.00077		
		C	.0167	.00083	.0214	.00110	.0186	.00119	.0203	.00128	.0253	.00148	.0222	.00146	.0225	.00157	.0264	.00152	.0232	.00138	.0221	.00131	.0193	.00121	.0184	.00100	.0177	.00091	.0193	.00069		
		D	.0155	.00131	.0129	.00108	.0126	.00087	.0144	.00075	.0146	.00064	.0081	.00052	.0087	.00050	.0102	.00052	.0121	.00057	.0102	.00069	.0160	.00086	.0151	.00099	.0163	.00136	.0221	.00151	0.37	0.00

Column gradually yielded under reduced loads until a load of 234,800 lb. = 26,390 lb. per sq. in. was reached, when it sprung suddenly to the east at middle of length.

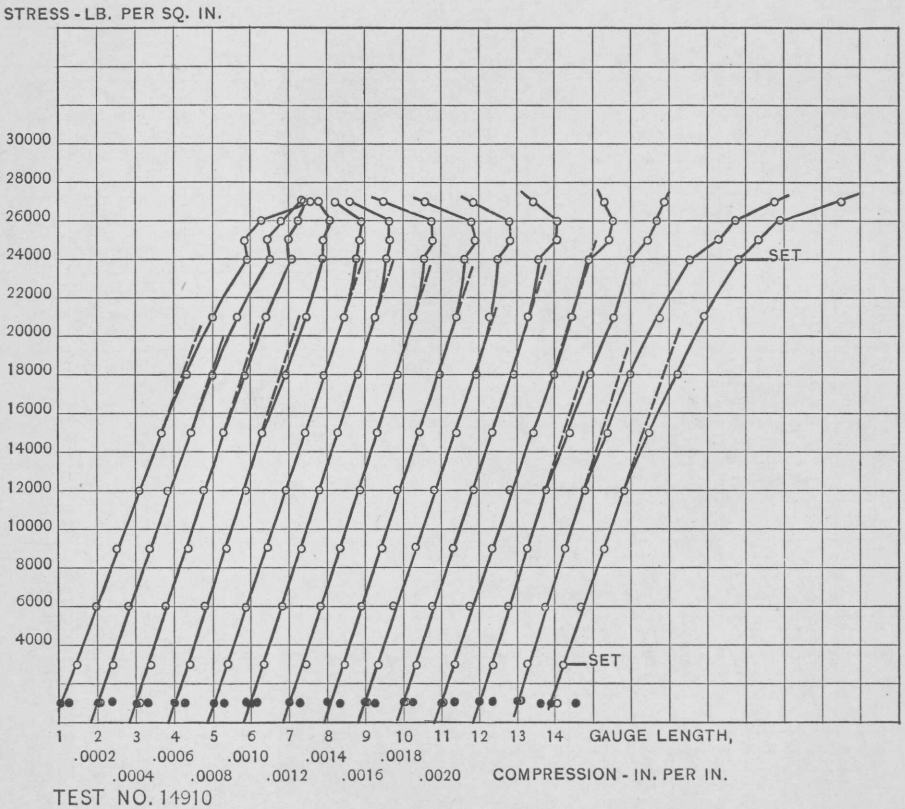


COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE B.



TEST NO. 14910.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE C.



TEST NO. 14910

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE D.

No. 14911.

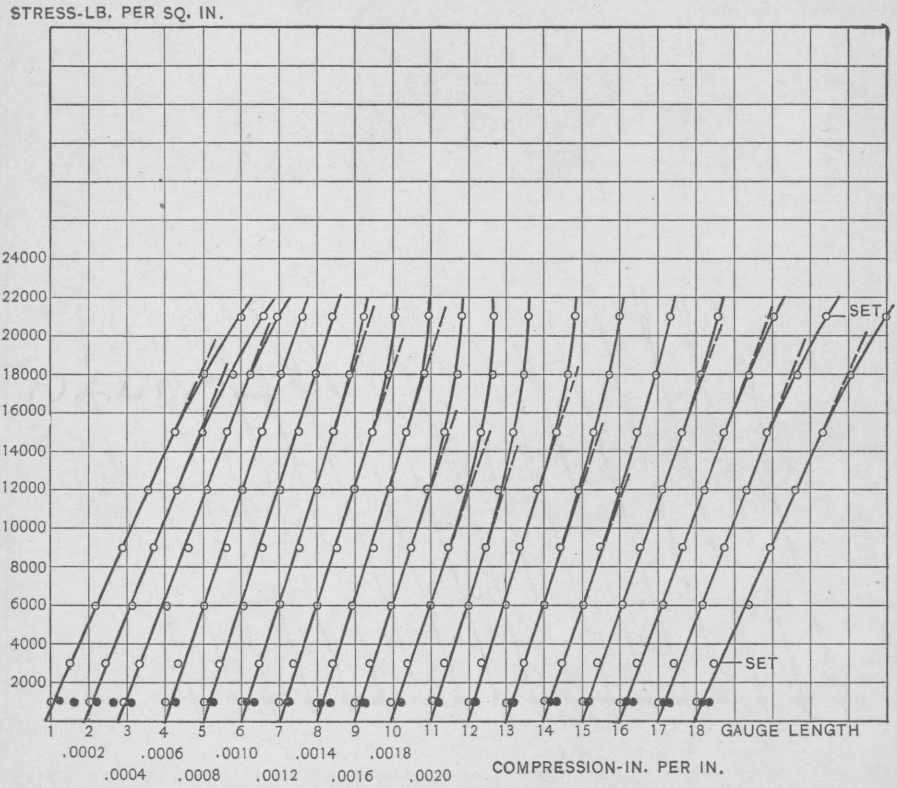
Built I column.
Figure 2, 60,000 lbs. carbon steel.
Length of column, 15 ft., 7.60 in.
Weight, 498½ lbs.
Sectional area, 9 sq. in.
Gauge lengths as per sketch.
Pin ends, figure 3, pins vertical in plane of web.
Length from center to center of pins, 16 ft., 4.30 in.

Built I Column. Schedule No. 2.

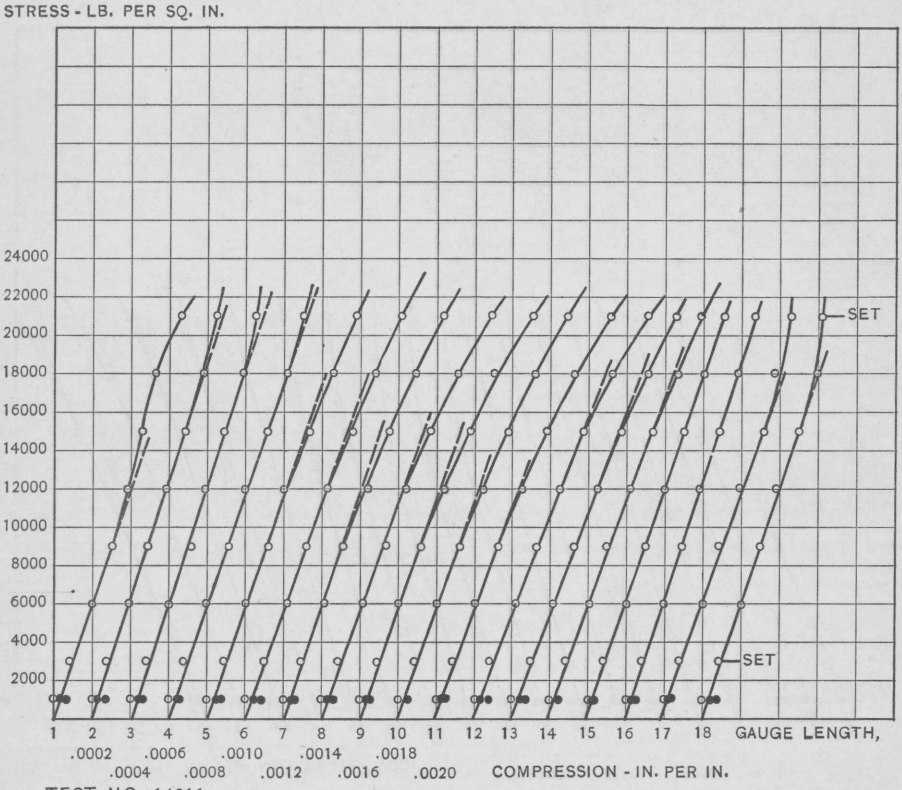
Gauge lengths.

Total load.	Stress per square inch.		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		Deflections.	
			Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Horizontal.	Vertical.
Lb.	*Lb.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
9,000	1,000	A	0.0124	0.	0.0141	0.	0.0136	0.	0.0134	0.	0.0145	0.	0.0150	0.	0.0093	0.	0.0162	0.	0.0092	0.	0.0118	0.	0.0134	0.	0.0120	0.	0.0150	0.	0.0112	0.	0.0106	0.	0.0131	0.	0.0125	0.	0.0132	0.	0.	0.
		B	.0138	0.	.0093	0.	.0131	0.	.0107	0.	.0103	0.	.0112	0.	.0118	0.	.0092	0.	.0128	0.	.0112	0.	.0115	0.	.0115	0.	.0102	0.	.0168	0.	.0138	0.	.0133	0.	.0123	0.	.0123	0.	.....	.....
		C	.0099	0.	.0100	0.	.0120	0.	.0125	0.	.0090	0.	.0125	0.	.0118	0.	.0092	0.	.0124	0.	.0130	0.	.0136	0.	.0119	0.	.0128	0.	.0130	0.	.0116	0.	.0110	0.	.0124	0.	.0130	0.	.....	.....
		D	.0112	0.	.0112	0.	.0123	0.	.0118	0.	.0132	0.	.0129	0.	.0106	0.	.0120	0.	.0124	0.	.0130	0.	.0136	0.	.0119	0.	.0128	0.	.0130	0.	.0116	0.	.0110	0.	.0124	0.	.0130	0.	.....	.....
27,000	3,000	A	.0135	.00011	.0151	.00010	.0144	.00008	.0142	.00008	.0154	.00009	.0160	.00010	.0101	.00008	.0170	.00008	.0100	.00008	.0127	.00009	.0142	.00008	.0128	.00008	.0160	.00010	.0122	.00010	.0115	.00009	.0141	.00010	.0135	.00010	.0143	.00011	0. 01	0. 01
		B	.0146	.00008	.0100	.00007	.0139	.00008	.0115	.00008	.0112	.00009	.0122	.00010	.0127	.00009	.0109	.00009	.0109	.00009	.0127	.00009	.0128	.00009	.0106	.00009	.0157	.00010	.0162	.00009	.0139	.00008	.0153	.00008	.0120	.00008	.0110	.00008	.....	.....
		C	.0110	.00011	.0110	.00010	.0129	.00009	.0135	.00010	.0100	.00010	.0134	.00009	.0128	.00010	.0100	.00008	.0139	.00011	.0123	.00011	.0126	.00011	.0125	.00010	.0112	.00010	.0177	.00009	.0149	.00011	.0141	.00008	.0132	.00009	.0132	.00009	.....	.....
		D	.0122	.00010	.0122	.00010	.0133	.00010	.0128	.00010	.0141	.00009	.0139	.00010	.0115	.00009	.0129	.00009	.0134	.00010	.0140	.00010	.0145	.00009	.0128	.00009	.0137	.00009	.0140	.00010	.0125	.00009	.0119	.00009	.0133	.00009	.0140	.00009	.....	.....
9,000	1,000	A	.0128	.00004	.0145	.00004	.0139	.00003	.0138	.00004	.0149	.00004	.0154	.00004	.0097	.00004	.0165	.00003	.0095	.00003	.0123	.00005	.0138	.00004	.0123	.00003	.0153	.00003	.0115	.00003	.0110	.00004	.0135	.00004	.0128	.00003	.0136	.00003	0. 01	0.
		B	.0141	.00003	.0097	.00004	.0135	.00004	.0111	.00004	.0108	.00005	.0171	.00005	.0122	.00004	.0104	.00004	.0104	.00004	.0122	.00004	.0122	.00003	.0100	.00003	.0152	.00005	.0158	.00005	.0134	.00003	.0148	.00003	.0115	.00003	.0106	.00004	.....	.....
		C	.0103	.00004	.0104	.00004	.0124	.00004	.0128	.00003	.0094	.00004	.0128	.00003	.0123	.00005	.0096	.00004	.0133	.00005	.0115	.00003	.0119	.00004	.0120	.00005	.0107	.00005	.0171	.00003	.0144	.00006	.0136	.00003	.0127	.00004	.0126	.00003	.....	.....
		D	.0114	.00002	.0114	.00002	.0126	.00003	.0122	.00004	.0135	.00003	.0132	.00003	.0109	.00003	.0123	.00003	.0127	.00003	.0135	.00005	.0138	.00002	.0122	.00003	.0130	.00002	.0133	.00003	.0118	.00002	.0112	.00002	.0127	.00003	.0133	.00002	.....	.....
54,000	6,000	A	.0148	.00024	.0164	.00023	.0157	.00021	.0154	.00020	.0166	.00021	.0170	.00020	.0113	.00020	.0181	.00019	.0112	.00020	.0138	.00020	.0154	.00020	.0139	.00019	.0170	.00020	.0133	.00021	.0128	.00022	.0154	.00023	.0149	.00024	.0160	.00028	0. 01	0. 01
		B	.0158	.00020	.0112	.00019	.0151	.00020	.0127	.00020	.0124	.00021	.0134	.00022	.0139	.00021	.0122	.00022	.0121	.00021	.0139	.00021	.0140	.00021	.0119	.00022	.0169	.00022	.0174	.00021	.0151	.00020	.0164	.00019	.0132	.00020	.0122	.00020	.....	.....
		C	.0123	.00024	.0123	.00023	.0141	.00021	.0148	.00023	.0112	.00022	.0148	.00023	.0141	.00023	.0114	.00022	.0152	.00024	.0135	.00023	.0138	.00023	.0139	.00024	.0125	.00023	.0188	.00020	.0162	.00024	.0154	.00021	.0143	.00020	.0146	.00023	.....	.....
		D	.0135	.00023	.0135	.00023	.0145	.00022	.0140	.00022	.0153	.00021	.0151	.00022	.0127	.00021	.0140	.00020	.0144	.00020	.0153	.00023	.0156	.00020	.0139	.00020	.0148	.00020	.0151	.00021	.0137	.00021	.0131	.00021	.0144	.00020	.0152	.00021	.....	.....
81,000	9,000	A	.0162	.00038	.0175	.00034	.0168	.00032	.0165	.00031	.0176	.00031	.0180	.00030	.0123	.00030	.0191	.00029	.0122	.00030	.0148	.00030	.0163	.00029	.0148	.00028	.0179	.00029	.0142	.00030	.0138	.00032	.0165	.00034	.0161	.00036	.0172	.00040	0. 02	0. 01
		B	.0168	.00030	.0122	.00029	.0162	.00031	.0138	.00031	.0135	.00032	.0144	.00032	.0149	.00031	.0133	.00033	.0132	.00032	.0150	.00032	.0152	.00033	.0130	.00033	.0180	.00033	.0183	.00030	.0161	.00030	.0174	.00029	.0141	.00029	.0132	.00030	.....	.....
		C	.0133	.00034	.0133	.00033	.0152	.00032	.0159	.00034	.0123	.00033	.0159	.00034	.0152	.00034	.0126	.00034	.0164	.00036	.0146	.00034	.0150	.00035	.0150	.00035	.0136	.00034	.0199	.00031	.0172	.00034	.0164	.00031	.0154	.00031	.0156	.00033	.....	.....
		D	.0146	.00034	.0146	.00034	.0157	.00034	.0151	.00033	.0164	.00032	.0162	.00033	.0137	.00031	.0150	.00030	.0154	.00030	.0163	.00033	.0166	.00030	.0150	.00031	.0157	.00029	.0162	.00032	.0147	.00031	.0141	.00031	.0155	.00031	.0165	.00034	.....	.....
108,000	12,000	A	.0175	.00051	.0187	.00046	.0178	.00042	.0175	.00041	.0185	.00040	.0190	.00040	.0133	.00040	.0200	.00038	.0130	.00038	.0153	.00035	.0170	.00036	.0157	.00037	.0188	.00038	.0152	.00040	.0148	.00042	.0176	.00045	.0172	.00047	.0185	.00053	0. 04	0. 02
		B	.0176	.00038	.0132	.00039	.0170	.00039	.0148	.00041	.0145	.00042	.0156	.00044	.0162	.00044	.0144	.00046	.0138	.00046	.0144	.00044	.0163	.00045	.0164	.00045	.0142	.00045	.0192	.00045	.0195	.00042	.0171	.00040	.0183	.00038	.0152	.00040	.0141	.00039	.....	.....
		C	.0142	.00043	.0143	.00043	.0162	.00042	.0168	.00043	.0134	.00044	.0170	.00045	.0164	.00046	.0160	.00048	.0176	.00048	.0160	.00048	.0164	.00049	.0164	.00049	.0149	.00047	.0210	.00042	.0181	.00043	.0173	.00040	.0165	.00042	.0166	.00043	.....	.....
		D	.0160	.00048	.0158	.00046	.0168	.00045	.0162	.00044	.0173	.00041	.0170	.00041	.0147	.00041	.0160	.00040	.0164	.00040	.0171	.00041	.0174	.00038	.0164	.00045	.0167	.00039	.0172	.00042	.0158	.00042	.0152	.00042	.0167	.00043	.0177	.00046	.....	.....
135,000	15,000	A	.0189	.00065	.0200	.00059	.0189	.00053	.0185	.00051	.0195	.00050	.0199	.00049	.0142	.00049	.0209	.00047	.0139	.00047	.0164	.00046	.0178	.00044	.0166	.00046	.0196	.00046	.0162	.00050	.0159	.00053	.0187	.00056	.0183	.00058	.0199	.00067	0. 06	0. 02
		B	.0184	.00046	.0142	.00049	.0180	.00049	.0159	.00052	.0157	.00054	.0168	.00056	.0173	.00055	.0157	.00057	.0158	.00058	.0176	.00058	.0177	.00058	.0154	.00057	.0204	.00057	.0206	.00053	.0181	.00050	.0194	.00049	.0164	.00052	.0152	.00050	.....	.....
		C	.0151	.00052	.0153	.00053	.0171	.00051	.0179	.00054	.0145	.00055	.0181	.00056	.0177	.00059	.0151	.00059	.0189	.00061	.0172	.00060	.0176	.00061	.0176	.00061	.0162	.00060	.0222	.00054	.0192	.00054	.0184	.00051	.0174	.00051	.0175	.00052	.....	.....
		D	.0171	.00059	.0170	.00058	.0178	.00055	.0172	.00054	.0183	.00051	.0180	.00051	.0157	.00051	.0169	.00049	.0172	.00048	.0179	.00049	.0184	.00049	.0169	.00050	.0177	.00049	.0181	.00051	.0167	.00051	.0163	.00053	.0178	.00054	.0189	.00058	.....	.....
162,000	18,000	A	.0204	.00080	.0216	.00075	.0201	.00065	.0195	.00061	.0204	.00059	.0207	.00057	.0150	.00057	.0218	.00056	.0146	.00054	.0170	.00052	.0183	.00049	.0172	.00052	.0204	.00054	.0171	.00059	.0169	.00063	.0199	.00068	.0198	.00073	.0214	.00082	0. 10	0. 02
		B	.0191	.00053	.0151	.00058	.0190	.00059	.0169	.00062	.0169	.00066	.0180	.00068	.0187	.00069	.0171	.00071	.0172	.00072	.0190	.00072	.0192	.00073	.0170	.00073	.0218	.00071	.0220	.00067	.0192	.00061	.0203	.00058	.0170	.00058	.0161	.00059	.....	.....
		C	.0160	.00061	.0163	.00063	.0180	.00060	.0189	.00064	.0158	.00063	.0194	.00069	.0190	.00072	.0167	.00075	.0204	.00076	.0188	.00076	.0192	.00077	.0191	.00076	.0175	.00073	.0233	.00065	.0203	.00065	.0193	.00060	.0182	.00059	.0182	.00059	.....	.....
		D	.0186	.00074	.0183	.00071	.0191	.00068	.0183	.00065	.0193	.00061	.0189	.00060	.0165	.00059	.0176	.00056	.0179	.00055	.0186	.00056	.0187	.00051	.0175	.00056	.0184	.00056	.0191	.00061	.0178	.00062	.0175	.00065	.0192	.00068	.0204	.00073	.....	.....
189,000	21,000	A	.0223	.00099	.0232	.00091	.0215	.00079	.0206	.00072	.0213	.00068	.0214	.00064	.0154	.00061	.0221	.00059	.0148	.00056	.0171	.00053	.0186	.00052	.0176	.00056	.0210	.00060	.0179	.00067	.0178	.00072	.0212	.00081	.0214	.00089	.0232	.00100	0. 17	0. 02
		B	.0204	.00066	.0158	.00065	.0197	.00066	.0178	.00071	.0181	.00078	.0194	.00082	.0202	.00084	.0189	.00089	.0191	.00091	.0207	.00089	.0211	.00092	.0188	.00091	.0233	.00086	.0232	.00079	.0202	.00071	.0212	.00067	.0178	.00066	.0164	.00062	.....	.....
		C	.0162	.00063	.0169	.00069	.0188	.00068	.0200	.00075	.0170	.00080	.0210	.00085	.0207	.00089	.0185	.00093	.0223	.00095	.0207	.00095	.0211	.00096	.0209	.00094	.0191	.00089	.0246	.00078	.0212	.00074	.0201	.00068	.0188	.00065	.0185	.00062	.....	.....
		D	.0204	.00092	.0200	.00088	.0205	.00082	.0194	.00076	.0202	.00070	.0195	.00066	.0170	.00064	.0180	.00060	.0182	.00058	.0188	.00058	.0190	.00054	.0176	.00057	.0190	.00062	.0200	.00070	.0189	.00073	.0189	.00079	.0208	.00084	.0222	.00091	.....	.....
9,000	1,000	A	.0136	.00012	.0154	.00013	.0142	.00005	.0139	.00005	.0151	.00006	.0156	.00006	.0098	.00005	.0169	.00007	.0097	.00005	.0123	.00005	.0138	.00004	.0125	.00005	.0155	.00005	.0119	.00006	.0111	.00005	.0137	.00006	.0132	.00007	.0140	.00008	0. 02	0.
		B	.0143	.00005	.0101	.00008	.0137	.00006	.0112	.00005	.0110	.00007	.0120	.00007	.0124	.00006	.0108	.00008	.0107	.00007	.0123	.00005	.0125	.00006	.0105	.00008	.0155	.00008	.0161	.00008	.0136	.00005	.0150	.00005	.0119	.00007	.0110	.00008	.....	.....
		C	.0105	.00006	.0109	.00009	.0126	.00006	.0132	.00006	.0096	.00006	.0131	.00006	.0124	.00006	.0098	.00006	.0136	.00008	.0119	.00007	.0122	.00007	.0124	.00009	.0110	.00008	.0173	.00005	.0145	.00007	.0139	.00006	.0128	.00005	.0128	.00005	.....	.....
		D	.0115	.00003	.0115	.00003	.0127	.00004	.0122	.00004	.0135	.00003	.0133	.00004	.0110	.00004	.0123	.00003	.0127	.00003	.0136	.00006	.0140	.00004	.0123	.00004	.0132	.00004	.0135	.00005	.0120	.00004	.0114	.00004	.0130	.00006	.0136	.00005	.....	.....

Ultimate strength = 216,000 lb. = 24,001 lb. per sq. in.
Column gradually deflected under maximum load until it sprung suddenly to east at middle of its length.

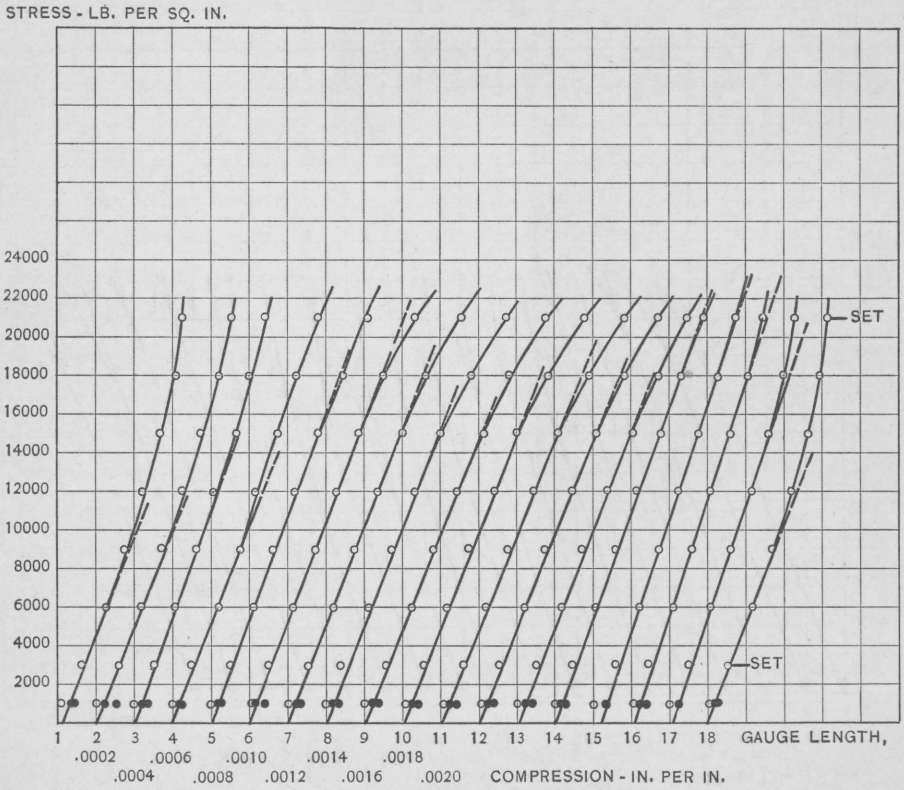


TEST NO. 14911 COMPRESSIVE TEST OF STEEL COLUMN. ANGLE A.



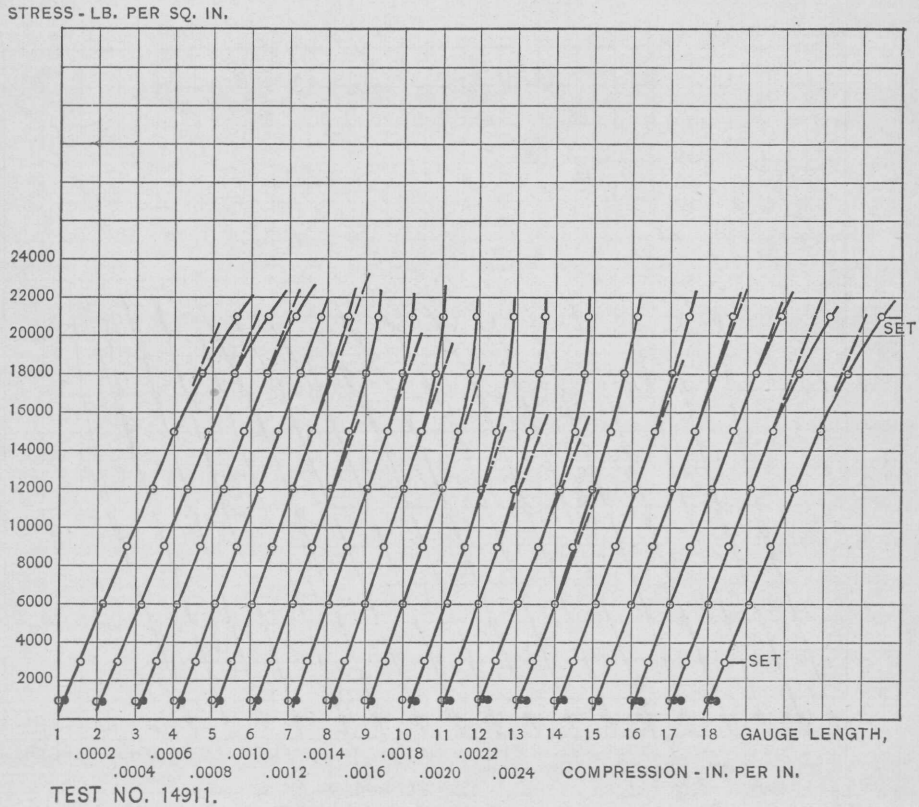
TEST NO. 14911.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE B.



TEST NO. 14911.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE C.



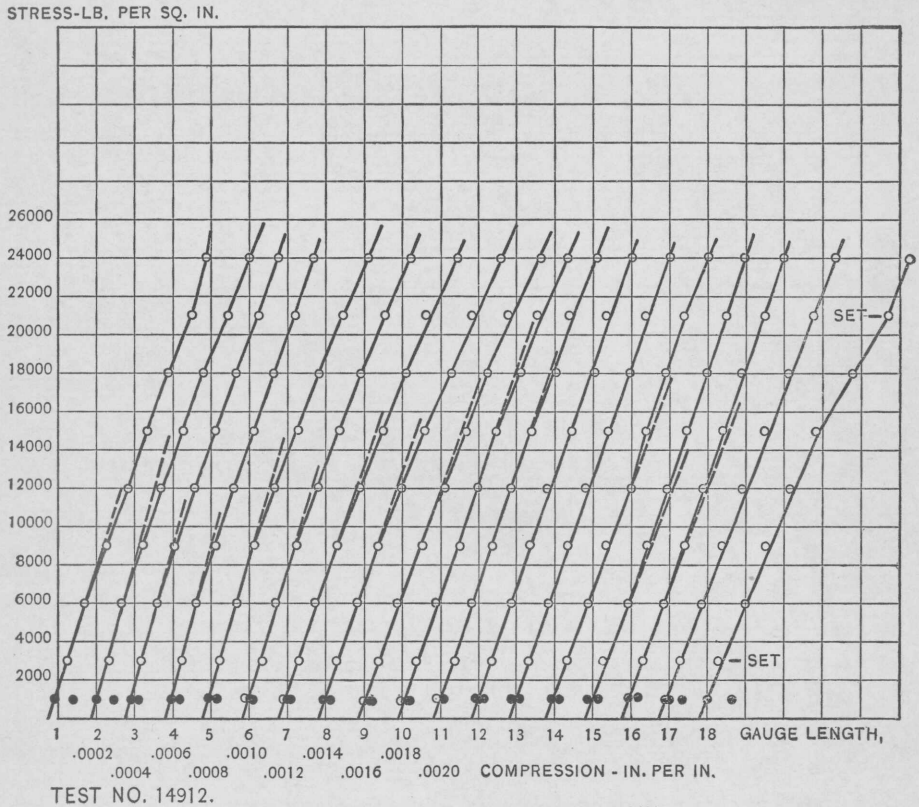
TEST NO. 14911.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE D.

No. 14912.

Built I column.
Figure 2, 60,000 lb. carbon steel.
Length of column, 15 ft., 7.60 in.
Weight, 501 lbs.
Sectional area, 9.046 sq. in.
Gauge lengths as per sketch.
Pin ends, figure 3, pins vertical in plane of web.
Length from center to center of pins, 16 ft., 4.30 in.

61783°—13——7



TEST NO. 14912.

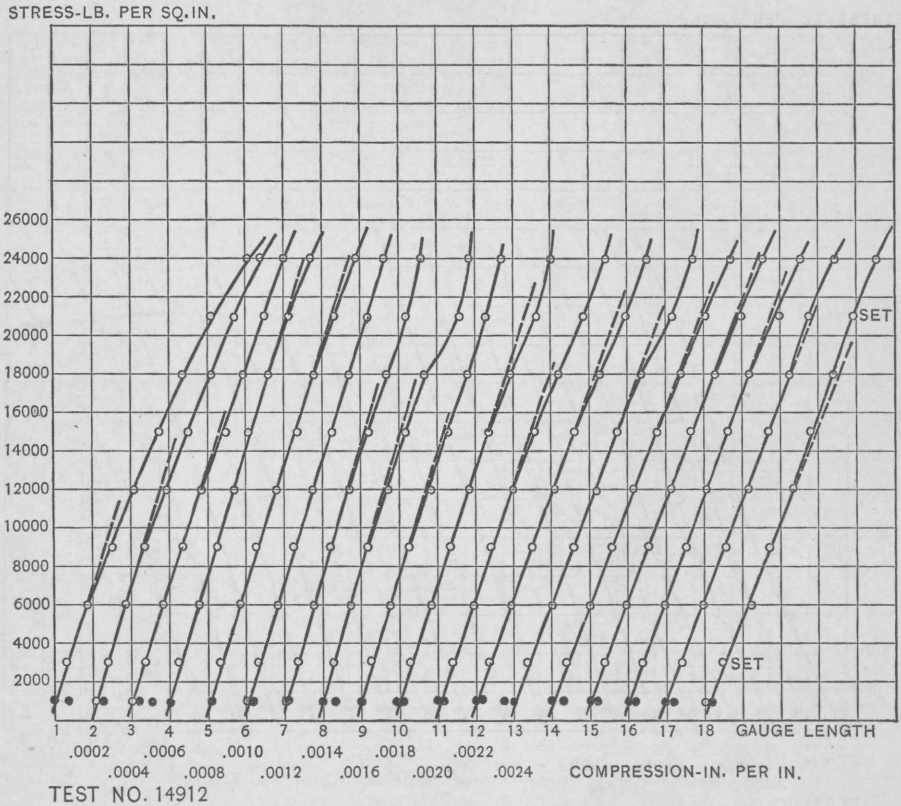
COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE A.

Built I Column. Schedule No. 2.

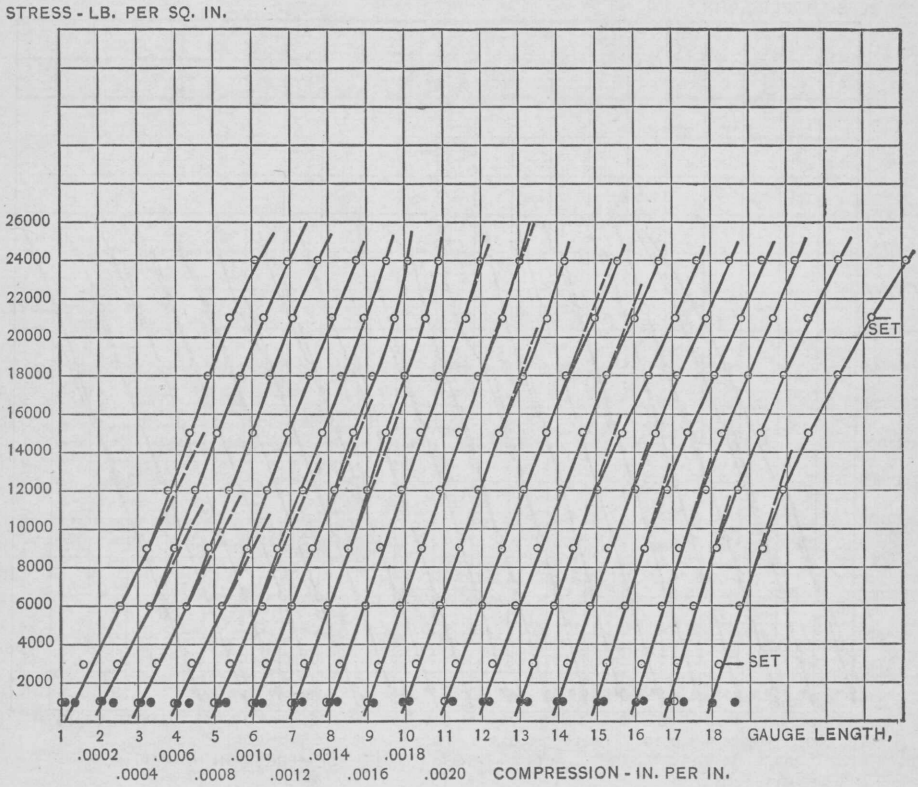
Gauge lengths.

Total load.	Stress per square inch.		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		Deflections.	
			Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Horizontal.	Vertical.
Lb.	*Lb.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
9,046	1,000	A	0.0055	0.	0.0076	0.	0.0111	0.	0.0034	0.	0.0049	0.	0.0059	0.	0.0062	0.	0.0051	0.	0.0088	0.	0.0034	0.	0.0057	0.	0.0056	0.	0.0041	0.	0.0048	0.	0.0054	0.	0.0036	0.	0.0029	0.	0.0041	0.	0.	0.
		B	.0065	0.	.0052	0.	.0058	0.	.0040	0.	.0081	0.	.0023	0.	.0059	0.	.0031	0.	.0065	0.	.0040	0.	.0068	0.	.0064	0.	.0082	0.	.0057	0.	.0054	0.	.0010	0.	.0063	0.	.0038	0.	.....	.....
		C	.0056	0.	.0127	0.	.0062	0.	.0049	0.	.0062	0.	.0050	0.	.0059	0.	.0048	0.	.0090	0.	.0048	0.	.0067	0.	.0079	0.	.0052	0.	.0073	0.	.0053	0.	.0054	0.	.0071	0.	.0034	0.	.....	.....
		D	.0092	0.	.0082	0.	.0047	0.	.0058	0.	.0058	0.	.0043	0.	.0031	0.	.0056	0.	.0040	0.	.0041	0.	.0076	0.	.0066	0.	.0050	0.	.0061	0.	.0086	0.	.0045	0.	.0046	0.	.0068	0.	.....	.....
27,139	3,000	A	.0060	.00005	.0082	.00006	.0115	.00004	.0039	.00005	.0054	.00005	.0066	.00007	.0069	.00007	.0058	.00007	.0097	.00009	.0043	.00009	.0065	.00008	.0064	.00008	.0048	.00007	.0055	.00007	.0061	.00007	.0043	.00007	.0036	.00007	.0048	.00007	0.01	0.
		B	.0070	.00005	.0059	.00007	.0064	.00006	.0044	.00004	.0086	.00005	.0029	.00006	.0065	.00006	.0036	.00005	.0070	.00005	.0045	.00005	.0075	.00007	.0070	.00006	.0089	.00007	.0064	.00007	.0061	.00007	.0017	.00007	.0071	.00008	.0048	.00010	.....	.....
		C	.0067	.00011	.0136	.00009	.0071	.00009	.0058	.00009	.0070	.00008	.0058	.00008	.0067	.00008	.0054	.00006	.0096	.00006	.0055	.00007	.0074	.00007	.0086	.00007	.0060	.00008	.0079	.00006	.0059	.00006	.0060	.00006	.0075	.00004	.0040	.00006	.....	.....
		D	.0100	.00008	.0090	.00008	.0055	.00008	.0066	.00008	.0066	.00008	.0050	.00007	.0039	.00008	.0064	.00008	.0048	.00008	.0048	.00007	.0083	.00007	.0072	.00006	.0057	.00007	.0069	.00008	.0095	.00009	.0052	.00007	.0054	.00008	.0077	.00009	.....	.....
9,046	1,000	A	.0054	—.00001	.0077	.00001	.0110	—.00001	.0034	0.	.0048	—.00001	.0060	.00001	.0063	.00001	.0052	.00001	.0090	.00002	.0037	.00003	.0059	.00002	.0057	.00001	.0041	0.	.0048	0.	.0054	0.	.0036	0.	.0028	—.00001	.0041	0.	0.01	0.
		B	.0065	0.	.0053	.00001	.0060	.00002	.0039	—.00001	.0081	0.	.0024	.00001	.0060	.00001	.0031	0.	.0065	0.	.0039	—.00001	.0068	0.	.0065	.00001	.0054	0.	.0058	.00001	.0054	0.	.0011	.00001	.0064	.00001	.0040	.00002	.....	.....
		C	.0057	.00001	.0128	.00001	.0063	.00001	.0050	.00001	.0064	.00002	.0051	.00001	.0061	.00002	.0048	0.	.0091	.00001	.0048	0.	.0068	.00001	.0079	0.	.0053	.00001	.0073	0.	.0053	0.	.0054	0.	.0070	—.00001	.0034	0.	.....	.....
		D	.0091	—.00001	.0081	—.00001	.0047	0.	.0057	—.00001	.0057	—.00001	.0042	—.00001	.0030	—.00001	.0056	0.	.0040	0.	.0041	0.	.0076	0.	.0065	—.00001	.0051	.00001	.0062	.00001	.0088	.00002	.0046	.00001	.0047	.00001	.0069	.00001	.....	.....
54,275	6,000	A	.0069	.00014	.0090	.00014	.0123	.00012	.0047	.00013	.0063	.00014	.0074	.00015	.0078	.00016	.0069	.00018	.0107	.00019	.0053	.00019	.0074	.00017	.0074	.00018	.0059	.00018	.0066	.00018	.0073	.00019	.0054	.00018	.0047	.00018	.0062	.00021	0.01	0.02
		B	.0081	.00016	.0068	.00016	.0074	.00016	.0054	.00014	.0097	.00016	.0039	.00016	.0074	.00015	.0045	.00014	.0080	.00015	.0056	.00016	.0086	.00018	.0082	.00018	.0102	.00020	.0076	.00019	.0073	.00019	.0029	.00019	.0082	.00019	.0062	.00024	.....	.....
		C	.0086	.00030	.0133	.00026	.0087	.00025	.0074	.00025	.0086	.00024	.0071	.00021	.0079	.00020	.0067	.00019	.0108	.00018	.0067	.00019	.0088	.00021	.0098	.00019	.0071	.00019	.0091	.00018	.0069	.00016	.0070	.00016	.0084	.00013	.0051	.00017	.....	.....
		D	.0112	.00020	.0101	.00019	.0067	.00020	.0076	.00018	.0076	.00018	.0063	.00020	.0050	.00019	.0076	.00020	.0059	.00019	.0060	.00019	.0094	.00018	.0081	.00015	.0066	.00016	.0078	.00017	.0105	.00019	.0063	.00018	.0066	.00020	.0091	.00023	.....	.....
81,415	9,000	A	.0080	.00025	.0100	.00024	.0132	.00021	.0056	.00022	.0072	.00023	.0084	.00025	.0089	.00027	.0079	.00028	.0118	.00030	.0064	.00028	.0085	.00028	.0084	.00028	.0068	.00027	.0076	.00028	.0082	.00028	.0064	.00028	.0058	.00029	.0073	.00032	0.01	0.03
		B	.0094	.00029	.0078	.00026	.0084	.00026	.0064	.00024	.0106	.00025	.0048	.00025	.0083	.00024	.0054	.00023	.0090	.00025	.0066	.00026	.0095	.00027	.0093	.00029	.0113	.00031	.0088	.00031	.0084	.00030	.0040	.00030	.0094	.00031	.0072	.00034	.....	.....
		C	.0100	.00044	.0166	.00039	.0099	.00037	.0086	.00037	.0096	.00034	.0082	.00032	.0090	.00031	.0076	.00028	.0119	.00029	.0077	.00029	.0098	.00031	.0110	.00031	.0081	.00029	.0101	.00028	.0079	.00026	.0079	.00025	.0095	.00024	.0062	.00028	.....	.....
		D	.0124	.00032	.0112	.00030	.0078	.00031	.0088	.00030	.0088	.00030	.0074	.00031	.0062	.00031	.0089	.00033	.0070	.00030	.0070	.00029	.0104	.00028	.0092	.00026	.0076	.00026	.0088	.00027	.0115	.00029	.0073	.00028	.0077	.00031	.0105	.00037	.....	.....
108,850	12,000	A	.0091	.00036	.0110	.00034	.0142	.00031	.0066	.00032	.0082	.00033	.0095	.00036	.0100	.00038	.0091	.00040	.0130	.00042	.0074	.00040	.0095	.00038	.0094	.00038	.0078	.00037	.0088	.00040	.0093	.00039	.0074	.00038	.0068	.00039	.0085	.00044	0.00	0.03
		B	.0106	.00041	.0090	.00038	.0094	.00036	.0073	.00033	.0117	.00036	.0058	.00035	.0093	.00034	.0065	.00034	.0101	.00036	.0076	.00036	.0107	.00039	.0105	.00041	.0125	.00043	.0100	.00043	.0096	.00042	.0051	.00041	.0106	.00043	.0085	.00047	.....	.....
		C	.0112	.00056	.0177	.00050	.0110	.00048	.0097	.00048	.0108	.00046	.0093	.00043	.0100	.00041	.0087	.00039	.0129	.00039	.0088	.00040	.0110	.00043	.0122	.00043	.0094	.00042	.0114	.00041	.0091	.00038	.0091	.00037	.0106	.00035	.0073	.00039	.....	.....
		D	.0135	.00043	.0124	.00042	.0090	.00043	.0098	.00040	.0100	.00042	.0087	.00044	.0074	.00043	.0109	.00046	.0082	.00042	.0081	.00040	.0115	.00039	.0102	.00036	.0086	.00036	.0098	.00037	.0125	.00039	.0084	.00039	.0089	.00043	.0118	.00050	.....	.....
135,690	15,000	A	.0101	.00046	.0121	.00045	.0153	.00042	.0076	.00042	.0091	.00045	.0106	.00047	.0112	.00050	.0103	.00052	.0141	.00053	.0084	.00050	.0105	.00048	.0105	.00049	.0089	.00048	.0096	.00048	.0103	.00049	.0084	.00048	.0080	.00051	.0099	.00058	0.01	0.03
		B	.0119	.00054	.0101	.00049	.0106	.00048	.0081	.00041	.0127	.00046	.0067	.00044	.0103	.00044	.0074	.00043	.0110	.00045	.0086	.00046	.0119	.00051	.0116	.00052	.0136	.00054	.0112	.00055	.0107	.00053	.0063	.00053	.0117	.00054	.0095	.00057	.....	.....
		C	.0123	.00067	.0189	.00062	.0122	.00060	.0108	.00059	.0119	.00057	.0103	.00053	.0109	.00050	.0096	.00048	.0139	.00049	.0098	.00050	.0122	.00055	.0133	.00054	.0106	.00054	.0125	.00052	.0102	.00049	.0101	.00047	.0118	.00047	.0087	.00053	.....	.....
		D	.0147	.00055	.0134	.00052	.0102	.00055	.0110	.00052	.0112	.00054	.0098	.00055	.0085	.00054	.0115	.00059	.0094	.00054	.0092	.00051	.0125	.00049	.0112	.00046	.0094	.00044	.0107	.00046	.0134	.00048	.0094	.00049	.0100	.00054	.0130	.00062	.....	.....
162,820	18,000	A	.0113	.00058	.0132	.00056	.0164	.00053	.0087	.00053	.0106	.00057	.0118	.00059	.0124	.00062	.0116	.00065	.0153	.00065	.0096	.00062	.0117	.00060	.0116	.00060	.0100	.00059	.0106	.00058	.0114	.00060	.0095	.00059	.0092	.00063	.0117	.00076	0.01	0.03
		B	.0132	.00067	.0133	.00059	.0092	.00052	.0136	.00055	.0077	.00054	.0112	.00053	.0084	.00053	.0121	.00056	.0098	.00058	.0132	.00064	.0129	.00065	.0149	.00067	.0125	.00068	.0120	.00066	.0074	.00064	.0128	.00065	.0106	.00068	.....	.....
		C	.0134	.00078	.0201	.00074	.0132	.00070	.0120	.00071	.0130	.00068	.0114	.00064	.0120	.00061	.0107	.00059	.0149	.00059	.0110	.00062	.0133	.00066	.0145	.00066	.0120	.00068	.0137	.00064	.0116	.00063	.0114	.00060	.0131	.00060	.0103	.00069	.....	.....
		D	.0158	.00066	.0147	.00065	.0114	.00067	.0122	.00064	.0123	.00065	.0111	.00068	.0099	.00068	.0128	.00072	.0106	.00066	.0103	.00062	.0134	.00058	.0121	.00055	.0104	.00054	.0117	.00056	.0144	.00058	.0102	.00058	.0130	.00064	.0140	.00072	.....	.....
189,970	21,000	A	.0125	.00070	.0145	.00069	.0176	.00065	.0098	.00064	.0118	.00069	.0130	.00071	.0135	.00073	.0128	.00077	.0164	.00076	.0106	.00072	.0126	.00069	.0124	.00068	.0109	.00068	.0116	.00068	.0124	.00070	.0106	.00070	.0105	.00076	.0135	.00094	0.02	0.03
		B	.0146	.00081	.0125	.00073	.0127	.00069	.0102	.00062	.0147	.00066	.0087	.00064	.0123	.00064	.0102	.00071	.0130	.00065	.0112	.00072	.0145	.00077	.0143	.00079	.0165	.00083	.0138	.00081	.0133	.00079	.0088	.00078	.0138	.00075	.0116	.00078	.....	.....
		C	.0145	.00089	.0213	.00086	.0144	.00082	.0132	.00083	.0141	.00079	.0125	.00075	.0130	.00071	.0120	.00072	.0162	.00072	.0123	.00075	.0147	.00080	.0160	.00081	.0134	.00082	.0152	.00079	.0130	.00077	.0128	.00074	.0144	.00073	.0120	.00086	.....	.....
		D	.0172	.00080	.0161	.00079	.0129	.00082	.0135	.00077	.0135	.00077	.0124	.00081	.0112	.00081	.0140	.00084	.0118	.00078	.0112	.00071	.0143	.00067	.0128	.00062	.0111	.00061	.0125	.00064	.0152	.00066	.0113	.00068	.0121	.00075	.0153	.00085	.....	.....
9,046	1,000	A	.0062	.00007	.0084	.00008	.0114	.00003	.0037	.00003	.0052	.00003	.0062	.00003	.0065	.00003	.0054	.00003	.0093	.00005	.0039	.00005	.0060	.00003	.0060	.00004	.0044	.00003	.0051	.00003	.0058	.00004	.0040	.00004	.0035	.00006	.0054	.00013	0.01	0.01
		B	.0070	.00005	.0056	.00004	.0061	.00003	(?)	(?)	.0066	.00004	.0046	.00003	.0033	.00002	.0037	.00006	.0065	0.	.0041	.00001	.0071	.00003	.0067	.00003	.0087	.00005	.0063	.00006	.0057	.00003	.0014	.00004	.0067	.00004	.0042	.00004	.....	.....
		C	.0062	.00006	.0133	.00006	.0067	.00005	.0055	.00006	.0066	.00004	.0054	.00004	.0064	.00005	.0052	.00004	.0094	.00004	.0050	.00002	.0071	.00004	.0082	.00003	.0056	.00004	.0077	.00004	.0056	.00003	.0058	.00004	.0076	.00005	.0047	.00013	.....	.....
		D	.0098	.00006	.0089	.00007	.0054	.00007	.0063	.00005	.0062	.00004	.0046	.00003	.0033	.00002	.0063	.00007	.0044	.00004	.0043	.00002	.0079	.00003	.0068	.00002	.0052	.00002	.0064	.00003	.0090	.00004	.0048	.00003	.0050	.00004	.0071	.00003	.....	.....
217,100	24,000	A	.0132	.00077	.0156	.00080	.0186	.00075	.0108	.00074	.0131	.00082	.0143	.00084	.0150	.00088	.0143	.00092	.0180	.00092	.0121	.00087	.0138	.00081	.0136	.00080	.0121	.00080	.0128	.00080	.0133	.00079	.0116	.00080	.0116	.00087	.0148	.00107	0.01	0.04
		B	.0167	.00102	.0140	.00088	.0138	.00080	.0114	.00074	.0158	.00077	.0095	.00072	.0130	.00071	.0107	.00076	.0138	.00073	.0120	.00080	.0156	.00088	.0154	.00090	.0176	.00094	.0151	.00094	.0145	.00091	.0100	.00090	.0151	.00088	.0128	.00090	.....	.....
		C	.0159	.00103	.0226	.00099	.0157	.00095	.0144	.00095	.0152	.00090	.0132	.00082	.0137	.00078	.0128	.00080	.0171	.00081	.0132	.00084	.0159	.00092	.0172	.00093	.0146	.00094	.0164	.00091	.0142	.00089	.0140	.00086	.0159	.00088	.0137	.00103	.....	.....
		D	.0180	.00088	.0173	.00091	.0140	.00093	.0148	.00090	.0149	.00091	.0139	.00096	.0127	.00096	.0158	.00102	.0134	.00094	.0128	.00087	.0157	.00081	.0140	.00074	.0123	.00073	.0135	.00074	.0164	.00078	.0125	.00080	.0134	.00088	.0166	.00098	.....	.....

Ultimate strength = 237,400 lb. = 26,245 lb. per sq. in. Column gradually yielded under reduced loads until a load of 226,000 lb. = 24,983 lb. per sq. in. was reached when it sprung suddenly to the east at middle of length.

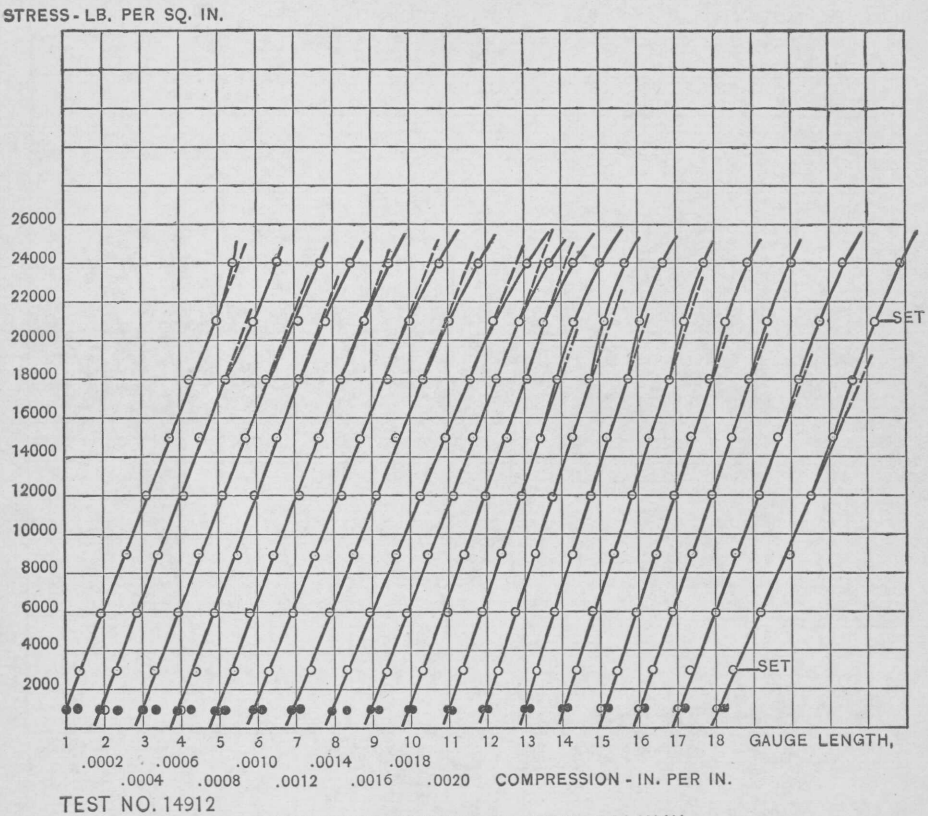


COMPRESSIVE TEST OF STEEL COLUMN
ANGLE B



TEST NO. 14912.

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE C.



COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE D.

No. 14913.

Built **I** column.
Figure 2, 60,000 lb. carbon steel.
Length of column, 15 ft. 7.60 in.
Weight, 497 lbs.
Sectional area, 8.971 sq. in.
Gauge lengths as per sketch.
Pin ends, figure 3, pins vertical in plane of web.
Length from center to center of pins, 16 ft. 4.30 in.

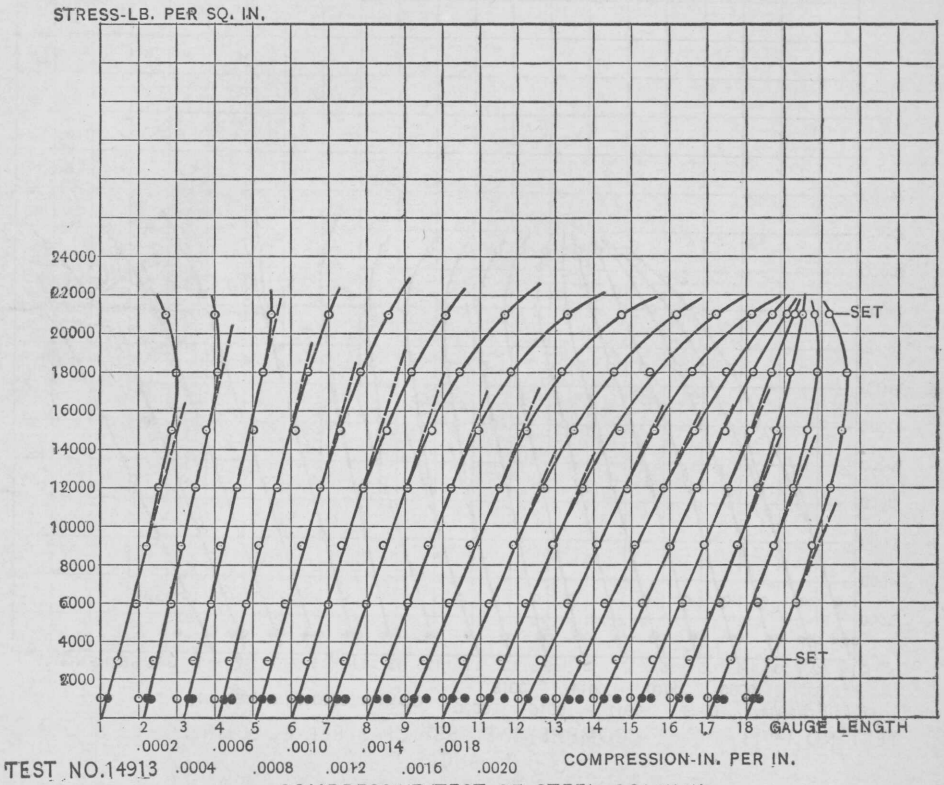
Built I Column. Schedule No. 2.

Gauge lengths.

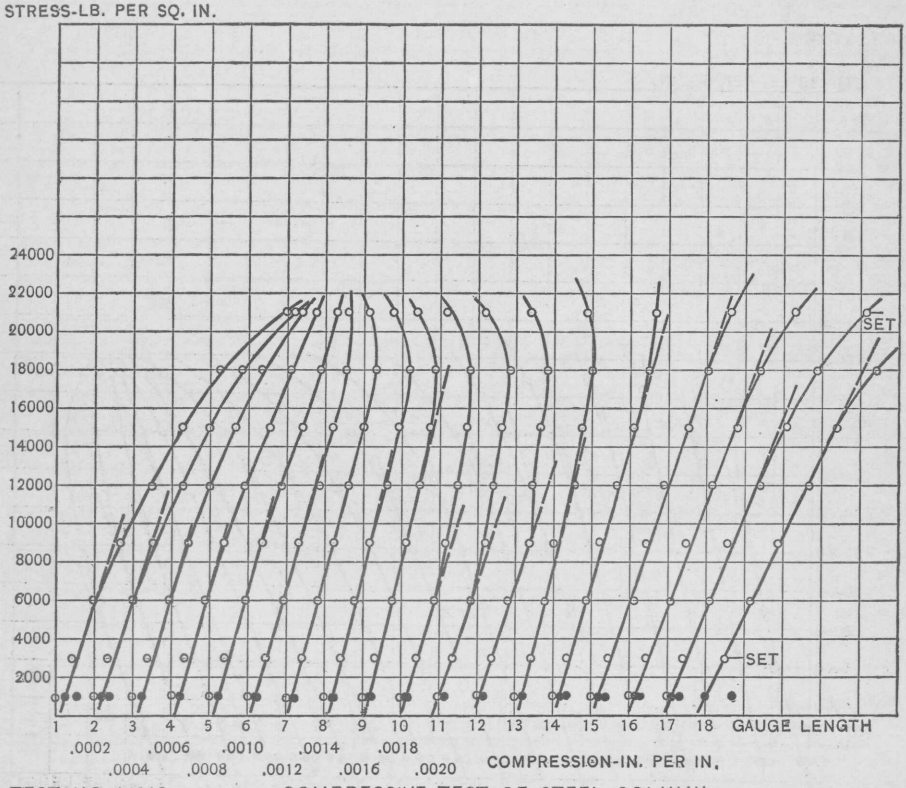
Total load.	Stress per square inch.		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		Deflections.	
			Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Compressometer reading.	Compression per inch.	Horizontal.	Vertical.
Lb.	*Lb.*		*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
8,971	1,000	A	0.0025	0.	0.0051	0.	0.0054	0.	0.0036	0.	0.0074	0.	0.0058	0.	0.0067	0.	0.0032	0.	0.0024	0.	0.0071	0.	0.0023	0.	0.0072	0.	0.0036	0.	0.0054	0.	0.0080	0.	0.0043	0.	0.0046	0.	0.0068	0.	0.	0.
		B	.0059	0.	.0075	0.	.0052	0.	.0068	0.	.0035	0.	.0035	0.	.0062	0.	.0065	0.	.0040	0.	.0038	0.	.0048	0.	.0037	0.	.0051	0.	.0036	0.	.0049	0.	.0055	0.	.0046	0.	.0076	0.		
		C	.0050	0.	.0047	0.	.0064	0.	.0064	0.	.0063	0.	.0052	0.	.0043	0.	.0060	0.	.0036	0.	.0059	0.	.0045	0.	.0016	0.	.0032	0.	.0039	0.	.0053	0.	.0019	0.	.0075	0.	.0056	0.		
		D	.0006	0.	.0038	0.	.0058	0.	.0061	0.	.0047	0.	.0080	0.	.0050	0.	.0074	0.	.0042	0.	.0046	0.	.0066	0.	.0070	0.	.0063	0.	.0037	0.	.0046	0.	.0034	0.	.0059	0.	.0041	0.		
26,913	3,000	A	.0033	.00008	.0058	.00007	.0062	.00008	.0043	.00007	.0081	.00007	.0066	.00008	.0075	.00008	.0041	.00009	0034	.00010	.0081	.00010	.0033	.00010	.0083	.00011	.0049	.00013	.0066	.00012	.0091	.00011	.0053	.00010	.0057	.00011	.0080	.00012	0.03	0.
		B	.0067	.00008	.0082	.00007	.0059	.00007	.0075	.00007	.0043	.00008	.0044	.00009	.0070	.00008	.0073	.00008	.0047	.00007	.0046	.00008	.0055	.00007	.0044	.00007	.0059	.00008	.0043	.00007	.0058	.00009	.0064	.00009	.0054	.00008	.0086	.00010		
		C	.0065	.00016	.0062	.00015	.0077	.00013	.0076	.00012	.0075	.00012	.0063	.00011	.0053	.00010	.0072	.00012	.0045	.00008	.0066	.00007	.0052	.00007	.0022	.00006	.0038	.00006	.0048	.00007	.0060	.00007	.0023	.00004	.0084	.00009	.0064	.00008		
		D	.0014	.00008	.0047	.00009	.0070	.00012	.0072	.00011	.0058	.00011	.0091	.00011	.0063	.00013	.0084	.00010	.0053	.00011	.0056	.00010	.0078	.00012	.0081	.00011	.0075	.00012	.0048	.00011	.0056	.00010	.0043	.00009	.0067	.00008	.0049	.00008		
8,971	1,000	A	.0028	.00003	.0055	.00004	.0059	.00005	.0040	.00004	.0078	.00004	.0062	.00004	.0071	.00004	.0036	.00004	.0028	.00004	.0075	.00004	.0027	.00004	.0076	.00004	.0042	.00006	.0059	.00005	.0085	.00005	.0047	.00004	.0051	.00005	.0074	.00006	0.02	0.
		B	.0063	.00004	.0079	.00004	.0056	.00004	.0071	.00003	.0039	.00004	.0039	.00004	.0065	.00003	.0070	.00005	.0043	.00003	.0042	.00004	.0052	.00004	.0040	.00003	.0054	.00003	.0038	.00002	.0052	.00003	.0057	.00002	.0048	.00002	.0077	.00001		
		C	.0054	.00004	.0052	.00005	.0069	.00005	.0067	.00003	.0067	.00004	.0056	.00004	.0046	.00003	.0064	.00004	.0039	.00003	.0062	.00003	.0047	.00002	.0018	.00002	.0033	.00001	.0041	.00002	.0055	.00002	.0020	.00001	.0077	.00002	.0057	.00001		
		D	.0008	.00002	.0040	.00002	.0062	.00004	.0064	.00003	.0050	.00003	.0083	.00003	.0054	.00004	.0076	.00002	.0045	.00003	.0049	.00003	.0071	.00005	.0074	.00004	.0068	.00005	.0043	.00006	.0050	.00004	.0037	.00003	.0063	.00004	.0045	.00004		
53,823	6,000	A	.0042	.00017	.0067	.00016	.0071	.00017	.0052	.00016	.0091	.00017	.0077	.00019	.0086	.00019	.0053	.00021	.0048	.00024	.0096	.00025	.0048	.00025	.0099	.00027	.0063	.00027	.0080	.00026	.0106	.00026	.0068	.00025	.0071	.00025	.0094	.00026	0.05	0.01
		B	.0079	.00020	.0094	.00019	.0070	.00018	.0085	.00017	.0053	.00018	.0053	.00018	.0078	.00019	.0081	.00016	.0055	.00015	.0055	.00017	.0064	.00016	.0052	.00015	.0066	.00015	.0053	.00017	.0070	.00021	.0076	.00021	.0068	.00022	.0100	.00024		
		C	.0064	.00034	.0078	.00031	.0093	.00029	.0090	.00026	.0088	.00025	.0076	.00024	.0055	.00022	.0082	.00022	.0055	.00019	.0076	.00017	.0060	.00015	.0029	.00013	.0045	.00015	.0053	.00014	.0069	.00016	.0033	.00014	.0091	.00016	.0074	.00018		
		D	.0021	.00015	.0057	.00019	.0079	.00021	.0082	.00021	.0070	.00023	.0103	.00023	.0075	.00025	.0097	.00023	.0066	.00024	.0071	.00025	.0092	.00026	.0096	.00026	.0087	.00024	.0062	.00025	.0067	.00021	.0053	.00019	.0076	.00017	.0058	.00017		
80,735	9,000	A	.0048	.00023	.0073	.00022	.0077	.00023	.0059	.00023	.0100	.00026	.0085	.00027	.0096	.00029	.0065	.00033	.0059	.00035	.0109	.00038	.0061	.00038	.0113	.00041	.0077	.00041	.0094	.00040	.0118	.00038	.0078	.00035	.0080	.00034	.0103	.00035	0.08	0.02
		B	.0092	.00033	.0105	.00030	.0080	.00028	.0095	.00027	.0062	.00027	.0061	.00026	.0086	.00024	.0088	.00023	.0062	.00022	.0061	.00023	.0071	.00023	.0064	.00027	.0072	.00021	.0060	.00024	.0078	.00029	.0085	.00030	.0078	.00032	.0113	.00037		
		C	.0100	.00050	.0092	.00045	.0106	.00042	.0103	.00039	.0100	.00037	.0086	.00034	.0075	.00032	.0092	.00032	.0063	.00027	.0084	.00025	.0068	.00023	.0036	.00020	.0052	.00020	.0061	.00022	.0077	.00024	.0044	.00025	.0102	.00027	.0086	.00030		
		D	.0030	.00024	.0066	.00028	.0089	.00031	.0093	.00032	.0081	.00034	.0116	.00036	.0087	.00037	.0110	.00036	.0079	.00037	.0085	.00039	.0107	.00041	.0110	.00040	.0102	.00039	.0075	.00038	.0078	.00032	.0063	.00029	.0085	.00026	.0067	.00026		
107,650	12,000	A	.0055	.00030	.0080	.00029	.0085	.00031	.0068	.00032	.0109	.00035	.0096	.00038	.0107	.00040	.0076	.00044	.0073	.00049	.0124	.00053	.0076	.00053	.0128	.00056	.0092	.00056	.0107	.00053	.0130	.00050	.0088	.00045	.0090	.00044	.0112	.00044	0.11	0.02
		B	.0108	.00049	.0120	.00045	.0092	.00040	.0106	.00038	.0072	.00037	.0071	.00036	.0095	.00033	.0097	.00032	.0069	.00029	.0068	.00030	.0076	.00028	.0056	.00029	.0081	.00030	.0069	.00033	.0087	.00038	.0098	.00043	.0093	.00047	.0120	.00053		
		C	.0116	.00066	.0107	.00060	.0120	.00056	.0116	.00052	.0112	.00049	.0098	.00046	.0085	.00042	.0101	.00041	.0072	.00036	.0089	.00030	.0074	.00029	.0043	.00027	.0060	.00028	.0070	.00031	.0085	.00032	.0053	.00034	.0114	.00039	.0100	.00044		
		D	.0039	.00033	.0074	.00036	.0099	.00041	.0104	.00043	.0094	.00047	.0129	.00049	.0102	.00052	.0125	.00051	.0094	.00052	.0100	.00054	.0123	.00057	.0124	.00054	.0111	.00048	.0091	.00054	.0089	.00043	.0074	.00040	.0095	.00036	.0073	.00032		
134,560	15,000	A	.0062	.00037	.0087	.00036	.0093	.00039	.0077	.00041	.0120	.00046	.0108	.00050	.0121	.00054	.0091	.00059	.0088	.00064	.0141	.00070	.0093	.00073	.0144	.00072	.0109	.00073	.0122	.00068	.0142	.00062	.0099	.00056	.0098	.00052	.0118	.00050	0.16	0.02
		B	.0125	.00066	.0134	.00059	.0105	.00053	.0119	.00051	.0083	.00048	.0079	.00044	.0102	.00040	.0104	.00039	.0075	.00035	.0072	.00034	.0080	.00032	.0070	.00033	.0086	.00035	.0077	.00041	.0099	.00050	.0110	.00055	.0107	.00061	.0144	.00068		
		C	.0133	.00083	.0122	.00075	.0134	.00070	.0129	.00065	.0124	.00061	.0107	.00055	.0094	.00051	.0110	.00050	.0077	.00041	.0095	.00036	.0078	.00033	.0048	.00032	.0066	.00034	.0077	.00038	.0096	.00043	.0066	.00047	.0128	.00053	.0116	.00060		
		D	.0044	.00038	.0083	.00045	.0108	.00050	.0114	.00053	.0106	.00059	.0142	.00062	.0116	.00066	.0140	.00066	.0111	.00069	.0118	.00072	.0139	.00073	.0140	.00070	.0128	.00065	.0103	.00066	.0101	.00055	.0082	.00048	.0102	.00043	.0080	.00039		
161,470	18,000	A	.0065	.00049	.0092	.00041	.0099	.00045	.0085	.00049	.0131	.00057	.0121	.00063	.0136	.00069	.0108	.00076	.0107	.00083	.0162	.00091	.0113	.00090	.0154	.00092	.0126	.00090	.0137	.00083	.0153	.00073	.0106	.00063	.0104	.00058	.0121	.00053	0.23	0.02
		B	.0144	.00085	.0152	.00077	.0120	.00068	.0130	.00062	.0093	.00058	.0086	.00051	.0108	.00046	.0108	.00043	.0077	.00037	.0073	.00035	.0084	.00036	.0073	.00036	.0091	.00040	.0085	.00049	.0109	.00060	.0124	.00069	.0124	.00078	.0165	.00089		
		C	.0153	.00103	.0138	.00091	.0148	.00084	.0140	.00076	.0134	.00071	.0115	.00063	.0100	.00057	.0113	.00053	.0080	.00044	.0097	.00038	.0079	.00034	.0050	.00034	.0071	.00039	.0084	.00045	.0104	.00051	.0078	.00059	.0144	.00069	.0136	.00080		
		D	.0047	.00041	.0088	.00050	.0115	.00057	.0124	.00063	.0118	.00071	.0157	.00077	.0135	.00085	.0159	.00085	.0130	.00088	.0138	.00092	.0158	.00092	.0159	.00089	.0144	.00081	.0117	.00080	.0113	.00067	.0090	.00056	.0108	.00049	.0083	.00042		
188,390	21,000	A	.0058	.00033	.0091	.00040	.0103	.00049	.0095	.00059	.0145	.00071	.0140	.00082	.0160	.00093	.0138	.00106	.0139	.00115	.0194	.00123	.0147	.00124	.0195	.90123	.0150	.00114	.0155	.00101	.0165	.00085	.0112	.00069	.0102	.00056	.0111	.00043	0.43	0.01
		B	.0178	.00119	.0180	.00105	.0140	.00088	.0144	.00076	.0101	.00066	.0088	.00053	.0105	.00043	.0101	.00036	.0068	.00028	.0062	.00024	.0072	.00024	.0065	.00028	.0089	.00038	.0089	.00053	.0122	.00073	.0142	.00087	.0149	.00103	.0202	.00126		
		C	.0195	.00145	.0158	.00111	.0166	.00102	.0152	.00088	.0140	.00077	.0116	.00064	.0096	.00053	.0107	.00047	.0071	.00035	.0084	.00025	.0068	.00023	.0042	.00026	.0068	.00036	.0087	.00048	.0114	.00061	.0096	.00077	.0168	.00093	.0171	.00115		
		D	.0035	.00029	.0088	.00050	.0120	.00062	.0135	.00074	.0135	.00088	.0179	.00099	.0162	.00112	.0191	.00117	.0163	.00121	.0175	.00129	.0191	.00125	.0192	.00122	.0169	.00106	.0136	.00099	.0122	.00076	.0096	.00062	.0106	.00047	.0072	.00031		
8,971	1,000	A	.0027	.00042	.0056	.00005	.0061	.00007	.0044	.00008	.0082	.00008	.0066	.00008	.0075	.00008	.0041	.00009	.0034	.00010	.0082	.00011	.0035	.00012	.0085	.00013	.0047	.00011	.0065	.00011	.0089	.00009	.0052	.00009	.0054	.00008	.0071	.00003	0.07	0.
		B	.0069	.00010	.0082	.00007	.0056	.00004	.0072	.00004	.0040	.00005	.0038	.00003	.0064	.00002	.0069	.00004	.0042	.00002	.0040	.00002	.0047	—.00001	.0038	.00001	.0054	.00003	.0041	.00005	.0055	.00006	.0059	.00004	.0052	.00006	.0090	.00014		
		C	.0077	.00027	.0054	.00007	.0071	.00007	.0068	.00004	.0069	.00006	.0057	.00005	.0047	.00004	.0068	.00008	.0040	.00004	.0061	.00002	.0046	.00001	.0016	0.	.0032	0.	.0042	.00003	.0054	.00001	.0021	.00002	.0078	.00003	.0065	.00009		
		D	.0007	.00001	.0048	.00010	.0068	.00010	.0071	.00010	.0058	.00011	.0091	.00011	.0063	.00013	.0084	.00010	.0052	.00010	.0058	.00012	.0077	.00011	.0081	.00011	.0072	.00009	.0049	.00012	.0053	.00007	.0043	.00009	.0069	.00010	.0046	.00005		

Ultimate strength was 196,000 lbs. = 21,849 lbs. per sq. in.
Column gradually yielded under maximum load until it sprung suddenly to west at middle of length.

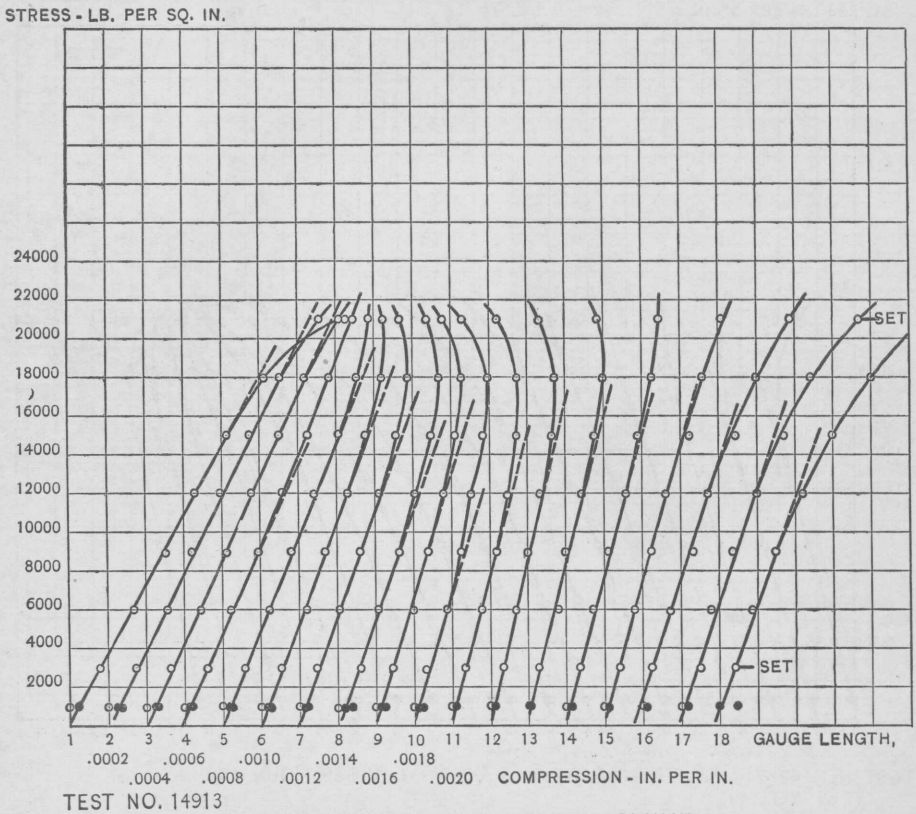
61783°—13. (To face page 102.)



COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE A.

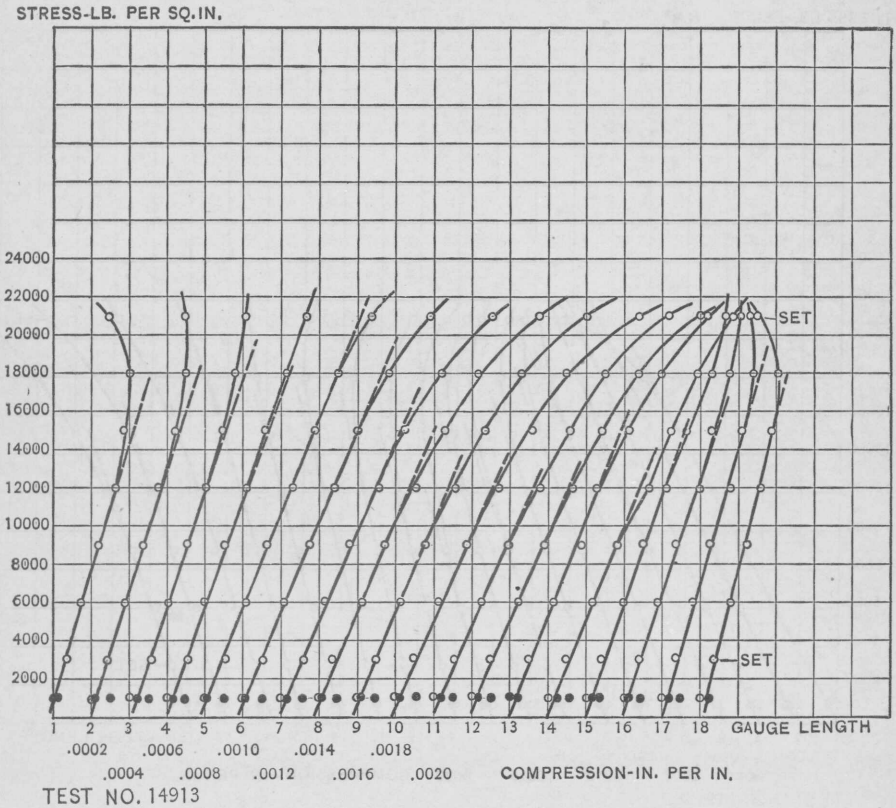


TEST NO. 14913 COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE B.



TEST NO. 14913

COMPRESSIVE TEST OF STEEL COLUMN.
ANGLE C.



COMPRESSIVE TEST OF STEEL COLUMN
ANGLE D

SPRINGS FOR ORDNANCE WORK.

TEST 14688.

TESTS OF HELICAL SPRINGS FOR WATERTOWN ARSENAL, MASS., ON P. O. 9245.

2 pawl springs. Dg. 12–14–10.
Springs first closed solid 100 times.

Outside diameter solid.	Inside diameter free.	Solid height.	Load at 3.83 inches.	Free height before test.	Free height after test.
In.	*In.*	*In.*	*Lb.*	*In.*	*In.*
1.312	1	2.187	50	.....	.....
1.3	1	2.05	49½	6.2	6.1
1.3	1	2.05	50½	6.15	6.07

Springs closed solid for 48 hours, then retested.

1.3	1	2.05	50	6.2	6.1
1.3	1	2.05	51	6.15	6.07

10 springs (2B). Drawing 72–1–3.

Tested after closing solid 100 times.

No.	Free height.	Load at assembled height of 1.625 inches.	Load at solid height of 1.32 inches.	Outside diameter.	Free height.	
					Before test.	Set.
	In.	*Lb.*	*Lb.*	*In.*	*In.*	*In.*
1	2.05	69	119	0.76	2.08	0.03
2	2.07	69	121	.76	2.08	.01
3	2.06	66½	119	.76	2.07	.01
4	2.07	69	119	.76	2.07	.00
5	2.05	64½	114	.76	2.09	.04
6	2.14	74	124	.76	2.15	.01
7	2.05	64	114	.76	2.07	.02
8	2.09	67½	118	.76	2.10	.01
9	2.12	73	121	.76	2.15	.03
10	2.06	64½	116	.76	2.08	.02

Retest after closing solid 48 hours.

No.	Free height.	Load at assembled height of 1.625 inches.	Load at solid height of 1.32 inches.	Outside diameter,	Total set.
	In.	*Lb.*	*Lb.*	*In.*	*In.*
1	2.05	64	110	0.76	0.03
2	2.04	63½	111	.76	.04
3	2.06	66	114½	.76	.01
4	2.06	65½	113	.76	.01
5	2.03	60	108	.76	.06
6	2.11	72	120	.76	.04
7	2.03	61	109	.76	.04
8	2.07	65	112	.76	.03
9	2.08	70	117	.76	.07
10	2.04	61	108½	.76	.04

TEST 14714.

TESTS OF 56-PAWL SAFETY LATCH SPRINGS, FOR 8-IN. D. C., MODEL 1896. DRAWING 8-9-8. REVISION OF MARCH 31, 1909.

Outside diameter, 1 in.
Free length, 8.5 in.
Inside diameter of hooks, 0.6 in.
Load at 0.75-in. extension, 20-lb. min., 22–30 lb.
Load at 2.50-in. extension, 65-lb. min., 75–80 lb.
Springs extended 2.5 in. 100 times before test with no set.

TEST No. 14743.

RETEST OF TWO PAWL SPRINGS, DRAWING 11-5-54, RECEIVED FROM SANDY HOOK PROVING GROUND, FOR 14 IN. D. C., MODEL OF 1897.

September 26, 1911, measurements when received:

Assembled height, 3.75 in.—40 lb. minimum required load; right spring, 19 lb. 9 oz.; left spring, 9 lb. 7 oz.

Solid height, 2 in.—60 lb. minimum rquired load; right spring, 61 lb. 8 oz.; left spring, 45 lb.

Free height—left spring, 4.3 in.; right spring, 4.9 in.

September 28, 1911, measurements after springs had been closed solid for 48 hours:

At assembled height—left spring, 8 lb. 15 oz.; right spring, 19 lb. 4 oz.

At solid height—left spring, 44 lb.; right spring, 59 lb. 4 oz.

Springs then closed solid 100 times:

At assembled height—left, 8 lb. 15 oz.; right, 19 lb. 3 oz.

At solid height—left, 44 lb.; right, 59 lb. 2 oz.

Free height after tests—right, 4.88 in.; left, 4.3 in.

The above springs appear to have been subjected to a large overload which caused the coils to overlap one another, thus straining the fibers in such a way as to cause a large permanent set, which effect could not be obtained without greatly overloading the springs.

Required: Approximate diameter of wire, 0.125 in.

Assembled height, 3.75 in. under not less than 40 lb.

Solid height, not over 2 in. under not less than 60 lb.

Outside diameter, not over 1.312 ($1\frac{5}{16}$) in.

COMPRESSIVE TEST OF BUFFER SPRINGS FOR 8-IN. AMMUNITION TRUCK.

Tested for acceptance. Quantity, 117. P. O. 848.

RESULTS OF TESTS OF SPRINGS.

Free height, from 7.44 to 7.78 in.
Outside diameter when closed down: Maximum, 2.12 in. (2 springs); minimum, 2.07 in. (5 springs).
Minimum inside diameter, 1.65 in.
Load at height of 4.75 in., from 58 to 74 lb.
Solid height, from 2.31 to 2.48 in.
Load at solid height, from 116 to 140 lb.

REQUIREMENTS.

Free height, 7.25 in.
Maximum outside diameter, 2.10 in.
Minimum inside diameter, 1.65 in.
To sustain 60 lb. at assembled height of 4.75 in.
Capacity, 120 lb. at solid height of 2.50 inches approximately.

TEST 14839.

COMPRESSIVE TESTS OF LATCH SPRINGS FOR WATERTOWN ARSENAL, MASS.

Number of springs, 28.
Outside diameter, maximum at solid height, 0.425 in.
Solid height, 1.80 to 1.95 in.
Height under 20 lb., 2.81 to 3.02 in.
Required: Outside diameter, maximum at solid height, 0.437 in. Solid height not over 2.25 in. Assembled height under 20 lb., 3 in.

TEST 14849.

COMPRESSIVE TESTS OF FRICTION SPRINGS FOR 15-POUNDER B. C., MODEL 1903, DRAWING 5-15-7, FOR WATERTOWN ARSENAL.

	1	2	3	4	5	6	7	8
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Inside diameter	0.635	0.635	0.635	0.635	0.635	0.635	0.635	0.635
Free height	2.30	2.30	2.30	2.30	2.30	2.28	2.33	2.28
Load at height of 2.13 in.	[1] 390	[1] 442	[1] 389	[1] 399	[1] 425	[1] 333	[1] 444	[1] 317
Height at load of 511 lb.	2.10	2.10	2.10	2.10	2.10	2.07	2.10	2.07
Load at height of 1.87 in.	[1] 1,087	[1] 1,112	[1] 1,117	[1] 1,176	[1] 1,155	[1] 1,065	[1] 2,498	[1] 1,028
Height at load of 1,279 lb.	1.86	1.84	1.87	1.86	1.87	1.82	1.90	1.83
Final free height	2.30	2.30	2.30	2.30	2.30	2.28	2.33	2.28

[1] Pounds.

REQUIREMENTS.

Inside diameter, 0.635 in. $\pm$ 0.01. Free height = 2.3 in.
Initial height under 511 lb. = 2.13 in.
Solid height under 1,279 lb. = 1.875 in.

TEST 14856.

COMPRESSIVE TESTS OF ELEVATING SLIDE SPRINGS FOR 6-IN. D. C., MODEL 1905, FOR WATERTOWN ARSENAL, MASS.

Number of springs, 6.

Springs closed solid for 48 hours: Decrease in free height—Maximum, 0.26 in.; average, 0.22 in.; minimum, 0.17 in.

Springs closed solid 100 times: Decrease in free height—Maximum, 0.01 in.; average, 0.005 in.; minimum, 0.0 in.

	Required.	Tested.
Minimum inside diameter	3.75 in	Maximum, 3.75 in. Average, 3.74 in. Minimum, 3.72 in.
Free height	12.8 in	Maximum, 13.03 in. Average, 12.99 in. Minimum, 12.90 in.
Height under 2,000 lb	10.5 in	Maximum, 10.94 in. Average, 10.90 in. Minimum, 10.86 in.
Load at 10.5 in	2,000 lb	Maximum, 2,500 lb. Average, 2,500 lb. Minimum, 2,400 lb.
Load at 8 in	Over 4,000 lb	Maximum, 5,600 lb. Average, 5,560 lb. Minimum, 5,500 lb.
Solid height	Under 8 in	Maximum, 7.90 in. Average, 7.87 in. Minimum, 7.80 in.

TEST 14855.

COMPRESSIVE TESTS OF BUFFER SPRINGS FOR 12-IN. D. C., MODEL 1896, FOR WATERTOWN ARSENAL, MASS.

Number of springs, 81.

Springs closed down 48 hours: Maximum decrease in free height, 0.29 in.; minimum decrease in free height, 0.07 in.; average decrease in free height, 0.195 in.

Closed solid 100 times: Maximum decrease, 0.18 in.; minimum decrease, 0.00 in.; average decrease, 0.065 in.

Test of springs.

	Required.	Tested.
Solid height at 120 lb	Under 2.07 in	Maximum, 1.98 in. Minimum, 1.90 in.
Assembled height at 60. lb or over	4.5 in.	Maximum, 4.80 in. Minimum, 4.50 in.
Inside diameter, free	Not under 1.69 in.	1.69 in.
Outside diameter	Under 2.05 in	Maximum, 2.07 in. (2–2.07 in.). (5–2.06 in.). Minimum, 2.05 in.

TEST 14896.

COMPRESSIVE TESTS OF TWO BUFFER SPRINGS FOR 14-IN. D. C., L. F., MODEL 1907, FOR WATERTOWN ARSENAL, MASS.

Number of springs, 2.
Buffer springs, flat.

	Required.	Spring A.	Spring B.
Inside diameter, free	4.50 in.	4.50 in.	4.52 in.
Load at height of 11.21 in		1,183 lb.	2,055 lb.
Height at load of 1,840 lb	11.208 in	6.57 in.	11.86 in.
Load at height of 6.125 in		1,783 lb.	12,342 lb.
Height at load of 2,800 lb		5.28 in.	9.22 in.
Height when solid	Not over 6.125 in.	5.25 in.	6.125 in.
Load when solid		3,438 lb.	12,342 lb.
Maximum outside diameter solid	Under 8.375 in.	7.92 in.	7.80 in.

All springs to have approximately the same load at solid height.

TEST 14909.

TENSILE TESTS OF CROSSHEAD PAWL SPRINGS FOR 10-IN. D. C., L. F., MODEL 1901, FOR WATERTOWN ARSENAL, MASS.

Number of springs, 25.

Free length: Maximum, 6.73 in.; minimum, 6.60 in.

Free length taken 0.30 in. from inside of hook at each end.

Six springs from lot extended 0.8 in. 100 times and returned to their original length without set.

Extension of springs at load of 105 lb.: Required, 0.33 in.; maximum, 0.31 in.; minimum, 0.21 in.

Extension of springs at load of 262 lb.: Required, 0.83 in.; maximum, 0.83 in.; minimum, 0.76 in.

Final free length: Maximum, 6.73 in.; minimum, 6.60 in.

Diameter at inside of hooks: Required, 0.60 in.; maximum, 0.56 in.; minimum, 0.51 in.

TEST 14920.

COMPRESSIVE TESTS OF OUTER AND INNER SPRINGS FOR 6-IN. B. C., MODEL 1910, FOR WATERTOWN ARSENAL, MASS.

OUTER SPRING.

	In.
Free height	21.35
Free height after being closed down 50 hours	19.25
Free height after being compressed 100 times	18.90

TEST OF SPRING.

	Required.	Results.
Load at height of 15.916 in	Not less than 2,216 lb	880 lb.
Solid height	Not more than 10.25 in	9.65 in.
Inside diameter, free	Not less than 4.902 in	4.92 in.
Outside diameter, solid	Not more than 6.908 in	6.80 in.
Final free height		18.88 in.

INNER SPRING.

	In.
Free height	22.17
Free height after being closed down 50 hours	21.00
Free height after being compressed 100 times	20.90

TEST OF SPRING.

	Required.	Results.
Load at height of 15.916 in	Not less than 1,072 lb	360 lb.
Solid height	Not more than 10.25 in	10.10 in.
Inside diameter, free	Not less than 3.391 in	3.50 in.
Outside diameter, solid	Not more than 4.82 in	4.63 in.
Final free height		20.93 in.

TEST 14931.

COMPRESSIVE TEST OF SPRINGS FOR 4.72-IN. DUMMY PROJECTILES FOR WATERTOWN ARSENAL.

	Required.	Results.
Free height	0.85 in	Maximum, 0.87 in. Minimum, 0.82 in.
Load at height of 0.70 in	4.25 lb	Maximum, 5.25 lb. Minimum, 3.75 lb.
Load at height of 0.462 in	10.94 lb	Maximum, 13.0 lb. Minimum. 11.0 lb.
Height when solid	.462 in	Maximum, 0.41 in. Minimum, 0.38 in.
Outside diameter	.31 in	0.31 in.
Final free height		Maximum, 0.87 in. Minimum, 0.82 in.

TEST 14932.

COMPRESSIVE TEST OF SPRINGS FOR 6-IN. DUMMY PROJECTILES FOR WATERTOWN ARSENAL, MASS.

	Required.	Results.
Free height	2.125 in	Maximum, 2.10 in. Minimum, 2.06 in.
Load at height of 1.535 in	16.55 lb	Maximum, 15.75 lb. Minimum, 14.25 lb.
Load at height of 1.276 in	23.8 lb	Maximum, 23 lb. Minimum, 21 lb.
Height when solid	1.276 in	Maximum, 1.25 in. Minimum, 1.20 in.
Outside diameter	0.375 in	0.375 in.
Final free height		Maximum, 2.10 in. Minimum, 2.06 in.

TEST 14933.

COMPRESSIVE TEST OF SPRINGS FOR 10-IN. DUMMY PROJECTILES FOR WATERTOWN ARSENAL, MASS.

	Required.	Results.
Free height	2.03 in.	Maximum, 2.14 in. Minimum, 2.06 in.
Load at height of 1.625 in.	58.7 lb.	Maximum, 89 lb. Minimum, 70 lb.
Load at height of 1.32 in.	103 lb.	Maximum, 137.50 lb. Minimum, 121.75 lb.
Height when solid	1.32 in.	Maximum, 1.16 in. Minimum, 1.07 in.
Outside diameter	0.75 in.	0.75 in.
Final free height		Maximum, 2.14 in. Minimum, 2.06 in.

TEST 14915.

COMPRESSIVE TEST OF A COUNTER-RECOIL SPRING, 12-IN. M. C., MODEL 1896 M1. INNER SPRING.

Coiled right hand. P. O. 7792. Draw. 12–12–4.

INCREASING LOAD.

	Required.	Obtained.
Free height		13.75 in.
Height at load of 3,800 lb		13.18 in.
Load at height of 12.65 in		6,600 lb.
Height when solid	Under 10 in	9.78 in.
Load when solid		20,900 lb.

DECREASING LOAD.

Load at height of 12.65 in	3,800 lb	2,800 lb..
Final free height		13.35 in.
Interior diameter free	Over 2.875 in	2.98 in.

TEST 14935.

COMPRESSIVE TEST OF COUNTER-RECOIL SPRINGS FOR 12-IN. M. C., MODEL 1896 M1, FOR WATERTOWN ARSENAL, MASS.

Inner spring No. 57 received from storehouse.
Inner spring coiled right hand.

INCREASING LOAD.

	Required.	Results.
Free height		14.82 in.
Load at height of 12.65 in. (assembled height)	To sustain a load of 3,800 lb	8,900 lb.
Solid height	Not to exceed 10 in	9.95 in.
Load at solid height		21,700 lb.
Exterior diameter when solid	5.625 in	5.48 in.

DECREASING LOAD.

Load at height of 12.65 in. (assembled height)	To sustain a load of 3,800 lb	5,900 lb.
Final free height		14.50 in.
Interior diameter free	Not less than 2.875 in	2.98 in.

STEEL CASTINGS FOR ORDNANCE WORK.

CAST STEEL FROM WATERTOWN ARSENAL STEEL PLANT.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3044	3	0.41	0.99	46,000	85,500	24.0	30.7	0.29*,0.19	25.0	.....	Silky.
3045	3	.38	.93	.....	.....	.....	.....	.....	.....	.....	
3046	2, 11	.36	.77	43,000	79,500	13.0	13.2	.15*, .11	25.0	.....	Fine granular.
3047	2, 11	.36	.77	76,470	81,250	24.5	31.0	.28*, .21	25.0	.....	Silky trace of granulation.
3048	2,3	.34	.88	.....	.....	.....	.....	.....	.....	.....	
3050	3	.40	.83	.....	.....	.....	.....	.....	.....	.....	
3051	3	.34	.86	.....	.....	.....	.....	.....	.....	.....	
3052	3	.39	.76	53,500	94,000	19.5	27.4	.16, .23*	27.0	.....	Dull silky.
3053	1,3	.34	.83	53,300	91,800	15.5	16.9	.17*, .14	.....	.....	Fine granular, 60 per cent; amorphous, 40 per cent.
3054	1,3	.34	.83	52,000	91,500	15.5	16.9	.18*, .13	25.5	.....	Dull silky, 80 per cent; granular, 20 per cent.
3055	2	.33	.74	.....	.....	.....	.....	.....	.....	.....	
3057	2, 3	.42	.75	.....	.....	.....	.....	.....	.....	.....	
3058	3	.35	.79	.....	.....	.....	.....	.....	.....	.....	
3059	3	.45	.74	45,000	81,500	25.0	30.7	.22, .28*	25.0	.....	Dull silky.
3060	.....	.42	.85	.....	.....	.....	.....	.....	.....	.....	
3061	2,11	.40	.74	56,000	88,000	18.5	24.0	.21*, .16	26.5	.....	Amorphous.
3062	2,11	.40	.74	.....	.....	.....	.....	.....	.....	.....	
3063	2	.36	.74	.....	.....	.....	.....	.....	.....	.....	
3065	2,3	.36	.82	.....	.....	.....	.....	.....	.....	.....	
3066	3	.38	.90	.....	.....	.....	.....	.....	.....	.....	
3067	3	.39	.72	.....	.....	.....	.....	.....	.....	.....	
3068	2	.39	.73	.....	.....	.....	.....	.....	.....	.....	
3069	2	.35	.81	.....	.....	.....	.....	.....	.....	.....	
3070	2,3	.37	.75	.....	.....	.....	.....	.....	.....	.....	
3071	2,3	.32	.72	.....	.....	.....	.....	.....	.....	.....	
3072	3	.42	.83	.....	.....	.....	.....	.....	.....	.....	
3073	3	.39	.83	.....	.....	.....	.....	.....	.....	.....	
3074	2	.44	.74	.....	.....	.....	.....	.....	.....	.....	
3075	2	.37	.89	.....	.....	.....	.....	.....	.....	.....	
3076	2	.31	.89	.....	.....	.....	.....	.....	.....	.....	
3077	2	.36	.78	.....	.....	.....	.....	.....	.....	.....	
3078	2	.36	.74	.....	.....	.....	.....	.....	.....	.....	
3079	3	.41	.81	50,500	103,000	21.0	37.1	.28*, .14	28.0	.....	Amorphous, 40 per cent; fine granular, 60 per cent.
3080	3	.42	.83	.....	.....	.....	.....	.....	.....	.....	
3081	3	.41	.78	59,500	88,000	9.5	13.2	.08, .11*	28.0	.....	Amorphous trace of granulation.
				46,000	86,500	21.5	24.0	.23*, .20*	26.5	.....	Dull silky lamellar, 50 per cent; fine granular, 50 per cent.
3082	2,3	.36	.69	46,500	86,500	19.0	20.5	.20*, .18	26.0	.....	Fine granular, 70 per cent; amorphous spot, 30 per cent.
3083	2,3	.35	.71	57,500	87,500	12.5	20.5	.10, .15*	27.0	.....	Amorphous.
3084	2	.39	.84	.....	.....	.....	.....	.....	.....	.....	

				48,500	80,000	20.5	27.4	.23*, .18	25.0	.....	Do.
3085	3	.35	.81	44,500	86,500	22.5	30.7	.25*, .20	26.5	.....	Amorphous, lamellar.
				46,000	86,000	15.0	16.9	.17*, .13	26.0	.....	Fine granular amorphous spot at circumference.
				52,500	91,000	20.0	27.4	.18 .22*	.....	.....	Silky.
3086	2,3	.32	.78	.....	.....	.....	.....	.....	.....	.....	.....
				61,000	94,500	11.0	13.2	.10 .12*	27.0	.....	Fine granular.
3087	2,3	.36	.78	64,270	93,420	9.5	15.6	.08 .11*	33.0	.....	Fine granular, 50 per cent; amorphous, 50 per cent.
				39,500	79,000	23.5	34.0	.29*, .18	25.0	.....	Silky trace of granulation.
				45,000	86,000	19.5	24.0	.19*, .20*	27.0	.....	Lamellar silky, 85 per cent; granular, 15 per cent.
3088	.....	.80	.97	.....	.....	.....	.....	.....	.....	.....	.....
3089	3	.40	.64	.....	.....	.....	.....	.....	.....	.....	.....
3090	2	.33	.92	.....	.....	.....	.....	.....	.....	.....	.....
3091	2	.33	.84	.....	.....	.....	.....	.....	.....	.....	.....
3093	2	.38	.84	.....	.....	.....	.....	.....	.....	.....	.....
3094	2	.40	.81	44,000	80,000	26.0	34.1	.25*, .27*	26.0	.....	Amorphous trace of granulation.
				44,000	80,000	24.5	34.0	.29*, .20	27.0	.....	Dull silky trace of granulation.
3095	[1] 1,2,3	.38	.91	49,500	85,000	22.5	27.4	.25*, .20	26.5	.....	Dull silky.
				36,500	85,000	22.0	30.7	.26*, .18	26.5	.....	Dull silky, 40 per cent; fine granular, 60 per cent.
3096	[1] 1,2	.38	.71	59,500	95,500	17.5	24.0	.19*, .16*	28.0	.....	Dull silky, part lamellar.
3097	2,3	.31	.77	49,000	87,000	20.0	24.0	.20*, .20	26.0	.....	Dull silky, 30 per cent; fine granular, 70 per cent.
				43,000	77,500	26.5	37.1	.26*, .27*	24.5	.....	Silky.
3098	3	.37	.71	54,500	84,000	21.0	24.0	.22*, .20	22.0	163	Amorphous.
3099	3	.33	.74	45,500	78,000	22.5	24.0	.25*, .20	23.5	.....	Amorphous lamellar, 50 per cent; fine granular, 50 per cent.
3100	3	.34	.80	47,000	81,500	22.5	27.4	.24*, .21	24.5	.....	Silky trace of granulation.
3101	.....	.36	.88	.....	.....	.....	.....	.....	.....	.....	.....
3102	2,3	.46	.74	48,000	98,000	20.5	30.7	.24*, .17	28.0	.....	Dull silky, 80 per cent; fine granular, 20 per cent.
3103	3	.46	.77	45,000	80,000	24.0	34.0	.21, .27*	24.0	.....	Silky.
3104	Dies ..	.97	.92	.....	.....	.....	.....	.....	.....	.....	.....
3105	3	.39	.83	51,000	85,170	27.5	37.1	.....	.....	.....	Do.
3106	3	.39	.84	59,500	97,000	23.0	40.3	.20, .26*	28.0	.....	Do.
				50,950	82,330	21.0	24.2	.18, .24*	23.0	.....	Amorphous trace of granulation.
3107	2,3	.37	.86	59,500	89,500	19.5	24.0	.17, .22*	26.0	.....	Silky.
				51,720	85,290	13.5	13.5	.14*, .13	25.0	.....	Fine granular.
3108	[1] 1,2,3	.34	.91	47,000	87,000	21.0	24.0	.21, .21*	26.5	.....	Fine granular amorphous spot at circumference.
				63,000	88,500	10.0	13.2	.11*, .09	28.0	.....	Amorphous, 50 per cent; fine granular, 50 per cent.
				47,380	83,390	16.5	17.2	.24*, .19	24.0	.....	Amorphous, trace of granulation.
3109	2	.36	.78	47,500	86,500	22.0	30.7	.25*, .19	26.5	.....	Silky trace of granulation.
3110	[1] 1,2,3	.30	.79	49,750	85,500	23.5	30.9	.23, .24*	26.0	.....	Amorphous, trace of granulation.
				52,000	85,500	24.0	37.1	.17, .31*	26.5	.....	Dull silky.
3111	3	.37	.88	54,000	95,000	22.0	30.7	.17, .27*	26.0	.....	Silky.
3112	3	.34	.83	50,500	98,000	17.0	16.9	.16, .18*	29.0	.....	Fine granular.
3113	Dies ..	.96	.97	.....	.....	.....	.....	.....	.....	.....	.....
3114	3	.32	.84	55,500	93,000	24.0	43.3	.35*, .13	.....	.....	Fine silky.
3115	3	.42	1.09	52,000	85,000	22.5	27.4	.25*, .20*	23.5	.....	Silky.
				50,000	87,000	17.0	16.9	.17, .17*	25.5	.....	Fine granular amorphous spot at circumference.
3116	2	.34	1.01	46,000	86,500	19.0	24.0	.20*, .18	27.0	.....	Fine granular, lamellar spot.
				45,000	81,000	24.0	30.7	.19, .29*	24.0	.....	Silky.
3117	[1] 1,2,3	.40	.81	45,500	83,000	24.5	37.1	.24*, .25*	37.1	.....	Dull silky.
3118	2,3	.32	.86	46,000	84,000	21.5	30.7	.26*, .17	24.5	.....	Silky trace of granulation.

[1] Navy.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3119	3	0.38	0.91	64,000	97,500	14.0	20.5	0.12, 0.26*	.....	.....	Silky.
3120	[1] 1,2,3	.41	.83	45,500	78,500	25.0	34.0	.27*, .23	23.0	.....	Do.
				55,500	91,500	19.5	30.7	.15, .24*	.....	.....	Dull silky.
3121	2,3	.31	.85	59,000	96,500	22.5	34.0	.25*, .20	.....	.....	Silky.
3122	3	.32	.87	67,000	104,500	19.5	34.0	.24*, .15	.....	.....	Do.
3123	3	.42	1.02	55,000	98,000	22.5	43.3	.31*, .14	27.5	.....	Dull silky.
3124	3	.47	1.01	55,500	90,500	25.5	40.3	.25*, .26*	24.5	.....	Silky.
3125	[1] 1,2,3	.36	.88	34,500	82,000	23.5	27.4	.25*, .22*	25.0	.....	Dull silky.
				40,500	77,500	23.5	27.4	.20, .27*	.....	.....	Do.
				48,500	91,000	19.0	20.5	.20*, .18	24.0	.....	Fine granular, 75 per cent; dull silky, 25 per cent.
				40,800	81,000	25.0	34.0	.20, .30*	.....	.....	Silky, bordering on granular.
3126	[1] 1,2,3	.37	.92	47,000	81,500	26.0	34.0	.28*, .24*	25.0	.....	Dull silky.
				47,500	91,000	20.0	27.4	.17, .23*	.....	.....	Do.
3127	3	.46	.90	60,000	96,000	23.0	37.1	.15, .31*	.....	.....	Silky.
3128	3	.39	.94	54,000	91,000	23.0	34.0	.24*, .22	27.0	.....	Dull silky.
3129	[1] 1,2,3	.39	.91	47,500	86,500	22.0	30.7	.23*, .21	26.0	.....	Dull silky trace of granulation.
3130	.....	.92	.95	.....	.....	.....	.....	.....	.....	.....	.....
3131	3	.38	.76	60,000	105,500	15.0	16.9	.17*, .13	29.0	.....	Fine granular amorphous spot at circumference.
3132	2	.34	1.01	49,500	85,000	15.5	24.0	.13, .18*	26.0	.....	Amorphous.
3133	1,2,3	.35	.97	43,000	80,000	23.0	27.4	.23*, .23*	25.0	.....	Dull silky.
				56,500	90,000	21.5	27.4	.19, .24*	.....	.....	Fine silky.
3134	[1] 1,2,3	.33	.83	40,000	77,500	25.0	37.1	.29*, .21	.....	.....	Silky.
				48,500	91,000	21.5	30.7	.18, .25*	25.0	.....	Fine granular, 20 per cent; dull silky, 80 per cent.
				42,500	77,500	28.0	37.1	.24, .32*	.....	.....	Dull silky.
3135	1,2,3	.33	.88	53,500	89,500	16.0	16.9	.18*, .14	.....	.....	Amorphous, 20 per cent; granular, 80 per cent.
				45,500	88,500	21.5	30.7	.17, .26*	22.0	.....	Dull silky trace of granulation.
3136	3	.34	.83	53,500	87,500	23.0	37.1	.19, .27*	26.0	.....	Dull silky.
3137	3	.36	.90	51,000	87,000	24.5	37.1	.32*, .17	25.0	.....	Silky.
3138	[1] 1,2,3	.40	.87	48,500	82,500	27.5	37.1	.24, .31*	.....	.....	Dull silky.
				52,000	87,500	23.5	37.1	.17, .30*	.....	.....	Do.
3139	3	.38	.75	59,500	106,500	20.0	37.1	.28*, .12	.....	.....	Do.
3140	1,2	.37	.90	38,500	79,000	26.5	34.0	.33*, .20	.....	.....	Dull silky trace of granulation.
				39,500	79,000	25.5	37.1	.26*, .25*	.....	.....	Do.
3141	2,3	.38	.81	40,500	75,500	27.5	37.1	.34*, .21	.....	.....	Silky.
				50,500	85,500	25.0	40.3	.27*, .23	.....	.....	Do.
3142	1,2	.36	.75	40,000	78,500	26.5	34.0	.26, .27*	.....	.....	Dull silky trace of granulation.
3143	2,3	.39	.68	44,500	82,500	21.5	27.4	.19, .24*	.....	.....	Dull silky oblique.
				56,500	93,000	17.5	16.9	.20*, .15	.....	.....	Fine granular, 50 per cent; amorphous, 50 per cent.
				46,500	88,000	20.0	27.4	.16, .24*	24.0	.....	Dull silky, 50 per cent; granular, 50 per cent.

3144	1,2,3	.42	.68	47,500	86,000	19.5	24.0	.18, .21*			Fine granular, 90 per cent; silky, 10 per cent.
3145	2,3	.40	.78	45,500	79,500	24.5	30.7	.18, .31*			Dull silky granular spots, slightly oblique fracture.
				59,000	89,500	21.5	27.4	.25*, .18			Dull silky.
3146	2	.36	.65	36,000	75,000	24.5	40.3	.33*, .16			Silky.
3147	2	.37	.75	60,000	104,000	20.0	27.4	.23*, .17			Dull silky trace of granulation.
3148	1,2	.37	.81	48,000	84,500	24.5	34.0	.30*, .19			Dull silky.
				40,500	77,500	25.5	34.0	.20*, .22			Do.
3149	2,3	.39	.81	50,500	78,500	20.0	30.7	.25*, .15	22.5	153	Amorphous.
				43,500	80,500	23.5	27.4	.25*, .22	22.0	153	Do.
				50,500	87,500	18.5	24.0	.19*, .18	23.5	163	Amorphous trace of granulation.
				46,000	87,000	14.5	13.2	.16*, .13			Fine granular, 60 per cent; dull silky, 40 per cent.
3150	[1] 1,2,3	.38	.75	48,000	87,000	14.0	13.2	.14*, .14			Granular, 85 per cent; dull silky, 15 per cent.
				54,500	88,500	25.0	30.7	.28*, .22			Dull silky.
3151	1,2	.40	.85								
3152	1,2	.39	.65	37,000	74,500	28.5	34.0	.27*, .30*			Dull silky, 30 per cent; fine granular, 70 per cent.
				55,000	84,500	23.0	30.7	.21, .25*	23.0	163	Amorphous.
3153	1,2,3	.41	.65	51,000	90,500	18.0	24.0	.18, .18*			Dull silky.
3154	1,2	.38	.71	39,500	78,000	27.5	37.1	.21, .34*			Do.
3155	1,2	.37	.78	45,000	84 000	25.0	34.0	.29*, .21			Dull silky, trace of granulation.
3156	2,3	.39	.94	51,000	90,000	19.0	24.0	.22*, .16			Dull silky.
3157	2	.38	.78	34,500	72,500	31.0	40.3	.39*, .23			Do.
				44,000	84 500	24.0	30.7	.20, .28*	23.0		Dull silky, trace of granulation.
3158	2	.37	.75	34,000	63,000	34.5	49.1	.28, .41*			Silky.
3159	2,3	.39	.66	40,000	77,000	31.5	43.3	.38*, .25			Dull silky.
				45,000	87,500	22.0	30.7	.26*, .18	25.0		Dull silky, 90 per cent; granular, 10 per cent.
3160	2	.39	.80	39,500	88,000	24.5	37.1	.32*, .17			Silky.
3161	2	.42	.80	44,000	81,500	22.0	24.0	.22*, .22			Granular, 70 per cent; dull silky, 30 per cent.
3162	2,3	.44	.78	64,500	101,500	20.5	30.7	.27*, .14			Dull silky, trace of granulation.
3163	2	.44	.75	40,000	77,500	30.0	37.1	.36*, .24			Fine granular, amorphous spot at circumference.
3164	2	.38	.74	39,000	74,500	28.0	37.1	.22, .34*			Dull silky.
3165	2	.38	.71	39,000	82,000	23.0	27.4	.28*, .18			Dull silky, 85 per cent; fine granular, 15 per cent.
3166	2,3	.36	.74	47,000	83,500	25.0	34.0	.25*, .25*			Do.
3167	1,2	.35	.75	50,000	99,500	15.5	20.5	.17*, .14			Fine granular, 90 per cent; amorphous, 10 per cent.
				33,500	83,000	26.0	34.0	.31*, .21	21.0		Dull silky, trace of granulation.
3168	2	.37	.80	50,500	88,500	22.5	34.0	.20, .25*			Silky, trace of granulation.
3169	2,3	.38	.74	55,000	88,500	22.5	27.4	.23*, .22			Dull silky.
3170	1,2	.40	.72	41,000	77,000	27.5	40.3	.25, .30*			Do.
3171	1,2,3	.39	.77	50,500	84,500	25.0	40.3	.17, .33*	23.0		Silky.
				41,000	77,500	24.5	37.1	.19, .30*			Do.
3172	2	.38	.72	49,500	89,500	21.5	30.7	.17, .26*			Do.
3173	1,2	.38	.67	44,000	80,500	27.0	37.1	.21, .33*			Do.
3174	2	.48	.67	51,500	93,500	18.5	20.5	.16, .21*			Fine granular, 85 per cent; silky, 15 per cent.
3175	2	.42	.76	47,500	81,500	22.5	27.4	.20, .25*			Silky, trace of granulation.
3176	2,3	.42	.72	49,000	89,500	8.0	9.5	.08*, .08			Fine granular, amorphous spot at circumference.
				48,500	91,000	20.0	27.4	.18, .22*	24.0		Dull silky, 30 per cent; granular 70 per cent.
3177	[1] 1,2	.36	.77	45,500	82,000	20.5	27.4	.23*, .18			Silky.
3178	2	.38	.80	39,000	73,000	27.5	40.3	.34*, .21			Silky.
				43,500	81,500	23.5	30.7	.17, .30*	24.0		Dull-silky, trace of granulation.
3179	1,2	.37	.79	34,500	72,500	30.0	37.1	.32*, .28			Silky.
				43,500	76,500	22.0	27.4	.19, .25*	20.0		Dull silky.
3180	1,2	.37	.77	39,000	68,500	29.5	40.3	.30*, .29*	20.0	137	Do.

[1] Navy.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3181	3	0.38	0.76	54,000	87,000	23.0	30.7	0.22, 0.24*	.....	.....	Silky.
3182	3	.36	.72	55,000	84,500	24.5	30.7	.22, .27*	.....	.....	Do.
				45,500	83,500	19.0	20.5	.23*, .15	.....	.....	Dull silky.
				55,500	89,500	22.0	30.7	.17, .27*	.....	.....	Do.
3183	1,2	.36	.78	35,500	71,500	28.5	37.1	.33*, .24	.....	.....	Silky.
				44,500	79,500	21.5	30.7	.18, .25*	23.0	.....	Dull silky, trace of granulation.
3184	3	.42	.75	41,000	81,500	24.0	30.7	.18, .30*	.....	.....	Silky granular spots.
				55,500	95,000	23.5	43.3	.19, .28*	27.5	.....	Silky.
3185	1,2	.39	.76	34,500	71,000	27.5	37.1	.22, .33*	.....	.....	Amorphous.
3186	1	.39	.72	48,500	80,000	26.5	34.0	.33*, .20	.....	.....	Dull silky.
3187	1,2	.36	.74	44,200	79,400	24.0	27.4	.20, .28*	.....	.....	Fine granular, 40 per cent; amorphous, 60 per cent.
				45,500	86,000	18.5	16.9	.21*, .16	.....	.....	Amorphous, 60 per cent; granular, 40 per cent.
3188	1,2	.37	.75	58,000	96,000	22.5	37.1	.23*, .22	.....	.....	Dull silky.
3189	.....	.41	.76	43,000	80,000	24.0	34.0	.29*, .19	.....	.....	Silky, granular spots.
3190	1	.40	.78	41,000	76 000	23.0	30.7	.18, .28*	.....	.....	Silky.
3191	1	.40	.75	44 000	80,000	25.0	30.7	.19, .31	.....	.....	Do.
3192	1,2	.42	.74	37,000	75,000	29.0	37.1	.29*, .29*	22.0	.....	Do.
3193	1,2	.39	.71	43,500	81,500	22.5	34.0	.28*, .17	.....	.....	Do.
3194	1,2	.46	.72	44,000	83,500	24.5	30.7	.26*, .23	22.5	.....	Do.
3195	2,3	.45	.74	42,000	81,000	24.0	34.0	.26*, .22	.....	.....	Do.
				50,500	82,500	23.0	30.7	.18, .28*	21.0	146	Amorphous.
3196	3	.42	.77	43,500	79,900	25.0	30.7	.25*, .25*	.....	.....	Dull silky, trace of granulation.
				40,500	74,500	26.5	37.2	.30*, .23	21.0	.....	Silky.
3197	1,2	.37	.79	50,500	92,500	15.0	16.9	.15*, .15	25.0	.....	Fine gr anular, 60 per cent; amorphous, 40 per cent.
3198	2	.35	.91	48,500	87,000	24.0	34.0	.31*, .17	25.0	.....	Silky.
3199	1,2	.41	.90	44,000	82,000	25.0	37.1	.22, .28*	.....	.....	Do.
3200	1	.38	.91	48,500	91,500	22.5	30.7	.27*, .18	.....	.....	Do.
3201	1	.37	.92	44,000	80,000	24.5	34.0	.22, .27*	.....	.....	Do.
3202	2	.35	.80	32,500	69,500	30.0	46.2	.27, .33*	21.0	.....	Dull silky.
3203	2,3	.38	.82	58,500	96,000	22.5	34.0	.24*, .21*	23.0	174	Do.
3204	1,2	.40	.84	45,000	84,500	24.0	30.7	.20, .28*	.....	.....	Silky.
3205	3	.35	.92	44,500	82,000	24.5	27.4	.19, .30*	.....	.....	Do.
3206	1	.38	.91	48,500	89,500	20.5	24.0	.22*, .19	25.0	.....	Silky, 40 per cent; granular, 60 per cent.
3207	1	.38	.78	44,500	84,000	24.0	27.4	.20, .28*	.....	.....	Silky.
3208	2,1	.36	.60	41,700	76,700	27.0	37.1	.34*, .20	.....	.....	Do.
3209	2,3	.38	.75	40,000	76,500	25.5	34.0	.29*, .22	20.0	146	Dull silky, trace of granulation.
				46,000	86,000	24.5	37.1	.25*, .24*	25.0	.....	Silky, trace of granulation.

3210	1,2	.37	.80	46,000	84 500	24.5	34.0	.19, .30*	23.0	.....	Silky.
3211	2,3	.37	.78	45,500	82,500	26.0	40.3	.29*, .23	23.0	.....	Dull silky.
				56,000	94,500	19.0	24.0	.23*, .15	27.0	.....	Silky.
3212	2	.35	.75	44,000	78,500	24.0	34.0	.20, .28*	21.0	146	Dull silky.
3213	1,2	.35	.85	43,500	78,500	26.0	37.1	.21, .31*	21.0	.....	Silky.
3214	1,2	.36	.80	41,500	79,000	26.0	37.1	.23, .29*	22.0	.....	Do.
3215	1	.34	.87	38,500	77,500	27.5	43.3	.35*, .20	23.0	.....	Silky, trace of granulation
3216	1,2	.36	.78	48,500	94,500	20.5	27.4	.20*, .21*	24.0	.....	Silky, granular spots.
3217	1,2	.35	.69	41,500	78,000	27.5	37.1	.28*, .27*	22.5	.....	Dull silky.
3218	2	.37	.70	41,500	76,500	25.0	40.3	.20, .30*	24.0	.....	Do.
3219	2	.38	.84	40,000	74,500	27.0	40.3	.25, .29*	21.0	.....	Silky.
3220	2	.36	.93	34,500	71,000	28.5	40.3	.38*, .19	21.0	.....	Do.
				50,500	84.500	23.5	30.7	.25*, .22	20.5	163	Dull silky.
3221	1,2	.34	.80	43,500	81,000	26.0	37.1	.19, .33*	22.5	.....	Do.
3222	1,2	.35	.71	42,000	78,500	25.5	40.3	.32,* .19	23.0	.....	Do.
3223	1	.32	.71	42,500	77,200	27.5	43.3	.23, .32*	.....	.....	Dull silky, trace of granulation.
				44,500	83,500	25.0	30.7	.27*, .23	22.0	.....	Dull silky, 40 per cent; fine granular, 60 per cent.
3224	1	.31	.70	44,300	82,400	23.0	34.0	.15, .31*	.....	.....	Dull silky, 80 per cent; fine granular, 20 per cent.
3225	2,3	.34	.71	46,500	85,000	24.5	37.1	.17, .32*	22.0	.....	Silky.
3226	1,2	.31	.92	39,000	75,500	28.5	37.1	.33*, .24	21.0	.....	Dull silky.
3227	1	.30	.75	37,000	72,000	28.5	43.3	.38*, .19	.....	.....	Dull silky, trace of granulation.
3228	1,2,3	.33	.78	37,500	76,500	25.5	34.0	.26*, .25*	21.5	.....	Silky, 80 per cent; granular, 20 per cent.
3229	1	.35	.81	36,500	76,500	25.0	37.1	.32*, .18	22.5	.....	Silky, granular spots.
3230	1,2	.35	.....	34,500	72,500	27.5	40,3	.26, .29*	22.0	.....	Silky.
3231	2,3	.33	.87	43,500	94,500	12.0	13.2	.11, .23*	28.0	.....	Granular, silvery luster.
				56,000	91,500	24.0	37.1	.29*, .19	24.5	.....	Dull silky.
				52,000	96,000	21.5	20.5	.21*, .22*	26.0	.....	Silky, 50 per cent; granular, 50 per cent.
3232	2	.32	.93	38,100	79,200	24.0	30.7	.15, .33*	.....	.....	Fine granular 70 per cent, amorphous 30 per cent.
3233	1,2	.33	.97	32,500	69,000	25.5	37.1	.30*, .21	22.0	.....	Silky.
				41,500	82,000	24.5	37.2	.16, .33*	21.5	.....	Dull silky.
3234	1	.32	.90	37,500	77,500	26.0	34.0	.22, .30*	23.0	.....	Fine granular 60 per cent, dull silky 40 per cent.
3235	1	.32	1.00	42,000	84,500	19.5	27.4	.16, .23*	25.0	.....	Dull silky 35 per cent, coarse granular 65 per cent.
3236	1,2	.35	.96	56,000	106,000	6.5	9.5	.06, .07*	32.0	.....	Granular.
				43,000	75,500	24.5	30.7	.25*, .24	21.0	.....	Dull silky trace of granulation.
3237	2	.33	.....	38,500	80,000	24.5	34.0	.21, .28*	25.0	.....	Dull silky granular spots.
3238	1,2	.35	.82	35,500	75,000	27.0	37.1	.32*, .22	22.0	.....	Do.
3239	1,2	.34	.92	36,000	70,500	26.5	34.0	.20, .33*	22.0	.....	Silky.
				40,500	78,500	24.5	34.0	.30*, .19	22.0	.....	Silky lamellar.
3240	1	.32	.94	42,300	79,600	24.5	34.0	.32*, .17	.....	.....	Dull silky.
3241	1	.34	.83	49,800	74,800	28.5	40.3	.32*, .25	.....	.....	Do.
3242	1,2	.32	.79	45,400	90,500	20.5	24.0	.18, .23*	.....	.....	Fine granular.
3243	2	.32	.87	36,000	75,000	25.5	34.0	.31*, .20	20.0	.....	Silky trace of granulation.
3244	1,2	.31	.92	39,000	78,200	25.5	27.4	.29*, .22	.....	.....	Fine granular 60 per cent, amorphous 40 per cent.
3245	2,3	.35	.95	38,500	80,000	24.5	30.7	.21, .28*	24.0	.....	Fine granular amorphous spot at circumference.
				48,000	81,500	26.0	30.7	.23, .29*	21.5	149	Amorphous.
3246	1,2	.34	.96	34,800	71,100	27.0	37.1	.17, .37*	.....	.....	Dull silky trace of granulation
				37,500	77,000	24.0	30.7	.30*, .18	20.5	.....	Fine granular 50 per cent, dull silky 50 per cent.
3247	1,2	.30	.77	34,500	71,500	27.5	40.3	.23, .32*	21.0	.....	Silky granular spots.
				45,500	78,500	24.5	37.2	.32*, .17	21.0	146	Silky.
3248	2	.32	.76	31,300	68,000	31.0	40.3	.35*, .27	.....	.....	Dull silky.
				38,500	75,000	26.0	37.2	.26*, .26*	21.5	.....	Do.
3249	1,2	.31	.78	39,500	74,500	26.0	34.0	.20, .32*	23.0	.....	Do.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3250	1,2	0.32	0.78	38,500	76,500.	25.0	30.7	0.26*,0.24*	22.0	.....	Silky.
3251	1,2,3	.34	.81	38,500	77,000	26.0	30.7	.22, .30*	23.0	.....	Do.
				31,500	68,000	29.5	37.1	.32*, .27*	22.0	.....	Do.
3252	1,2	.33	.82	37,700	76,700	24.5	30.7	.24, .25*	.....	.....	Fine granular 70 per cent, amorphous 30 per cent.
				39,300	76,400	24.0	24.0	.25*, .23	.....	.....	Fine granular 75 per cent, amorphous 25 per cent.
3253	1,2	.33	.84	38,400	76,600	26.0	37.1	.33*, .19	.....	.....	Dull silky trace of granulation.
3254	2	.30	.80	49,700	71,400	27.0	37.1	.32*, .22	.....	.....	Dull silky.
				37,500	79,000	23.5	27.4	.20, .27*	21.0	.....	Fine granular 80 per cent, smooth spot at circumference 20 per cent.
3255	2	.32	.83	40,900	73,100	27.0	37.1	.24, .30*	.....	.....	Dull silky.
3256	2	.32	.79	46,500	77,000	26.0	40.3	.34*, .18	22.0	.....	Silky.
				41,100	75,000	29.0	37.1	.22, .36*	.....	.....	Dull silky.
3257	2,3	.33	.84	50,500	95,000	21.0	27.4	.18, .24*	26.0	.....	Amorphous trace of granulation.
				40,100	73,700	26.0	30.7	.28*, .24	.....	.....	Dull silky 50 per cent, fine granular 50 per cent.
				45,500	86,000	23.5	34.0	.21, .26*	24.0	.....	Dull silky.
3258	1,2	.34	.85	50,500	88,200	16.0	16.9	.15, .17	.....	.....	Dull silky 30 per cent, fine granular 70 per cent.
				43,500	78,500	25.0	43.3	.23, .27*	21.0	.....	Dull silky.
3259	1,2	.32	.83	33,900	63,400	28.5	40.3	.35*, .22	.....	.....	Do.
				43,000	78,500	27.0	37.2	.30*, .24*	23.0	.....	Do.
3260	2	.....	.....	41,500	74,500	26.5	40.3	.25*, .28*	20.0	.....	Do.
3261	1,2	.....	.....	39,500	73,200	27.5	34.0	.22, .33*	.....	.....	Do.
				39,500	77,500	22.0	24.0	.25*, .19	23.0	.....	Silky 55 per cent, granular 45 per cent.
3262	2	.....	.72	44,500	88,500	19.5	20.5	.20*, .19	24.5	.....	Fine granular silky spot at circumference.
3263	2	.41	.72	39,000	75,000	25.0	30.7	.30*, .20	20.0	.....	Dull silky trace of granulation.
3264	.....	.40	.75	.....	.....	.....	.....	.....	.....	.....	.....
3265	2	.38	.82	32,300	68,100	26.5	27.4	.23, .30*	.....	.....	Fine granular 75 per cent, amorphous 25 per cent.
				35,500	75,000	26.5	37.1	.19, .34*	21.0	.....	Dull silky.
3266	1,2	.39	.81	35,500	72,800	33.0	40.3	.26, .40*	.....	.....	Dull silky trace of granulation.
				41,500	84,000	17.5	20.5	.14, .21*	23.0	.....	Granular.
				49,000	92,000	11.5	13.3	.13*, .10	21.5	.....	Fine granular 75 per cent, amorphous 25 per cent.
3267	2	.37	.83	43,000	80,500	25.0	34.0	.20, .30*	21.5	.....	Dull silky.
				38,500	80,500	19.5	24.0	.17, .22*	23.5	.....	Fine granular 70 per cent, dull silky 30 per cent.
3268	2,3	.38	.85	36,500	73,500	28.0	37.2	.38*, .18*	19.5	.....	Dull silky.
				48,000	82,000	24.5	34.0	.29*, .20	23.0	.....	Do.
3269	2,3	.38	.80	40,500	75,000	27.0	34.0	.27*, .27*	20.0	.....	Do.
				46,000	79,500	22.5	27.4	.26*, .19	22.0	.....	Do.
3270	1,2	.37	.....	42,500	73,000	27.0	37.2	.27*, .27*	20.0	.....	Do.
				40,500	76,500	25.0	30.7	.20, .30*	21.0	.....	Dull silky trace of granulation.
3271	1	.38	.84	42,500	76,000	24.5	34.0	.21, .28*	20.5	.....	Dull silky.
3272	2	.36	.....	39,000	80,000	21.5	24.0	.25*, .18	23.0	.....	Dull silky, 60 per cent; fine granular, 40 per cent.

3273	2,3	.34	.80	45,500	87,000	21.0	27.4	.25*, .17	24.0	.....	Silky, 40 per cent; granular, 60 per cent.
3274	1,3	.46	.84	42,500	76,000	25.0	30.7	.23, .27*	21.0	.....	Dull silky.
				43,500	83,000	10.0	16.9	.12*, .08	22.5	.....	Dull silky trace of granulation.
				53,500	83,500	21.0	24.0	.19, .23*	22.5	.....	Dull silky.
3275	2,3	.40	.83	45,000	81,000	23.0	34.0	.18, .28*	21.0	.....	Do.
3276	2	.42	.....	40,500	75,000	25.5	34.0	.25*, .26*	21.0	.....	Do.
3277	2	.50	.80	43,500	72,000	29.0	40.3	.26, .32*	20.0	.....	Do.
				36,000	74,000	26.0	30.7	.29*, .23	20.5	.....	Do.
3278	2	.43	.79	43,000	79,000	24.5	34.0	.19, .30*	22.0	149	Silky.
3279	2	.42	.79	43,000	80,000	24.5	30.7	.23, .26*	23.0	116	Dull silky.
3280	2	.42	.79								
3281	1,2	.48	.79	39,500	75,000	26.0	34.0	.25, .27*	22.0	137	Do.
3282	2,3	.41	.80	44,500	67,000	9.0	13.3	.12*, .06	21.0	149	Amorphous, spongy spot at circumference.
3283	2,3	.41	.80								
3284	2,3	.45	.80	45,500	89,500	21.0	27.4	.23*, .19	24.0	163	Dull silky 50 per cent, fine granular 50 per cent.
3285	3	.49	.91	47,000	87,000	21.0	27.4	.18, .24*	23.5	163	Do.
3286	2,3	.46	.85	43,000	82,000	25.0	37.2	.29*, .21	22.0	143	Silky.
				57,500	86,500	22.0	27.4	.21, .23*	25.0	.....	Amorphous.
3287	2	.47	.87	49,000	89,500	17.5	16.9	.17*, .18*	25.0	166	Dull silky 60 per cent, granular 40 per cent.
3288	2	.47	.87	51,500	91,000	17.0	16.9	.17, .17*	21.5	163	Dull silky 60 per cent, fine granular 40 per cent.
				55,000	85,500	20.0	27.4	.23*, .17	21.0	159	Amorphous.
3289	1,2	.48	.82	50,500	92,000	19.5	24.0	.22*, .17	25.0	170	Dull silky 30 per cent, granular 70 per cent.
				52,500	92,500	20.0	27.4	.17, .23*	22.5	163	Amorphous 50 per cent, fine granular 50 per cent.
3290	2,3	.46	.84	55,500	95,500	14.0	9.5	.14, .14	26.0	163	Fine granular 90 per cent, dull silky 10 per cent.
3291				57,000	87,500	25.0	37.2	.31*, .19	24.0	156	Dull silky.
3292	1,2,3	.44	.85	39,500	74,000	26.5	34.0	.27*, .26*	21.5	140	Silky.
				54,500	82,500	23.5	30.7	.28*, .19	23.0	156	Dull silky.
3293	1	.43	.71	.....	.....	.....	.....	.....	.....	.....	.....
3294	2	.42	.77	40,500	75.500	26.0	40.3	.29*, .23	20.5	131	Do.
3295	2	.45	.75	44,000	75,500	26.0	37.2	.20, .32*	20.5	143	Do.
3296											
3297	2	.44	.78	43,000	75,500	26.0	34.0	.21, .31*	20.5	143	Do.
3298	2,3	.42	.74	40,500	73,500	15.0	20.5	.17*, .13	21.0	126	Dull silky, sandy spot at circumference.
3299				53,500	85,000	17.0	24.0	.19*, .15	23.0	170	Amorphous.
3300	2	.45	.75	45,500	84,500	20.0	20.5	.20*, .20*	22.0	163	Amorphous, 70 per cent; granular, 30 per cent.
3301	2	.40	.80	36,500	74,500	23.0	27.4	.19, .27*	21.0	140	Dull silky.
3302	2	.38	.78	45,000	78,000	25.0	30.7	.23, .27*	21.5	143	Do.
3303											
3304	2	.43	.75	45,500	81,500	22.5	30.7	.17, .28*	20.0	153	Do.
3305	2	.42	.71								
3306	2	.45	.78	45,000	79,000	24.0	34.0	.20, .28*	22.0	153	Amorphous.
3307	2,3	.42	.73	43,500	78,500	23.0	30.7	.25*, .21	21.5	140	Dull silky.
				52,000	84,000	16.0	20.5	.15, .17*	24.0	156	Amorphous.
3308	2	.40	.81	45,500	81,000	23.0	30.7	.25*, .21	23.0	146	Dull silky.
3309	2	.46									
3310	1,2	.42	.76	42,500	75.500	25.5	40.3	.31*, .20	21.0	137	Do.
3311											
3312	2,3	.43	.79	39,500	76,000	24.5	34.0	.16, .15	22.0	149	Silky.
3313				54,000	87,500	19.0	20.5	.25*, .13	21.5	163	Dull silky.
3314	2	.43	.80	44,000	79,500	24.0	30.7	.24*, .24*	23.0	156	Amorphous.
3315	2	.46	.74	45,500	79,500	15.5	24.0	.18*, .13	21.5	146	Dull silky.
3316	3	.41	.77	53,500	88,000	22.5	34.0	.25*, .20	24.0	159	Silky.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3317	2	.39	.70	45,500	81,000	25.5	37.2	.27*, .24	22.0	156	Silky oblique.
3318			.75								
3319	1,2	.44	.73	39,500	70,500	28.5	37.2	.30*, .27*	22.0	126	Dull silky.
3320	2	.41	.70	43,000	82,000	22.5	30.7	.28*, .17	22.5	149	Amorphous.
3321											
3322	1,2	.38	.91	40,500	74,500	21.5	27.4	.22*, .21	22.0	131	Dull silky, trace of granulation.
3323				54,500	83,500	12.5	16.9	.15*, .10	22.0	156	Amorphous, trace of granulation.
3324	2,3	.42	.85	49,500	84,500	22.5	30.7	.28*, .17	23.0	.....	Amorphous.
3325				50,500	84,500	25.0	40.3	.31*, .19	23.0	163	Dull silky.
3326	2,3	.44	.78	41,500	72,000	10.5	13.3	.12*, .09	21.5	143	Ganular.
				44,500	75,500	14.0	16.9	.09, .19*	22.0	131	Amorphous, trace of granulation.
				47,500	88,500	20.5	27.4	.17, .24*	23.5	170	Amorphous, 60 per cent; granular, 40 per cent.
3327	2	.43	.88	36,500	66,000	32.0	46.2	.39*, .25	21.0	121	Silky.
				38,500	67,000	25.0	43.3	.16, .34*	20.0	126	Do.
				57,500	88,000	19.0	24.0	.21*, .17	25.0	170	Amorphous.
3328	3	.39	.74	44,000	83,000	26.0	40.3	.22, .30*	22.5	149	Dull silky.
				50,500	81,000	23.0	30.7	.23*, .23*	21.0	153	Amorphous.
3329	2,3	.41	.70	45,500	80,000	25.0	34.0	.20, .30*	21.0	149	Dull silky.
3330	2,3	.40	.73								
3331	2	.39	.75	43,000	77,500	25.0	30.7	.24*, .26*	21.5	143	Do.
3332	1,2,3	.40	.72	40,500	76,000	14.5	24.0	.12, .17*	22.0	137	Dull silky, trace of granulation.
3333		.42	.88	50,000	94,500	14.5	20.5	.12, .17*	25.0	183	Dull silky.
3334	2,3	.50	.78	40,500	74,000	28.0	37.2	.28*, .28*	21.0	126	Do.
				50,500	80,500	20.5	27.4	.22*, .19	23.5	149	Amorphous.
3335	3	.42	.78	40,500	74,000	21.0	27.4	.24*, .18	22.0	131	Silky.
				48,000	76,500	9.5	16.9	.08, .11*	22.0	149	Amorphous.
				49,000	96,000	14.5	16.9	.13, .16*	25.0	170	Amorphous, 70 per cent; granular, 30 per cent.
3336	2,3	.40	.76	43,500	78,500	26.5	30.7	.23, .30*	22.0	149	Dull silky, trace of granulation.
3337		.41	.80	49,500	94,000	18.0	20.5	.15, .21*	24.0	170	Amorphous, 50 per cent; granular, 50 per cent.
3338	2,3	.39	.73	43,000	80,500	18.5	20.5	.17, .20*	22.0	149	Fine granular, 70 per cent; dull silky, 30 per cent.
				56,000	89,500	18.5	16.9	.17, .20*	23.0	163	Amorphous.
				55,000	83,000	22.0	24.0	.24*, .20	22.0	149	Silky.
3339	1,2	.43	.76	42,000	79,500	24.5	30.7	.23*, .26*	23.0	143	Silky trace of granulation.
3340		.46	.79								
3341	2,3	.39	.78	41,500	78,000	20.5	27.4	.23*, .18	23.0	137	Do.
				54,500	86,000	19.0	20.5	.18*, .20*	23.0	163	Amorphous.
3342	3	.38	.81	37,500	69,000	30.0	43.3	.21, .39*	21.0	126	Silky.
				45,500	75,500	26.5	37.2	.30*, .23	21.0	143	Amorphous.
				50,500	88,500	18.0	20.5	.18*, .18	23.0	163	Do.

3343	2,3	.39	.70	40,500	79,000	19.0	24.0	.18, .20*	23.0	143	Do.
				51,000	90,000	21.5	27.4	.25*, .18	24.0	163	Do.
				45,500	82,000	20.0	30.7	.17, .23*	23.0	143	Amorphous, 50 per cent; granular, 50 per cent.
3344	2,3	.44	.70	45,500	80,500	21.0	24.0	.25*, .17	22.0	149	Amorphous.
				55,500	88,000	17.0	20.5	.17, .17*	24.5	166	Do.
				43,000	82,000	17.0	16.9	.19*, .15	23.0	149	Amorphous, trace of granulation.
3345 3346	1,2,3	.42	.84	45,000	80,000	22.5	24.0	.19, .26*	22.0	149	Amorphous, 50 per cent; granular, 50 per cent.
				52,500	92,500	16.0	20.5	.20*, .12	25.0	163	Amorphous, trace of granulation.
3347 3348	3 3	.41 .41	.88 .88	49,500	87,000	14.5	13.3	.14, .15*	23.0	163	Dull silky, 40 per cent; fine granular, 60 per cent.
3349	.....	.42	.....	.....	.....	.....	.....	.....	.....	.....	.....
3350	2,3	.45	.80	45,000	85,000	22.5	24.0	.20*, .25*	23.5	163	Amorphous, 85 per cent; granular, 15 per cent.
3351	3	.41	.78	44,400	81,300	27.0	40.3	.28*, .26*	23.0	149	Amorphous, trace of granulation.
				53,000	85,000	24.5	40.3	.17, .32*	22.0	163	Amorphous.
3352	.....	.40	.80	.....	.....	.....	.....	.....	.....	.....	.....
3353	2,3	.39	.76	42,500	82,000	19.5	24.0	.15, .24*	22.5	156	Amorphous, trace of granulation.
				54,000	87,500	18.0	24.0	.18*, .18	24.0	166	Amorphous.
3354 3355	1,2	.39	.70	39,000	72,000	24.5	30.7	.18, .31*	22.0	134	Dull silky, trace of granulation.
				35,500	75,500	24.0	27.4	.23, .25*	22.0	146	Amorphous, 30 per cent; fine granular, 70 per cent.
				45,000	83,000	15.0	16.9	.12, .18*	23.0	163	Amorphous.
3356	2,3	.40	.72	45,000	77,000	26.5	34.0	.31*, .22	22.0	137	Silky.
				43,000	80,000	18.0	24.0	.15 .21*	21.0	149	Amorphous.
3357	2,3	.37	.74	.....	.....	.....	.....	.....	.....	.....	.....
3358	2	.36	.80	49,000	80,500	17.0	20.5	.14, .20*	22.0	159	Granular, 60 per cent; dull silky, 40 per cent.
				45,000	78,000	25.0	30.7	.23, .27*	23.0	143	Amorphous.
3359	2,3	.37	.90	51,000	80,500	23.0	27.4	.21, .25*	21.5	156	Do.
				48,000	79,500	26.0	40.3	.34*, .18	20.5	153	Dull silky.
				42,500	82,000	16.5	20.5	.15, .18*	22.0	156	Amorphous, 15 per cent; granular, 85 per cent.
3360	3	.34	.85	58,500	90,000	18.0	24.0	.20*, .16	23.5	170	Amorphous, 80 per cent; granular, 20 per cent.
3361	2,3	.35	.83	46,500	84,000	19.0	24.0	.19, .19*	22.5	163	Granular, 30 per cent; dull silky, 70 per cent.
3362	1,2,3	.38	.82	44,500	75,500	26.0	27.4	.27,* .25*	18.5	137	Dull silky.
				36,000	73,000	27.0	37.2	.28,* .26*	21.0	131	Do.
3363	2	.37	.86	55,000	86,500	19.0	20.5	.21,* .17	23.0	163	Amorphous.
3364	2,3	.36	.84	50,500	83,500	15.5	20.5	.14, .17*	23.5	153	Do.
3365	2,3	.40	.80	44,500	81,500	22.0	27.4	.22,* .22*	23.0	156	Amorphous trace of granulation.
				55,500	88,000	21.0	24.0	.19, .23*	24.5	153	Amorphous, 85 per cent; granular, 15 per cent.
				31,500	66,500	27.0	37.2	.20, .34*	20.0	124	Dull silky.
				32,500	67,000	25.0	34.0	.30,* .20	19.5	124	Amorphous.
				45,000	74,500	19.5	24.0	.22*, .17	20.5	137	Do.
3366	2,3	.38	.82	45,500	72,000	25.5	30.7	.27,* .24	20.0	126	Do.
				36,000	69,500	26.5	37.2	.26,* .29*	20.0	134	Dull silky.
				41,500	69,500	20.0	27.4	.22,* .18	20.5	128	Amorphous.
3367 3368	1	.40	.85	36,000	67,000	30.0	40.3	.36,* .24	19.0	124	Silky.
				36,000	77,000	22.5	27.4	.29,* .16	23.0	143	Amorphous, 60 per cent; granular, 40 per cent.
3369	2,3	.43	.82	47,000	85,500	18.5	27.4	.22,* .15	23.0	166	Dull silky.
				49,500	81,500	15.0	16.9	.14, .16*	21.0	149	Granular, 60 per cent; amorphous, 40 per cent.
				38,300	78,100	22.0	27.8	.21, .23	22.0	143	Amorphous trace of granulation.
				47,000	86,000	19.5	27.4	.15, .24*	23.0	170	Amorphous.
3370	2,3	.42	.80	42,500	79,500	21.5	27.4	.23,* .20	21.0	149	Dull silky trace of granulation.
				48,000	87,000	23.0	30.7	.20, .26*	22.0	156	Amorphous trace of granulation.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3371	3	0.41	0.78	42,500	79,000	17.5	24.0	.15, .22*	22.5	153	Amorphous.
				51,500	83,500	17.0	24.0	.19,* .15	22.5	159	Do.
				45,500	79,500	14.5	16.9	.16,* .13	21.0	156	Do.
				54,000	83,500	13.0	16.9	.11, .15*	22.0	156	Do.
3372	1	.41	.78	38,000	77,000	22.0	27.4	.25,* .19	21.0	143	Amorphous trace of granulation.
3373		.42	.82								
3374	2	.42	.85	48,500	76,500	6.0	5.7	.06, .06	25.0	166	Amorphous, 80 per cent; fine granular, 20 per cent.
				38,500	75,500	22.0	24.0	.24,* .20	21.5	149	Amorphous trace of granulation.
3375	3	.43	.83	35,000	72,000	22.5	27.4	.27,* .18	21.0	137	Dull silky.
				47,000	78,000	23.5	30.7	.22, .25*	23.0	149	Silky.
				44,000	74,500	23.5	30.7	.19, .28*	20.0	137	Amorphous.
				46,000	79,000	23.0	27.4	.20, .26*	20.0	149	Do.
3376	2,3	.41	.81	33,500	70,500	25.0	30.7	.31,* .19	22.0	134	Amorphous trace of granulation.
				48,000	78,000	23.5	30.7	.25,* .22	22.0	149	Amorphous.
				36,000	73,000	22.5	27.4	.18, .27*	20.5	143	Amorphous, 85 per cent; granular, 15 per cent.
				45,500	77,500	19.0	24.0	.22,* .16	20.5	134	Amorphous.
3377	2	.45	.84	36,000	73,000	26.5	37.2	.32,* .21	22.0	137	Do.
3378	2	.43	.83								
3379	2,3	.43	.85	55,500	91,500	18.5	24.0	.19,* .18*	23.0	179	Do.
3380	2,3	.41	.85	55,000	84,000	23.5	37.2	.26,* .21	21.0	163	Do.
3381	2,3	.44	.84	55,500	91,000	17.5	20.5	.16, .19*	22.5	179	Do.
3382	3	.45	.86	55,500	85,000	23.0	30.7	.21, .25*	21.5	163	Do.
3383	1	.40	.83	43,000	80,500	23.0	30.7	.25,* .21	23.0	153	Do.
3384		.39	.84								
3385	2	.42	.84	50,000	90,500	15.5	16.9	.15, .16*	23.0	170	Amorphous, 50 per cent; fine granular, 50 per cent.
				49,000	84,500	22.5	30.7	.21, .24*	22.5	163	Amorphous trace of granulation.
3386	2,3	.40	.86	53,500	91,000	21.0	30.7	.25,* .17	22.0	174	Dull silky.
3387	3	.44	.84	54,500	86,500	22.5	30.7	.17, .28*	23.0	163	Amorphous.
3388	2,3	.45	.83	47,500	81,500	23.0	30.7	.19, .27*	22.0	149	Do.
3389	2,3	.43	.85	48,500	91,000	20.0	27.4	.16, .24	23.0	179	Silky oblique.
3390	2,3	.42	.82	52,500	87,500	22.5	30.7	.25,* .20	23.0	170	Amorphous.
3391	2,3	.42	.85	51,000	89,500	19.0	27.4	.16, .22*	23.0	166	Do.
3392	2	.41	.84	44,000	79,000	23.5	24.0	.28,* .19	20.0	149	Do.
3393	2	.42	.86	45,500	81,500	20.0	24.0	.20,* .20*	22.0	159	Do.
3394	1,2	.40	.83	48,000	81,000	24.0	34.0	.29,* .19	22.0	153	Do.
3395	2	.40	.82	40,500	77,500	28.0	43.3	.36,* .20	22.0	146	Silky.

				54,500	93,500	13.5	16.9	.15,* .12	25.0	174	Amorphous, 80 per cent; granular, 20 per cent.
				56,500	90,500	14.0	16.9	.13, .15*	22.0	166	Amorphous, 70 per cent; granular, 30 per cent.
3396	2,3	.44	.81	57,000	88,000	10.5	16.9	.10, .11*	22.5	170	Amorphous, 50 per cent; fine granular, 50 per cent.
				57,000	87,000	9.5	16.9	.11,* .08	22.5	170	Amorphous.
				50,000	82,500	12.0	13.3	.11, .13*	22.0	149	Dull silky, 30 per cent; granular, 70 per cent.
				70,000	122,000	4.5	5.7	.05, .04	32.5	255	Fine granular; silky spot at circumference.
				47,500	101,500	8.0	9.5	.08, .08*	27.0	207	Granular.
3397	2,3	.43	.85	66,000	119,500	5.0	5.7	.06,* .04	34.0	249	Fine granular.
				45,000	97,500	8.5	9.5	.07,* .10*	26.0	192	Fine granular; amorphous spot at circumference.
3398	3	.45	.83	55,500	86,500	19.0	20.5	.21,* .17	23.0	163	Amorphous.
3399	3	.44	.84	50,500	88,000	21.0	30.7	.25,* .17	21.0	170	Do.
				60,500	116,500	5.0	5.7	.04, .06*	31.0	241	Fine granular; amorphous spot at circumference.
3400	2	.....	.....	47,500	101,000	7.5	5.7	.09,* .06	28.5	202	Fine granular; silky spot at circumference.
				64,000	118,000	5.5	5.7	.07,* .04	32.0	241	Fine granular, with amorphous spot at circumference.
3401	2,3	.....	.....	45,500	81,500	24.0	37.2	.19, .29*	20.0	149	Silky.
3402	2	.....	.....	48,000	81,000	26.0	37.2	.23, .29*	21.0	156	Amorphous.
3403	2	.....	.....	45,000	82,000	24.0	27.4	.23 .25*	22.0	153	Amorphous trace of granulation.
3404	2,3	.40	.85	40,500	74,000	25.0	43.3	.35,* .15	18.0	137	Silky.
				45,500	79,500	26.0	40.3	.30,* .22	20.0	156	Dull silky.
3405	2	.38	.86	49,000	85,000	20.5	24.0	.21,* .20	23.0	163	Amorphous.
3406	2	.39	.83	44,500	84,000	24.0	30.7	.22, .26*	22.0	156	Do.
3407	2,3	.38	.84	53,500	94,500	17.0	20.5	.17, .17*	25.5	179	Fine granular, 70 per cent; amorphous, 30 per cent.
3408	2,3	.41	.81	64,000	101,500	13.5	16.9	.14,* .13*	26.0	192	Do.
				48,000	88,500	18.5	20.5	.18, .19*	25.0	163	Fine granular; silky spot at circumference.
3409	.....	.40	.85	.....	.....	.....	.....	.....	.....	.....	.....
3410	3	.41	.86	50,000	85,000	22.5	27.4	.23,* .22*	22.5	163	Amorphous trace of granulation.
				40,500	74,000	27.0	40.3	.25, .29*	21.0	137	Dull silky.
3411	2,3	.40	.82	44,500	75,500	24.0	27.4	.20, .28*	20.5	137	Amorphous.
				45,000	79,000	23.5	30.7	.21, .26*	22.5	149	Silky.
				58,500	83,500	6.5	5.7	.06, .07*	24.5	170	Amorphous.
3412	1,2	.38	.84	52,500	77,500	9.0	9.5	.10,* .08	23.0	156	Do.
				64,500	84,000	8.0	9.5	.10,* .06	24.5	170	Do.
				60,500	100,500	11.0	13.3	.09, .13*	26.0	196	Fine granular, 70 per cent; amorphous, 30 per cent.
3413	2,3	.43	.87	45,000	88,000	15.5	13.3	.16,* .15*	24.0	159	Fine granular, 70 per cent; silky, 30 per cent.
3414	2	.41	.81	49,000	87,500	21.0	24.0	.19, .23*	20.0	156	Silky.
3415	2	.43	.85	41,500	81,000	21.5	27.4	.25,* .18	18.0	149	Dull silky.
3416	3	.45	.84	39,500	75,000	27.0	46.2	.38,* .16	18.5	134	Silky.
				50,500	94,500	19.0	27.4	.22,* .16	22.5	183	Amorphous.
3417	3	.42	.84	49,500	87,500	22.5	30.7	.19, .26*	19.0	156	Dull silky.
3418	.....	.40	.82	.....	.....	.....	.....	.....	.....	.....	.....
3419	2	.41	.83	44,500	78,000	26.5	37.2	.32,* .21	20.0	143	Do.
3420	.....	.43	.81	.....	.....	.....	.....	.....	.....	.....	.....
3421	2,3	.43	.85	65,500	103,000	16.5	20.5	.17,* .16*	26.0	192	Fine granular 85 per cent, amorphous 15 per cent.
3422	2,3	.42	.87	55,000	94,000	22.0	30.7	.25,* .19	24.0	174	Amorphous.
3423	2	.38	.82	45,500	81,500	31.0	43.3	.25, .37*	20.0	149	Dull silky.
3424	3	.42	.84	44,500	80,500	24.5	30.7	.25,* .24*	20.0	146	Do.
3425	2	.32	.82	50,500	88,000	23.5	30.7	.26,* .21	20.5	170	Do.
3426	3	.39	.85	42,500	79,500	24.0	30.7	.28,* .20	20.0	149	Do.
				48,500	85,000	21.0	27.4	.24,* .18	21.0	163	Amorphous trace of granulation.
3427	3	.40	.81	45,000	80,500	22.5	30.7	.21, .24*	21.0	153	Dull silky.
3428	.....	.38	.86	.....	.....	.....	.....	.....	.....	.....	.....
3429	2	.37	.83	45,000	81,000	31.0	40.3	.32,* .30	20.0	146	Do.

Cast steel from Watertown Arsenal steel plant—Continued.

Heat No.	Grade.	Chemical composition.		Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.						Shore.	Brinell.	
		Per cent.	*Per cent.*	*Lb.*	*Lb.*	*Per cent.*	*Per cent.*	*In.*			
3430	2,3	0.43	0.87	56,500	85,000	8.0	9.5	0.07, 0.09*	24.0	170	Amorphous trace of granulation.
				50,500	79,000	10.5	9.5	.10, .11*	24.0	149	Amorphous.
				59,500	80,500	6.0	5.7	.07,* .05	24.0	170	Do.
				52,000	74,500	8.5	9.5	.07, .10*	22.0	143	Do.
3431	3	.34	.83	45,500	85,500	23.5	27.4	.25,* .22	22.0	163	Amorphous trace of granulation.
3432	3	1.25	.85								
3433	2	.39	.85	45,500	79,000	26.5	37.2	.31,* .22	19.0	146	Dull silky.
3434		.41	.86								
3435	2	.41	.84	47,500	80,500	25.0	34.0	.30,* .20	21.0	143	Do.
3436	3	.44	.82	54,000	92,500	22.5	34.0	.28,* .17	23.0	174	Do.
3437	3	.39	.85	55,500	85,000	9.5	13.3	.10,* .09	23.0	159	Amorphous trace of granulation.
				50,500	80,000	14.0	13.3	.16,* .12	23.0	153	Amorphous.
				59,500	85,000	11.0	13.3	.13,* .09	23.0	170	Do.
				50,500	76,000	13.5	13.3	.15,* .12	22.0	149	Do.
3438	2	.44	.83	57,500	88,000	9.5	9.5	.08, .11*	23.5	170	Amorphous trace of granulation.
				50,000	80,500	12.5	13.3	.12,* .13*	24.0	149	Do.
				60,000	86,000	9.0	9.5	.08, .10*	24.0	179	Amorphous.
				51,500	77,000	11.0	13.3	.13,* .09	22.0	146	Do.
3439	2,3	.45	.82	57,500	85,500	7.5	9.5	.09,* .06	24.0	166	Amorphous trace of granulation.
				51,000	80,000	10.5	9.5	.10,* .11*	23.5	149	Do.
				57,500	84,000	8.0	9.5	.09,* .07	24.0	179	Amorphous.
				52,500	77,500	12.0	13.3	.14,* .10	22.5	149	Amorphous trace of granulation.
3440		.40	.84								
3441		.42	.82								
3442	3	.46	.93	59,000	85,500	8.5	5.7	.07, .10*	23.5	170	Do.
				50,500	75,500	11.0	13.3	.13,* .09	22.0	143	Do.
3443		.38	.85								
3444	3	.44	.86	57,000	86,500	8.5	9.5	.07, .10*	23.0	170	Amorphous 50 per cent, granular 50 per cent.
				49,500	77,500	12.0	13.3	.14,* .10	23.0	149	Amorphous 70 per cent, fine granular 30 per cent.
3445	3	.46	.83	52,500	91,000	17.0	20.5	.16, .18*	21.0	166	Amorphous 75 per cent, granular 25 per cent.
3446	2,3	.44	.82	50,500	87,500	18.0	20.5	.17, .19*	22.0	166	Amorphous trace of granulation.
3447	2,3	.45	.83	49,000	84,500	22.5	27.4	.24,* .21*	22.0	159	Dull silky.
3448	3	.44	.85	42,500	78,500	23.5	34.0	.24,* .23*	20.0	137	Do.
				45,500	77,500	26.0	30.7	.24, .28*	21.0	137	Do.
				53,500	80,500	19.5	27.4	.15, .24*	22.0	156	Do.
3449		.46	.86								
3450		.46	.86								
3451	3	.44	.86	45,000	87,000	22.0	34.0	.20, .24*	23.0	170	Do.
3452	3	.43	.90	44,500	84,500	20.0	27.4	.19, .21*	21.0	153	Dull silky trace of granulation.

3453	2,3	.44	1.00	45,500	85,000	25.5	34.0	.30,* .21	21.0	156	Dull silky.
3454	.....	.43	.81	.....	.....	.....	.....	.....	.....	.....	
3455	.....	.41	.86	.....	.....	.....	.....	.....	.....	.....	
3456	.....	.38	.91	.....	.....	.....	.....	.....	.....	.....	
3457	.....	.41	.90	.....	.....	.....	.....	.....	.....	.....	
3458	3	.43	.85	40,500	78,000	23.5	30.7	.22,* .25*	21.5	146	Do.
				50,500	86,500	19.0	24.0	.18, .20*	23.0	163	Do.
3459	.....	.42	.83	.....	.....	.....	.....	.....	.....	.....	
3460	3	.38	.79	.....	.....	.....	.....	.....	.....	.....	
3461	.....	.39	.82	.....	.....	.....	.....	.....	.....	.....	
3462	.....	.43	.83	.....	.....	.....	.....	.....	.....	.....	
3463	2,3	.45	.85	42,500	80,000	21.0	24.0	.20, .22*	22.0	149	Dull silky 50 per cent, fine granular 50 per cent.
				55,000	88,500	20.5	24.0	.22,* .19*	23.0	174	Dull silky.
3464	1	.30	.78	39,500	72,000	28.0	37.2	.29,* .27	21.0	134	Silky.
3465	.....	.35	.86	.....	.....	.....	.....	.....	.....	.....	
3466	2,3	.43	.84	47,000	84,500	24.0	30.7	.21, .27*	22.5	159	Dull silky.
3467	.....	.38	.82	.....	.....	.....	.....	.....	.....	.....	
3468	.....	.37	.84	.....	.....	.....	.....	.....	.....	.....	
3469	3	.....	.....	48,000	82,000	23.5	34.0	.24,* .23*	23.5	149	Do.
3470											
3471	1,3	.43	.83	55,500	88,500	11.5	13.3	.10*, .13*	24.5	166	Fine granular 50 per cent, amorphous 50 per cent.
				48,500	79,000	15.5	16.9	.17,* .14	22.0	143	Amorphous 50 per cent, fine granular 50 per cent.
3473	3	.45	.85	49,000	89,500	18.0	24.0	.18,* .18*	23.0	170	Amorphous.
3474	.....	.38	.87	.....	.....	.....	.....	.....	.....	.....	
3477	1	.47	.95	49,000	80,500	26.5	37.2	.24, .29*	22.0	156	Do.
3478	3	.37	1.05	60,500	88,000	8.0	9.5	.08,* .08*	25.0	179	Amorphous 70 per cent, fine granular 30 per cent.
				50,500	79,000	11.5	13.3	.11, .12*	22.2	149	Amorphous.
3479	3	.46	1.19	60,500	89,500	8.5	9.5	.10,* .07	24.0	179	Amorphous 70 per cent, fine granular 30 per cent.
				49,500	79,500	13.0	16.9	.12, .14*	23.0	156	Amorphous 50 per cent, granular 50 per cent.

CAST STEEL FROM OPEN-HEARTH FURNACE AT WATERTOWN ARSENAL FOUNDRY.

Heat No.	Grade.	Chemical composition.					Elastic limit (pounds per square inch).	Tensile strength (pounds per square inch).	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
		Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.						Shore.	Brinell.	
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Lb.*	*Lb.*	*P. ct.*	*P. ct.*	*In.* *In.*			
1 O. H..	.....	0.32	0.70	0.344	0.038	0.044	46,300	83,800	20.0	20.5	0.18, 0.22*	23.0	.....	Granular, 80 per cent; dull silky, 20 per cent.
2 O. H..	2,3	.41	.71	.280	.032	.035	39,000	80,500	17.0	16.9	.18*, .16	22.0	.....	Fine granular; silky spot at circumference.
							34,500	81,000	25.5	30.7	.25, .26*	23.0	.....	Silky, 30 per cent; granular, 70 per cent.
							49,000	87,500	24.5	30.7	.24, .25*	23.0	163	Silky.
3 O. H..	1,2,3	.38	.70	.283	.035	.040	38,500	81,000	18.5	20.5	.16, .21*	24.5	.....	Fine granular; silky spot at circumference.
							36,500	71,500	32.2	46.2	.38*, .26	21.0	.....	Silky.
4 O. H..	2,3	.50	.70	.280	.036	.040	38,500	81,500	6.5	9.5	.05, .08*	24.0	.....	Fine granular.
							39,000	85,500	11.5	9.5	.12*, .11	25.0	.....	Do.
							38,000	85,000	18.0	16.9	.15, .21*	24.5	.....	Fine granular; silky spot at circumference.
							46,500	87,500	9.5	13.3	.09, .10*	24.5	170	Fine granular, 90 per cent; amorphous, 10 per cent.
5 O. H..	2,3	.45	.65	.283	.040	.040	55,000	85,500	17.0	24.0	.17, .17	23.0	163	Amorphous.
							44,500	84,000	19.5	24.0	.16, .23*	23.0	.....	Fine granular, 50 per cent; dull silky, 50 per cent.
6 O. H..	1,2,3	.39	.65	.250	.038	.035	32,500	71,000	28.0	40.3	.25, .31*	19.5	.....	Dull silky.
							44,000	78,000	24.0	30.7	.20, .28	21.5	153	Silky.
							46,000	88,000	9.5	13.3	.10*, .09	24.0	170	Fine granular, 85 per cent; amorphous, 15 per cent.
7 O. H..	1,2,3	.38	.68	.262	.040	.038	52,500	83,000	24.0	34.0	.22*, .26*	21.0	159	Dull silky.
							35,000	71,500	23.0	30.7	.20, .26*	21.5	.....	Do.
							48,000	80,500	16.0	24.0	.13, .19*	21.5	153	Dull silky trace of granulation.
8 O. H..	1,2,3	.39	.72	.300	.036	.035	35,000	72,000	24.0	27.4	.27*, .21	21.0	.....	Dull silky.
							42,500	77,000	29.0	40.3	.27, .31*	22.0	146	Silky.
							47,000	90,000	10.5	13.3	.12*, .09	23.5	174	Fine granular, 80 per cent; amorphous, 20 per cent.
9 O. H..	2,3	.41	.70	.285	.030	.040	46,500	82,000	27.5	34.0	.21, .34*	21.0	156	Silky.
							39,000	79,500	22.0	27.4	.26*, .18	23.0	.....	Dull silky trace of granulation.
							43,000	88,500	18.0	27.4	.10, .26*	22.5	159	Granular, smooth spot at circumference.
							48,500	84,000	23.5	37.2	.16, .31*	22.0	159	Silky.
							49,500	90,500	11.5	16.9	.10, .13*	25.0	179	Fine granular, 65 per cent; amorphous, 20 per cent.
10 O. H..	1,2,3	.38	.68	.....	.038	.037	57,000	85,000	21.0	27.4	.18, .24*	25.0	159	Amorphous.
							37,500	75,500	29.0	43.3	.23, .35*	21.0	.....	Dull silky.
							50,000	84,000	16.5	24.0	.15, .18*	22.0	156	Do.
11 O. H..	2,3	.38	.69	.....	.039	.039	37,500	76,500	24.0	30.7	.27*, .21	22.0	143	Silky.
							50,000	82,500	23.5	30.7	.27*, .20	21.0	149	Amorphous.
12 O. H.. Al Ti...	1,2,3	.40	.68	.....	.038	.038	39,000	82,000	23.5	34.0	.29*, .18	22.0	156	Silky, with granular spots near circumference.

13 O. H.. Al Ti...	2,3	.45	.63	.....	.....	.....	50,000	91,000	21.0	27.4	.22*, .20	23.5	170	Silky.
14 O. H.. Al Ti...	2,3	.46	.55	.....	.036	.040	40,000	85,500	19.5	20.5	.17, .22*	23.0	159	Do.
							48,000	88,000	11.0	13.3	.09, .13*	24.0	170	Fine granular, 50 per cent; amorphous, 5 per cent.
							50,500	91,000	16.0	20.5	.18*, .14	25.0	170	Dull silky.
15 O. H..	2,3	.47	.36				39,500	82,500	19.5	24.0	.17, .22*	23.0	156	Silky, 85 per cent; granular, 15 per cent.
							51,500	88,000	19.5	20.5	.19*, .19*	22.5	166	Dull silky, 65 per cent; granular, 35 per cent.

* Inch section in which fracture occurred.

STEEL FORGINGS FOR ORDNANCE WORK.

FORGED STEEL FROM WATERTOWN ARSENAL SMITH SHOP.

[The inch in which fracture occurred is marked thus: *.]

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
276F	D	131,500	154,000	15.5	43.3	0.23*, 0.08	48.0	.....	Silky.
454F	3	37,500	76,500	17.5	43.3	.09, .26*	28.5	.....	Dull silky.
		43,000	86,500	25.0	40.3	.19, .31*	26.0	.....	Silky.
		61,000	99,000	22.5	51.9	.35*, .10	33.0	.....	Do.
476F	3	43,000	99,500	19.5	34.0	.27*, .12	32.0	.....	Dull silky, 30 per cent; granular, 70 per cent.
517F	A	79,000	122,000	20.0	49.1	.10, .30*	39.0	.....	Silky.
519F [1]	.....	100,000	121,500	17.5	54.6	.06, .29*	37.0	.....	Fine silky.
520F [1]	.....	67,000	113,000	21.5	49.1	.12, .31*	36.0	.....	Silky.
521F	3	49,500	93,000	11.0	16.9	.09, .13*	28.0	.....	Amorphous, 30 per cent; fine granular, 70 per cent.
		47,000	81,000	25.0	40.3	.20, .30*	24.0	.....	Silky.
		72,500	103,500	8.0	13.2	.10*, .06	33.5	.....	Silky and lamellar.
		61,000	100,500	16.5	30.7	.10, .23*	29.0	.....	Silky.
535F [1]	.....	104,000	165,000	13.0	43.3	.05, .21*	46.0	.....	Do.
536F [1]	.....	60,000	118,500	18.5	37.1	.27*, .10	35.0	.....	Silky; trace of granulation.
537F	D	97,500	155,500	14.0	40.3	.23*, .05	41.0	.....	Silky, serrated.
541F	2	50,000	81,500	27.5	49.1	.28*, .27*	25.0	.....	Silky.
762F	3	58,230	91,330	27.0	49.3	.36*, .18	27.0	.....	Fine silky.
764F	C and 3	58,200	101,000	22.0	46.4	.12, .32*	28.0	.....	Do.
		106,000	109,000	15.5	54.6	.12, .19*	33.0	.....	Do.
		73,000	106,000	25.5	59.8	.34*, .17	32.0	.....	Fine silky; cup shaped.
		77,000	106,000	26.5	62.2	.38*, .15	33.0	.....	Fine silky.
765F	C and 3	55,900	101,000	23.0	49.3	.13, .33*	29.0	.....	Do.
		74,000	102,000	26.0	64.6	.40*, .12	38.0	.....	Do.
		77,000	106,000	26.0	57.2	.26*, .26*	34.0	.....	Fine silky; cup shaped.
767F	C	55,500	109,000	8.5	9.5	.07, .10*	35.0	.....	Fine granular.
771F	C	50,000	101,000	13.0	13.2	.11, .15*	.....	.....	Coarse granular.
		146,000	155,000	15.0	43.3	.24*, .06	47.0	.....	Fine silky.
785F	2	56,000	107,000	18.5	34.0	.25*, .12	31.5	.....	Amorphous, trace of granulation.
		62,000	110,000	21.5	34.0	.23*, .20	32.0	.....	Do.
787F	3	60,000	90,000	27.5	64.6	.42*, .13	34.0	.....	Fine silky.
815F	3	45,500	94,000	20.5	34.0	.28*, .13	32.0	.....	Amorphous.
826F	3	45,000	76,500	28.0	43.3	.38*, .18	26.0	.....	Silky.
		66,500	102,500	18.5	34.0	.18, .19*	30.5	.....	Fine granular, 50 per cent; amorphous, 50 per cent.
829F	3	49,500	85,000	28.0	51.9	.23, .33*	27.0	.....	Silky.
		62,000	102,000	19.0	49.1	.08, .30*	31.0	.....	Dull silky.
830F	3	50,000	90,500	28.0	43.3	.36*, .20	29.0	.....	Silky.
832F	2	50,500	78,500	31.0	59.8	.44*, .18	26.0	.....	Fine silky.
844F	3	52,000	93,000	23.0	30.5	.23*, .23*	29.0	.....	Silky; trace of granulation.
847F	3	44,000	81,000	27.0	51.9	.40*, .14	25.0	.....	Dull silky.
		49,000	85,000	28.0	54.6	.17, .39*	.....	.....	Fine silky.
		50,000	87,000	29.0	54.6	.19, .39*	.....	.....	Do.
		[2] 61,500	.....	.....	.....	.....	.....	.....	.....
		67,000	104,500	21.0	51.9	.30*, .12*	30.0	.....	Do.
850F	3	47,000	104,500	13.5	13.2	.14*, .13	.....	.....	Fine granular with amorphous spot at circumference.
		46,000	100,500	17.5	20.5	.20*, .15	.....	.....	Do.
853F	2	46,000	91,000	22.5	43.3	.12, .33*	.....	.....	Dull silky.
		51,000	85,500	27.5	43.3	.21, .34	27.0	.....	Do.

[1] 60,000 lb. per sq. in. elastic limit required.
[2] Stripped threads on specimen at 20,600-lb. load.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
		63,000	105,000	26.0	51.9	0.22, 0.30*	.....	.....	Fine silky.
		72,500	111,000	25.0	57.2	.33*, .17	.....	.....	Do.
		72,000	111,500	25.0	54.6	.36*, .14	.....	.....	Do.
865F	C.....	75,000	108,500	25.5	59.8	.38*, .13	.....	.....	Fine silky, cup shaped.
		73,500	108,500	25.0	57.2	.20, .30*	.....	.....	Do.
		98,000	124,000	17.0	49.1	.07, .27*	.....	.....	Fine silky.
866F	.....	94,000	119,500	16.5	51.9	.27*, .06	.....	.....	Do.
867F	.....	98,000	124,500	17.0	49.1	.27*, .07	.....	.....	Fine silky, cup shaped.
868F	.....	99,500	124,000	16.5	51.9	.27*, .06	.....	.....	Fine silky.
877F	3.....	64,000	110,000	20.0	51.9	.08, .32*	28.0	.....	Do.
879F	3.....	49,000	84,000	28.0	51.9	.39*, .18	.....	.....	Silky.
883F	3.....	88,000	142,500	14.5	30.7	.21*, .08	.....	.....	Fine granular, silky spot in center.
		47,500	90,500	23.5	30.7	.22*, .25*	.....	.....	Silky.
885F [1]	.....	44,500	80,000	25.0	40.3	.34*, .16	25.5	.....	Dull silky.
886F	3.....	55,500	96,500	20.5	43.3	.31*, .10	.....	.....	Fine silky.
890F	C.....	67,000	116,500	23.0	57.2	.34*, .12	.....	.....	Do.
		83,000	123,000	17.5	43.3	.25*, .10	.....	.....	Silky; trace of granulation.
891F	.....	87,000	124,000	17.0	40.3	.10, .24*	.....	.....	Do.
892F	.....	84,500	123,500	17.0	43.3	.16, .18*	.....	.....	Do.
902F	3.....	50,000	99,000	19.5	30.7	.22*, .17	.....	.....	Dull silky, granular spots.
903F	C.....	70,000	114,500	15.0	37.1	.06, .24*	.....	.....	Dull silky.
		141,500	143,500	16.5	49.1	.06, .27*	.....	.....	Fine silky, serrated.
904F	C.....	119,000	138,000	18.0	51.9	.27*, .09	.....	.....	Do.
906F	2.....	55,000	96,500	25.5	40.3	.33, .18	.....	.....	Silky.
913F	C.....	119,000	138,000	18.5	51.9	.29*, .08	.....	.....	Silky, serrated.
914F	.....	123,000	142,000	19.0	51.9	.13, .25*	.....	.....	Do.
919 F	3.....	46,500	60,500	32.5	66.9	.18, .47*	.....	.....	Fine silky.
921 F	2.....	59,500	88,500	26.5	46.2	.29*, .24*	.....	.....	Do.
927 F	D.....	150,000	164,500	13.0	46.2	.23*, .03	.....	.....	Do.
		100,000	145,500	12.5	51.9	.22*, .03	.....	.....	Fine silky; cup shaped.
928 F	D.....	119,500	141,000	13.0	37.1	.21*, .05	.....	.....	Fine silky.
		47,500	99,500	20.0	37.1	.10, .30*	.....	.....	Fine granular; silky spot at circumference.
930 F	D.....	65,000	114,000	21.0	46.2	.16, .26*	.....	.....	Fine silky.
931 F	No. 5 Navy	70,500	109,500	16.5	37.1	.09, .24*	.....	.....	Fine granular.
932 F	...do.....	86,500	113,000	22.5	49.1	.13, .32*	33.0	.....	Fine silky.
933 F	3.....	56,500	98,500	21.5	54.6	.11, .32*	.....	.....	Do.
935 AB	Nickel steel.	53,000	95,000	23.5	46.2	.34*, .13	.....	.....	Silky.
935 F	...do.....	79,000	111,000	20.0	57.2	.32*, .08	32.0	.....	Fine silky; cup shaped.
936 F	...do.....	88,000	118,000	21.0	57.2	.09, .33*	32.0	.....	Fine silky; serrated.
936 BB	...do.....	51,000	92,500	24.5	51.9	.13, .36*	.....	.....	Silky.
936 BM	...do.....	57,500	95,000	24.5	51.9	.12, .37*	.....	.....	Do.
937 F	...do.....	93,000	124,500	17.5	51.9	.05, .30*	31.0	.....	Fine silky.
		81,000	120,500	18.5	46.2	.22,* .15	33.0	.....	Do.
937 CB	...do.....	55,500	99,000	19.0	30.7	.14, .24*	.....	.....	Fine granular; amorphous spot at circumference.
937 CM	...do.....	59,000	91,000	25.5	57.2	.15, .36*	.....	.....	Fine silky.
938 F	...do.....	86,500	117,000	20.5	57.2	.09, .32*	36.0	.....	Fine silky; serrated.
938 DB	...do.....	51,000	94,500	19.0	46.2	.10, .28*	.....	.....	Silky.
938 DM	...do.....	57,500	92,500	25.0	54.6	.14, .36*	.....	.....	Do.
939 F	...do.....	96,000	127,000	18.0	54.6	.29*, .07	35.0	.....	Fine silky.
939 EB	...do.....	50,500	89,500	24.5	49.1	.14, .35*	.....	.....	Do.
939 EM	...do.....	57,500	100,000	22.0	49.1	.11, .33*	.....	.....	Do.
940 F	3.....	60,000	98,500	18.0	40.3	.28*, .08	.....	.....	Fine silky, with small open seam at center.
942 F	Nickel steel.	54,000	99,500	23.0	46.2	.32*, .14	.....	.....	Silky.
		58,500	99,000	24.0	51.9	.36*, .12	.....	.....	Do.
		86,000	113,500	20.0	59.8	.33*, .07	31.0	.....	Fine silky; cup shaped.

[1] 60,000 lb. per sq. in. elastic limit required.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
943 F	Nickel steel.	57,000	102,500	19.0	37.1	0.11, 0.27*	.....	.....	Dull silky; trace of granulation.
		64,500	98,000	25.0	51.9	.14, .36*	.....	.....	Silky.
		62,000	95,000	15.0	57.2	.29*, .01	23.0	.....	Fine silky.
		72,500	104,500	23.5	59.8	.24*, .23*	31.0	.....	Do.
944 F	...do.....	57,000	100,500	23.0	43.3	.18, .28*	.....	.....	Dull silky.
		65,000	96,500	26.0	51.9	.37*, .15	.....	.....	Fine silky.
		85,500	115,500	20.5	57.2	.14, .27*	33.0	.....	Do.
945 F	...do.....	51,500	93,000	22.0	49.1	.11, .33	.....	.....	Dull silky.
		64,000	95,500	26.0	54.6	14, .38*	.....	.....	Fine silky.
		83,500	112,500	21.5	59.8	.34*, .09	31.0	.....	Do.
946 F	...do.....	57,500	102,000	22.0	43.3	.13, .31*	.....	.....	Dull silky; trace of granulation.
		56,500	99,000	23.0	46.2	.14, .32*	.....	.....	Silky.
		77,000	106,000	21.0	62.2	.35*, .07	30.0	.....	Fine silky; cup shaped.
947 F	3.....	64,000	105,000	21.5	37.1	.13, .30*	.....	.....	Fine granular.
953 F	3.....	43,000	87,500	24.0	43.3	.35*, .13	.....	.....	Silky.
		42,500	91,500	21.0	37.1	.12, .30*	.....	.....	Dull silky; trace of granulation.
954 F	2.....	49,000	101,500	18.0	24.0	.18*, .18*	.....	.....	Medium fine granular.
		58,000	106,000	18.0	46.2	.08, .28*	.....	.....	Fine silky.
		62,500	98,000	24.5	54.6	.36*, .13	.....	.....	Do.
966 F	1.....	41,000	61,500	35.5	66.9	.51*, .20	.....	.....	Do.
982 F	3.....	62,500	95,000	26.0	57.2	.14 .38*	.....	.....	Do.
986 F	2.....	58,000	127,000	12.5	16.9	.10, .15*	.....	.....	Fine granular.
		64,000	97,500	24.5	51.9	.12, .37*	.....	.....	Fine silky.
1003	2.....	58,500	124,500	10.5	16.9	.13*, .08	37.0	.....	Fine granular.
1006	2.....	56,000	100,000	21.5	37.1	.22*, .21*	.....	.....	Silky; trace of granulation.
1010 F	1.....	37,000	61,000	36.5	64.7	.40*, .33*	.....	.....	Fine silky.
1018 F	3.....	54,000	83,500	27.5	57.2	.15, .40*	.....	.....	Do.
		77,000	108,000	22.0	54.6	.13, .31*	32.0	.....	Do.
1034 F	D.....	65,500	93,500	26.5	54.6	.16, .37*	.....	.....	Do.
		145,500	160,000	14.0	51.9	.03, .24*	48.0	.....	Fine silky; cup shaped.
1038 F [1]	.....	58,500	86,000	26.0	46.2	.25*, .27*	25.0	.....	Fine silky.
		99,000	126,000	19.5	54.6	.23*, .16	39.0	.....	Silky; serrated.
1039 F	A.....	122,000	140,500	19.0	59.6	.08, .30*	36.0	.....	Fine silky; serrated
1040 F	3.....	48,000	80,500	29.0	54.6	.42*, .16	.....	.....	Fine silky.
		56,500	95,000	25.5	49.1	.29*, .22	28.0	.....	Do.
1046 F	3.....	58,500	94,500	25.0	46.2	.33*, .17	.....	.....	Do.
1047 F	3.....	46,500	77,500	30.0	51.9	.36*, .24	.....	.....	Do.
1051 F	Nickel steel No. 2 Navy.	65,000	92,500	27.0	51.9	.....	.....	.....	Silky; cup shaped.
		65,000	92,500	28.0	54.6	.22, .34*	23.5	.....	Fine silky.
1052 F	...do.....	53,800	92,200	26.5	51.9	.36*, .17	25.0	.....	Do.
		98,000	124,500	18.0	49.1	.28*, .08	33.0	241	Silky, serrated.
		93,000	121,000	20.5	59.8	.30*, .11	36.0	235	Fine silky; serrated.
		93,500	121,000	20.5	59.8	.15, .26*	34.0	241	Fine silky; cup shaped.
1053 F	...do.....	65,000	97,500	27.5	59.8	.17, .38*	24.0	.....	Fine silky.
1054 F	...do.....	56,000	91,500	28.0	57.2	.22, .34*	24.0	.....	Fine silky; cup shaped.
		96,000	132,000	15.5	43.3	.05, .26*	35.0	262	Fine silky.
		89,500	119,500	20.5	54.6	.32*, .09	31.0	235	Fine silky; serrated.
1055 F	...do.....	62,500	91,000	29.0	54.6	.40*, .18	24.0	.....	Fine silky.
1056 F	...do.....	64,500	99,000	25.0	57.2	.13, .37*	25.0	.....	Do.
		58,500	97,500	24.5	57.2	.37*, .12	26.0	.....	Do.
1057 F	...do.....	100,000	122,000	17.5	51.9	.06, .29*	33.0	241	Silky; serrated.
		90,000	116,500	22.0	59.8	.17, .27*	34.0	241	Fine silky; serrated.
		92,000	118,500	21.5	59.8	.30*, .13	33.0	241	Do.
1058 F	...do.....	56,000	90,500	28.0	57.2	.16, .40*	24.0	.....	Fine silky.
		113,000	132,000	18.5	49.1	.17, .20*	35.0	255	Silky, serrated.
		93,500	123,500	19.5	51.9	.29,* .10	36.0	248	Fine silky; serrated
		91,500	121,500	19.5	54.6	.32,* .07	34.0	255	Do.
1059 F	...do.....	51,500	90,500	27.5	51.9	.20, .35*	27.0	.....	Fine silky.
		51,000	91,000	21.0	54.6	.14, .38*	.....	.....	Silky.
		95,000	128,500	17.0	49.1	.28*, .06	36.0	255	Fine silky.
		92,000	122,000	19.0	54.6	.09, .29*	34.0	241	Fine silky; serrated.

[1] 60,000 lbs. per sq. in. elastic limit required.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
1060 F	Nickel steel No. 2 Navy.	62,000	101,500	26.5	54.6	0.33*, 0.20	26.0	.....	Fine silky.
1061 F	...do.....	63,000	99,500	26.5	57.2	.14, .39*	25.0	.....	Do.
1062 F	...do.....	68,500	97,500	28.0	59.8	.25, .31*	26.0	.....	Do.
1063 F	...do.....	65,000	105,000	22.5	51.9	.11, .34*	28.0	.....	Do.
1064 F	...do.....	57,500	93,500	28.5	59.8	.18, .39*	29.0	.....	Do.
		100,000	121,500	19.5	57.2	.07, .32*	33.5	241	Silky; serrated.
		94,000	120,500	21.5	59.8	.23*, .20*	34.0	248	Fine silky; serrated.
		91,500	120,000	22.0	57.2	.20*, .24*	32.0	248	Do.
1065 F	...do.....	49,000	90,500	27.5	51.9	.34*, .21	.....	.....	Fine silky.
1067 F	...do.....	59,000	100,000	22.0	34.0	.24*, .20*	27.0	183	Silky.
		58,000	101,500	21.0	34.0	.21*, .21*	27.0	192	Silky; trace of granulation.
1068 F	...do.....	55,500	93,000	25.5	43.3	.28*, .23*	23.5	170	Fine silky; cup shaped.
1071 F	...do.....	60,500	93,000	23.5	34.0	.23*, .24*	23.0	170	Fine silky.
1074 F	...do.....	83,000	116,500	19.0	51.9	.31*, .07	34.0	255	Fine silky; serrated.
1080 F	...do.....	55,000	95,000	24.5	43.3	.25*, .24*	24.0	179	Fine silky.
		83,500	119,000	18.5	46.2	.12, .25*	24.0	.....	Silky; cup shaped.
1081 F	...do.....	66,500	94,500	27.5	54.6	.34*, .21	28.0	.....	Fine silky; cup shaped.
1082 F	...do.....	66,000	93,500	27.0	51.9	.35*, .19	25.0	.....	Fine silky.
1083 F	.....	64,500	113,500	20.0	40.3	.14, .26*	31.0	.....	Do.
1086 F	C.....	66,500	116,000	17.0	40.3	.08, .26*	31.0	.....	Silky.
1099 F	Nickel steel No. 2 Navy.	122,500	147,000	16.0	46.2	.23,* .09	40.0	.....	Fine silky.
1103 F	...do.....	57,000	96,500	23.0	40.3	.16, .30*	28.0	183	Silky.
1104 F	2.....	58,500	93,500	24.5	34.0	.27,* .22*	27.0	170	Do.
1112 F	No. 2 Navy	53,000	90,000	27.0	54.6	.30,* .24*	.....	.....	Fine silky.
1117 F	...do.....	68,500	103,000	25.0	57.2	.12, .38*	27.5	.....	Do.
1145 F	No. 5 Navy	56,000	101,500	24.5	51.9	.13, .36*	29.5	.....	Do.
1159 F	...do.....	57,000	100,500	24.5	49.1	.14, .35*	.....	.....	Silky, cup shaped.
1185 F	1.....	42,500	78,500	30.5	49.1	.42,* .19	.....	.....	Silky.
		41,000	59,000	36.0	66.9	.21, .51*	.....	.....	Fine silky.
1207 F	No. 5 Navy	50,000	64,500	37.0	62.2	.24, .50*	21.0	.....	Do.
1221 F	...do.....	46,500	89,000	23.5	57.2	.10, .37*	.....	.....	Do.
1226 F	2.....	53,000	96,000	24.0	37.1	.24,* .24*	25.0	.....	Dull silky.
1233 F [1]	.....	41,000	97,000	20.5	37.1	.17, .24*	.....	.....	Fine granular, 90 per cent; silky, 10 per cent.
		48,000	84,000	24.0	37.1	.31,* .17	25.0	.....	Fine silky.
		60,000	103,500	17.5	34.0	.09, .26*	29.0	.....	Silky.
1240 F	3.....	42,500	110,500	10.0	9.5	.12* .08	30.0	.....	Fine granular.
1248 F	2.....	64,000	115,000	9.5	13.2	.12,* .07	32.0	.....	Do.
		35,000	75,000	29.5	54.6	.41,* .18	24.0	.....	Fine silky.
		57,500	117,000	10.5	13.3	.08, .13*	30.5	.....	Fine granular.
1258 F	3.....	53,500	111,000	15.0	20.5	.10, .20*	33.0	.....	Do.
1264 F	2.....	76,500	134,000	8.0	13.2	.11,* .05	35.0	.....	Fine granular, silky spot in center.
		73,500	127,500	10.5	13.2	.14,* .07	34.0	.....	Fine granular, amorphous spot at center.
		72,000	134,500	10.0	13.3	.07, .13*	37.0	.....	Fine granular, silky spot at center.
1272 F	No. 5 Navy	57,000	101,500	22.0	34.0	.23,* .21*	26.0	.....	Fine silky, trace of granulation.
1349	B.....	66,500	101,500	25.0	49.1	.26,* .24	28.0	.....	Fine silky.
1353 F	2.....	53,500	82,500	31.5	57.2	.18, .45*	25.0	.....	Do.
1355 F	3.....	57,000	97,500	25.5	54.6	.35,* .16	30.0	.....	Fine silky, cup shaped.
1365 F	1.....	71,000	109,000	22.0	46.2	.28,* .16	31.0	.....	Fine silky.
		68,000	104,000	24.0	51.9	.13, .35*	29.0	.....	Fine silky, cup shaped.
		40,000	63,100	36.5	67.0	.21, .52*	19.0	.....	Fine silky.
1369 F	B.....	114,500	130,000	19.5	62.2	.07, .32*	41.0	.....	Silky, cup shaped, serrated.
1396 F	D.....	127,000	143,500	17.5	54.6	.28,* .07	41.0	.....	Fine silky, serrated.
1414	C.....	117,500	134,500	18.5	57.2	.28, .09	39.0	.....	Do.
1424 F	A.....	120,000	138,500	18.0	54.6	.06, .30*	40.0	.....	Do.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.		Hardness.		Appearance of fracture.
								Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In.*	*In.*			
1440 F	2	44,800	76,700	29.0	54.6	0.16,	0.42*	22.0	.....	Fine silky, cup shaped.
1464 F	4	47,000	87,500	30.5	54.6	.41,*	.20	24.0	.....	Fine silky.
1476 F	2	48,000	93,000	27.0	46.2	.34,*	.20	26.0	.....	Silky, cup shaped.
1477 F	1	43,000	87,000	22.5	51.9	.36,*	.09	24.5	.....	Silky.
		41,500	86,500	29.5	54.6	.40,*	.19	24.0	.....	Do.
1481 F	No. 5 Navy	50,000	94,000	24.0	37.1	.24,*	.24*	24.0	.....	Do.
1505 F [1]		55,500	79,000	22.5	40.3	.31,*	.14	26.5	.....	Fine silky.
		48,000	90,500	26.0	51.9	.38,*	.14	25.5	293	Silky.
		75,500	121,000	18.5	43.3	.09,	.28*	31.0	241	Do.
1507 F	3	46,500	65,000	32.0	64.7	.17,	.47*	18.0	.....	Fine silky.
		62,000	77,000	24.0	65.4	.32,*	.16	21.0	.....	Do.
		74,000	107,000	20.5	40.3	.29,*	.12	33.0	.....	Do.
1509 F	No. 5 Navy	52,000	97,500	22.5	34.0	.25,*	.20*	24.5	.....	Dull silky.
1525 F	A	67,000	101,000	25.0	54.6	.14,	.36*	26.5	.....	Fine silky.
1526 F	No. 5 Navy	48,000	94,500	23.5	40.3	.31,*	.16	25.0	.....	Dull silky.
		49,000	81,000	28.0	46.2	.34,*	.22	22.5	137	Fine silky; open longitudinal seam in stem.
1538 F [1]		125,500	170,000	12.0	34.0	.19,*	.05	45.0	.....	Silky.
1539 F	2	34,000	61,000	37.0	62.3	.49,*	.25	19.0	.....	Fine silky.
		40,000	74,000	27.5	40.3	.39,*	.16	21.0	.....	Silky.
1540 F	No. 5 Navy	75,500	117,000	22.5	54.6	.29,*	.16	30.0	.....	Fine silky, serrated.
		48,000	85,000	28.5	51.9	.26,	.31*	21.5	149	Fine silky, cup shaped.
1565 F	3	62,500	115,000	15.5	34.0	.23,*	.08	30.5	.....	Fine granular, silky center.
1573 F	3	50,500	92,000	26.5	51.9	.14,	.39*	26.5	.....	Fine silky.
1626 F	3	77,000	109,500	21.5	51.9	.27,*	.16	32.5	.....	Do.
1686 F	1	61,500	111,500	20.0	43.3	.26,*	.14	28.5	.....	Silky.
		62,000	112,000	21.5	43.3	.20,	.23*	30.0	.....	Dull silky.
1688 F	2	62,500	96,500	26.0	51.9	.35,*	.17	26.5	.....	Silky.
1692 F	3	53,500	95,500	24.5	40.3	.17,	.32*	23.5	.....	Do.
1694 F	2	47,000	80,000	30.0	51.9	.42,*	.18	22.0	.....	Dull silky.
1702 F	3	46,500	94,000	22.0	30.7	.27,*	.17	26.0	.....	Dull silky, trace of granulation.
1704 F	C	55,500	103,000	25.0	51.9	.25,*	.25*	26.0	.....	Silky.
		56,500	101,000	26.0	57.2	.38,*	.14	28.0	.....	Fine silky.
		124,000	141,000	18.5	57.2	.30*	.07	42	.....	Do.
1705 F	3	53,500	101,500	23.5	40.3	.29,*	.18	28.0	187	Silky.
1753 F	3	48,000	92,500	25.0	43.3	.23,	.27*	28.0	.....	Dull silky.
1759 F	3	50,000	98,500	24.0	46.2	.23,	.25*	27.5	.....	Silky.
1783 F	A	80,500	131,500	15.5	37.2	.22,*	.09	36.0	.....	Silky, trace of granulation.
		54,000	123,000	15.0	40.3	.09,	.21*	32.0	.....	Fine silky.
		79,500	101,000	24.5	57.2	.37,*	.12	28.0	212	Silky serrated.
1787 F	2	26,500	57,500	39.5	69.2	.56,*	.23	19.0	.....	Fine silky.
		51,500	91,000	22.5	40.3	.30,*	.15	26.0	179	Silky.
1791 F	3	56,000	93,500	26.0	46.2	.32,*	.20	25.0	.....	Fine silky.
1793 F	D	82,500	112,500	16.0	43.3	.06,	.26*	34.0	.....	Do.
		118,500	137,000	19.5	59.8	.07,	.32*	40.5	277	Fine silky, serrated.
1795 F	2	48,500	76,000	31.0	59.8	.44,*	.18	21.0	.....	Fine silky.
1799 F	No. 5 Navy	67,000	111,000	22.0	54.6	.34.*	.10	30.5	212	Do.
1800 F	...do.....	88,000	129,000	18.5	43.3	.16,	.21*	35.0	255	Silky.
		108,500	131,000	18.5	57.2	.27,*	.10	34.0	277	Fine silky, serrated.
1847 F	3	50,000	93,500	25.0	43.3	.15,	.35*	24.0	170	Silky.
1901	No. 5 Navy	65,500	111,000	23.5	57.2	.13,	.34*	29.5	212	Fine silky.
1925 F	D	64,500	105,500	24.0	46.2	.13,	.35*	27.5	187	Silky.
		119,500	137,500	18.0	51.9	.06,	.30*	39.0	286	Silky, serrated.
1933 F	3	49,500	93,000	24.0	40.3	.32,*	.16	25.5	170	Silky.
1949 F	3	47,500	92,500	21.0	27.4	.20,*	.22*	26.0	170	Fine granular, 60 per cent; amorphous, 40 per cent.
1965 F	3	51,000	94,000	21.5	27.4	.22,*	.21*	27.0	179	Fine granular, 75 per cent; amorphous, 25 per cent.
1981 F	2	50,500	93,500	23.0	40.3	.29,*	.17	26.0	179	Silky.
1999 F	3	50,000	99,500	22.5	40.3	.14,	.31*	26.5	187	Silky, trace of granulation.

[1] 60,000 lb. per sq. in. elastic limit required.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.		Hardness.		Appearance of fracture.
								Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In.*	*In.*			
2000 A F	3	50,500	105,500	21.5	37.2	0.28,*	0.15	27.0	202	Dull silky.
2009 F	3	55,000	98,000	25.0	46.2	.34,*	.20	26.5	187	Silky.
2025 F	No. 5 Navy	51,000	93,000	30.0	54.6	.19,	.41*	26.0	174	Fine silky.
2073 F	2	62,500	87,500	25.0	64.7	.09,	.41*	24.5	156	Do.
2090 F	D	132,000	152,000	15.0	46.2	.05,	.25*	46.0	321	Silky, serrated.
2102	D	95,000	128,500	16.5	46.2	.27,*	.06	34.0	241	Silky.
2103 F	3	61,500	106,000	22.5	49.1	.33,*	.12	27.0	202	Do.
2108 F	2	50,000	102,000	18.0	30.7	.23,*	.13	26.0	202	Dull silky, 40 per cent; granular, 60 per cent.
		48,500	98,500	21.0	34.0	.14,	.28*	27.0	187	Fine granular, 90 per cent; dull silky, 10 per cent.
2109 F	3	69,000	108,000	21.0	34.0	.23,*	.19	28.0	207	Silky.
2141 F	3	56,500	113,500	16.5	40.3	.15,*	.18*	30.0	223	Dull silky.
2146 F	No. 5 Navy	31,000	53,000	38.5	67.0	.22,	.55*	17.0	95	Fine silky.
		105,500	152,500	13.0	40.3	.04,	.22*	42.5	302	Silky, trace of granulation.
2203 F	3	56,500	110,500	16.5	40.3	.08,	.25*	27.0	207	Do.
2219 F	D	62,000	93,000	26.0	64.7	.38,*	.14	28.0	192	Fine silky.
		66,000	100,000	25.0	59.8	.35,*	.15	26.0	207	Do.
		131,500	165,000	10.0	40.3	.18,*	.02	48.0	332	Silky.
2223 F	D	154,000	180,500	10.5	40.3	.03,	.18*	50.0	375	Silky, cup shaped.
		144,000	162,000	13.0	43.3	.03,	.23*	45.5	340	Fine silky.
2240 F	3	49,000	98,500	24.0	43.3	.21,	.27*	27.0	183	Silky.
2272 F	2	50,000	93,500	25.0	46.2	.15,	.35*	24.0	170	Dull silky.
2279 F	2	47,000	91,000	23.5	40.3	.23,*	.24*	23.0	170	Silky.
2286 F		45,500	86,500	25.0	40.3	.24*,	.26*	22.5	159	Do.
2288 F	3	46,500	87,000	24.0	30.7	.24*,	.24*	24.5	163	Amorphous.
		54,000	97,000	20.5	30.7	.19*,	.22*	28.5	187	Silky.
2296 [1]		70,500	122,000	18.5	40.3	.10,	.27*	31.0	235	Do.
2298 F	2	50,500	99,000	21.0	37.2	.30*,	.12	26.5	170	Dull silky.
2299 F	Nickel steel No. 2.	59,500	94,000	26.5	51.9	.33*,	.20	25.5	179	Fine silky; cup-shaped.
		60,000	93,500	26.5	49.1	.26*,	.27*	27.5	170	Fine silky.
2306 F	No. 5 Navy	49,000	84,500	30.0	54.6	.24,	.36*	23.5	156	Silky.
1 F	B	57,000	90,500	26.0	54.6	.38*,	.14	23.0	170	Fine silky; cup-shaped.
		61,500	91,000	27.0	54.6	.34*,	.20	23.0	163	Fine silky.
		61,500	93,500	25.5	54.6	.38*,	.13	28.0	163	Do.
		79,000	107,500	23.5	64.7	.36*,	.11	28.0	207	Do.
11 F	B	64,000	110,500	21.0	49.1	.10,	.32*	29.5	212	Fine silky; cup-shaped.
		69,000	111,000	22.5	54.6	.10,	.35*	28.0	207	Fine silky.
17 F	B	70,000	112,500	20.0	40.3	.28*,	.12	30.0	212	Do.
18 F	B	69,000	99,000	25.0	51.9	.14,	.36*	27.0	179	Fine silky; cup-shaped.
25 F	3	48,500	95,500	20.0	27.4	.21,	.19	26.0	179	Fine granular, 80 per cent; dull silky, 20 per cent.
29 F	D	103,000	138,500	14.0	49.1	.24*,	.04	42.0	302	Fine silky.
45 F	3	60,000	101,000	17.0	49.1	.07,	.27*	28.0	187	Fine silky; cup-shaped.
78 F	3	43,500	87,000	22.5	34.0	.31*,	.14	26.5	163	Dull silky.
		50,500	98,500	22.5	40.3	.28*,	.17	25.0	179	Silky.
81 F	2	55,000	93,500	26.0	49.1	.15,	.37*	24.5	163	Do.
85 F	3	35,500	70,000	31.0	49.1	.33*,	.29*	21.0	126	Fine silky.
		69,500	106,000	16.0	30.7	.20*,	.12	32.5	217	Dull silky, 40 per cent; fine granular, 60 per cent.
86 F	Nickel steel No. 2.	52,000	85,500	25.0	54.6	.12,	.38*	24.0	179	Silky.
		63,000	96,000	28.0	57.2	.35*,	.21	23.5	183	Silky; cup-shaped.
87 F	A	68,500	108,500	26.0	57.2	.22,	.30*	28.0	207	Fine silky.
95 F	A	66,000	98,500	27.0	57.2	.35*,	.19	28.0	192	Do.
127 F	2	46,000	96,500	23.0	40.3	.18,	.28*	26.5	179	Silky.
128 F	3	47,000	96,000	22.0	34.0	.18,	.26*	25.0	179	Do.
163 F	C and D	157,000	183,000	1.0	1.8	.01,	.01	53.5	387	Fine granular.
		128,500	153,000	11.5	27.4	.05,	.18*	45.0	302	Silky.
		105,000	143,500	14.5	46.2	.24*,	.05	36.0	286	Fine silky.

[1] 60,000 lb. per sq. in. elastic limit required.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In.* *In.*			
181 F	3	40,000	80,500	24.5	59.8	0.17, 0.32*	25.0	149	Silky.
		61,500	116,500	18.5	34.0	.12, .25*	29.0	217	Silky; trace of granulation.
186 F	Nickel steel No. 2.	67,500	96,000	27.5	59.8	.39*, .16	25.0	179	Fine silky; cup-shaped.
187 F	...do	66,000	95,000	27.5	59.8	.39*, .16	25.0	174	Fine silky.
188 F	...do	61,500	90,000	28.0	57.2	.39*, .17	23.5	170	Do.
189 F	...do	68,000	98,500	26.5	59.8	.39*, .14	26.5	183	Do.
190 F	...do	67,000	96,000	27.5	59.8	.37*, .18	24.5	179	Do.
191 F	...do	66,000	95,500	28.0	59.8	.16, .40*	25.5	179	Fine silky; cup-shaped.
192 F	...do	66,300	95,400	28.5	59.1	.18, .39*	25.5	174	Fine silky.
193 F	...do	69,000	96,000	28.0	59.8	.16, .40*	24.0	179	Fine silky; cup-shaped.
195 F	No. 5 Navy	43,000	84,500	27.5	43.3	.23, .32*	23.5	156	Silky.
200 F	Nickel steel No. 2.	50,500	91,000	26.0	59.8	.13, .39*	23.0	170	Fine silky.
		84,000	113,500	18.5	43.3	.26*, .11	32.0	235	Silky.
201 F	...do	62,500	92,000	21.5	34.0	.19, .24*	22.0	166	Silky, oblique.
204 F	...do	64,500	96,500	26.0	46.2	.17, .35*	25.0	179	Fine silky.
205 F	...do	58,000	89,500	25.5	46.2	.37*, .14	23.0	163	Do.
206 F	...do	56,000	90,000	29.0	57.2	.38*, .20	23.0	166	Fine silky; cup-shaped.
207 F	...do	86,000	119,000	11.0	16.9	.13*, .09	25.0	228	Fine granular, 70 per cent; dull silky, 30 per cent.
209 F	...do	79,000	109,000	22.5	59.8	.31*, .14	30.5	228	Fine silky.
210 F	No. 5 Navy	43,500	84,500	28.5	46.2	.34*, .23	24.0	156	Silky.
211 F	...do	39,000	82,000	18.5	27.4	.25*, .12	23.0	153	Lamellar.
212 F	...do	40,000	76,000	23.5	46.2	.10, .37*	22.0	137	Silky.
215 F	3	49,500	90,500	26.0	37.2	.27*, .25*	24.0	163	Fine silky.
221 F	No. 5 Navy	48,000	84,500	29.5	51.9	.25, .34*	25.0	156	Do.
226 F	D	145,000	160,000	12.5	46.2	.03, .22*	42.5	332	Do.
		134,000	166,500	13.5	40.3	.05, .22*	44.0	293	Do.
		145,600	160,400	13.0	42.5	.20*, .06	39.0	340	Do.
229 F	B	60,000	109,000	23.0	49.1	.22*, .24*	27.0	207	Do.
		68,500	108,500	23.5	49.1	.17, .30*	27.0	207	Silky.
		68,000	108,000	21.5	40.3	.19, .24*	26.5	207	Fine silky; cup-shaped.
230 F	B	66,000	109,000	22.0	51.9	.33*, .11	28.0	212	Do.
231 F	3	47,000	88,000	22.5	37.2	.30*, .15	23.0	156	Silky.
234 F	2	38,000	82,500	27.5	57.2	.19, .36*	23.0	159	Fine silky.
240 F	No. 5 Navy	42,000	91,000	26.5	43.3	.25, .28*	24.0	163	Dull silky.
244 F	Nickel steel No. 2.	70,000	94,000	26.0	58.0	.28*, .24	22.5	170	Fine silky.
247 F	No. 5 Navy	46,000	83,000	25.5	49.1	.36*, .15	22.0	149	Silky.
253 F	3	40,500	83,500	27.5	46.2	.32*, .23	22.0	163	Do.
		46,500	93,500	25.0	46.2	.21, .29*	23.0	174	Silky; cup-shaped.
255 F	2	43,000	80,000	27.5	49.1	.16, .39*	20.5	143	Silky.
256 F	Nickel steel No. 2.	58,500	101,500	24.0	51.9	.17, .31*	26.5	170	Do.
257 F	...do	67,500	97,500	24.0	40.3	.24*, .24*	25.0	179	Fine silky.
268 F	3	54,000	95,500	27.5	51.9	.16, .39*	22.0	170	Silky.
270 F	A	60,000	96,500	27.0	54.6	.30*, .24*	22.5	179	Fine silky.
273 F	3	58,000	106,000	18.0	43.3	.10, .26*	25.0	187	Silky.
282 F	2	52,500	89,500	26.5	49.1	.36*, .17	23.0	163	Dull silky.
283 F	2	51,000	95,000	25.0	46.2	.29*, .21	24.0	170	Do.
295 F	3	53,400	94,900	22.0	47.9	.28*, .16	30.0	143	Silky.
334 F	3	62,000	103,000	23.0	37.2	.21*, .25*	26.5	196	Do.
335 F	3	46,500	93,000	23.0	43.3	.14, .32*	25.0	174	Do.
337 F	3	45,500	86,000	26.0	43.3	.19, .33*	22.0	163	Do.
338 F	C	69,500	105,000	24.5	51.9	.35*, .14	28.0	196	Fine silky; cup-shaped.
		70,000	105,000	25.5	49.1	.26*, .25*	23.5	187	Fine silky.
339 F	C	60,500	103,000	24.0	46.2	.30*, .18	26.5	192	Do.
		68,500	104,000	25.0	51.9	.28*, .22*	24.0	196	Do.
343 F	3	47,500	78,500	32.5	54.6	.42*, .23	21.0	143	Do.
344 F	3	39,500	83,500	28.5	49.1	.38*, .19	22.5	146	Dull silky.
345 F	3	42,000	80,500	29.5	49.1	.31*, .28*	21.0	146	Fine silky.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
346 F	3	45,000	80,500	29.5	49.1	0.28, 0.31*	21.5	153	Fine silky; cup-shaped.
347 F	3	43,500	82,000	29.5	51.9	.38*, .21	21.5	149	Silky.
348 F	3	44,000	81,000	29.5	51.9	.38*, .21	23.0	146	Do.
349 F	3	39,000	81,500	26.5	49.1	.38*, .15	22.0	146	Do.
350 F	3	40,500	81,500	30.5	51.9	.36*, .25	21.5	156	Do.
351 F	3	48,500	79,500	31.5	49.1	.31*, .32*	22.0	146	Fine silky.
352 F	3	44,000	87,000	26.5	46.2	.17, .36*	23.0	163	Silky.
353 F	3	44,000	87,500	26.0	46.2	.15, .37*	23.0	159	Do.
354 F	3	44,500	85,000	27.5	49.1	.36*, .19	23.0	149	Do.
355 F	3	50,000	95,000	21.5	40.3	.29*, .14	24.0	183	Do.
356 F	1	48,000	100,500	21.0	37.2	.13, .29*	27.5	196	Dull silky; trace of granulation.
		50,500	93,500	24.0	43.3	.28*, .20	24.0	196	Silky.
357 F	3	54,500	86,000	22.5	51.9	.15, .30*	24.0	146	Silky; cup-shaped.
369 F	3	47,500	89,500	27.5	49.1	.22, .33*	22.0	156	Silky.
370 F	3	39,500	75,500	8.5	16.9	.11*, .06	27.0	179	Silky, 85 per cent; lamellar, 15 per cent.
		44,500	95,500	23.5	37.2	.30*, .17	25.0	183	Dull silky; trace of granulation.
371 F	3	51,000	88,500	27.0	46.2	.36*, .18	24.0	159	Fine silky.
372 F	3	48,500	96,000	22.5	37.2	.22*, .23*	24.0	183	Silky.
373 F	3	66,500	99,000	22.5	43.3	.15, .30*	24.0	183	Do.
374 F	3	47,500	96,000	22.5	40.3	.13, .32*	25.0	183	Do.
375 F	3	50,500	94,500	25.0	43.3	.19, .31*	25.0	170	Do.
376 F	3	48,500	91,000	27.0	46.2	.36*, .18	24.0	159	Do.
377 F	3	54,000	91,000	24.5	46.2	.15, .34*	24.0	170	Do.
378 F	3	54,500	98,000	23.0	43.3	.31*, .15	25.0	179	Do.
379 F	3	53,500	97,000	22.0	40.3	.32*, .12	24.0	179	Do.
380 F	3	49,000	103,500	18.0	24.0	.23*, .13	26.5	187	Fine granular, 90 per cent; silky, 10 per cent.
381 F	D	167,500	180,500	8.5	37.2	.16*, .01	52.0	351	Fine silky; cup-shaped.
		120,000	138,500	19.0	54.6	.19*, .19*	38.5	277	Fine silky; serrated.
382 F	3	44,500	88,000	27.0	46.2	.28*, .26*	22.0	163	Silky.
384 F	2	55,000	98,000	25.5	57.2	.13, .38*	24.0	192	Fine silky.
408 F	C	73,500	120,000	17.0	49.1	.27*, .07	31.0	255	Do.
409 F	C	65,400	112,700	21.0	54.7	.32*, .10	28.0	217	Fine silky; cup shaped.
410 F	C	70,500	118,000	21.0	59.8	.33*, .09	28.0	217	Fine silky.
411 F	C	68,500	114,000	22.0	54.6	.11, .33*	28.0	217	Fine silky; cup shaped.
412 F	C	69,500	118,500	21.0	54.6	.30*, .12	29.0	235	Fine silky.
413 F	C	70,500	118,000	22.0	57.2	.24*, .20*	28.0	228	Do.
414 F	C	66,500	114,000	22.0	54.6	.13, .31*	29.0	217	Do.
415 F	C	70,500	117,000	22.0	51.9	.14, .30*	29.0	212	Do.
416 F	C	73,000	122,000	17.0	46.2	.27*, .07	30.0	241	Do.
417 F	C	75,500	114,000	24.0	59.8	.17, .31*	28.5	217	Do.
418 F	C	72,500	109,500	23.0	59.8	.10, .36*	26.0	212	Fine silky; cup shaped.
419 F	C	71,000	117,500	21.0	54.6	.24*, .18	27.0	235	Fine silky.
420 F	C	72,500	115,500	22.0	57.2	.32*, .12	28.0	212	Fine silky; cup shaped.
421 F	C	70,500	116,500	20.5	54.6	.10, .31*	28.5	212	Fine silky.
422 F	C	69,500	117,000	21.5	57.2	.12, .31*	27.0	228	Do.
423 F	C	71,000	120,000	19.5	51.9	.10, .29*	30.0	241	Do.
424 F	C	70,000	117,500	21.0	57.2	.10, .32*	27.0	228	Do.
425 F	C	71,000	118,500	21.0	54.6	.32*, .10	28.0	223	Do.
426 F	C	70,000	119,000	21.0	54.6	.31*, .11	27.0	228	Fine silky; cup shaped.
427 F	C	74,500	115,000	23.0	59.8	.34*, .12	28.0	228	Fine silky.
428 F	C	70,500	116,500	22.5	57.2	.33*, .12	27.5	228	Fine silky; cup shaped.
429 F	C	73,000	115,000	23.5	57.2	.21, .26*	28.0	228	Do.
430 F	C	81,000	112,000	18.5	46.2	.17, .20*	30.0	228	Fine silky.
431 F	C	69,000	116,000	22.0	54.6	.29*, .15	29.5	217	Do.
432 F	B	88,500	117,000	21.0	57.2	.33*, .09	34.0	255	Do.
448 F	A	57,500	102,500	22.0	46.2	.12, .32*	25.0	202	Silky.
449 F	A	60,500	98,500	25.5	54.6	.34*, .17	24.5	196	Do.
450 F	A	60,500	98,500	23.5	54.6	.37*, .10	25.5	183	Do.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*Per cent.*	*Per cent.*	*In. In.*			
451 F	A	55,500	98,000	24.0	54.6	0.36*, 0.12	24.0	187	Silky.
452 F	A	59,000	98,000	25.5	54.6	.37*, .14	24.0	192	Do.
453 F	A	58,000	98,500	25.0	51.9	.18, .32*	24.5	196	Do.
454 F	A	60,000	97,000	26.5	54.6	.16, .37*	24.0	183	Do.
455 F	A	66,500	96,500	26.5	54.6	.19, .34*	23.0	183	Do.
456 F	A	66,000	102,000	23.5	57.2	.35*, .12	25.5	207	Do.
457 F	A	64,000	102,500	24.0	54.6	.21, .27*	25.5	196	Do.
458 F	A	63,000	105,000	23.0	54.6	.12, .34*	25.0	196	Do.
459 F	A	64,500	103,000	25.0	57.2	.37*, .13	25.0	207	Do.
460 F	A	60,500	98,000	23.5	43.3	.24*, .23*	24.5	187	Do.
461 F	B	71,500	120,500	19.0	46.2	.28*, .10	28.5	228	Do.
462 F	D	124,500	146,000	15.5	49.1	.06, .25*	39.0	302	Fine silky; serrated.
463 F	3	49,500	96,000	23.0	40.3	.16, .30*	25.5	183	Dull silky.
475 F–C	D	89,500	120,000	8.5	9.5	.09*, .08*	33.0	228	Fine granular.
475 F–T	D	79,500	123,500	11.5	20.5	.07, .16*	32.0	235	Fine granular, silky center.
475 F–L		68,500	116,000	18.0	30.7	.22*, .14*	29.0	217	Silky; trace granulation.
477 F	B	52,500	85,500	29.5	51.9	.29*, .30*	21.0	156	Fine silky.
		57,500	100,000	20.5	37.2	.14, .27*	24.0	170	Silky.
479 F	B	58,000	99,000	23.5	43.3	.25*, .22	25.0	187	Fine silky.
		65,000	115,000	18.0	37.2	.12, .24*	24.5	217	Silky.
480 F	B	58,000	87,500	28.5	57.2	.40*, .17	22.5	163	Fine silky.
		57,000	96,000	24.0	51.9	.35*, .13	23.0	179	Silky.
486 F	2	52,000	92,500	23.5	49.1	.11, .36*	24.0	170	Do.
512 F	B	62,000	105,500	20.0	43.3	.30*, .10	25.0	196	Do.
513 F	B	62,500	103,500	22.5	40.3	.22*, .23	24.0	196	Fine silky.
514 F	B	65,000	105,000	21.5	37.2	.23*, .20*	25.0	196	Do.
515 F	B	64,500	101,000	24.0	49.1	.32*, .16	24.5	196	Fine silky; cup shaped.
516 F	B	63,000	106,000	23.5	46.2	.29*, .18	24.0	196	Do.
517 F	B	65,000	101,500	22.5	49.1	.34*, .11	22.0	187	Silky.
518 F	B	63,000	105,000	21.5	46.2	.11, .32*	23.0	192	Do.
519 F	B	62,000	104,000	23.0	46.2	.32*, .14	24.0	187	Do.
520 F	2	50,000	103,500	20.0	37.2	.23*, .17	24.5	202	Dull silky; trace of granulation.
532 F	2	61,500	95,500	26.0	57.2	.15, .37*	24.5	183	Fine silky.
536 F	No. 5 Navy	65,500	101,500	19.0	49.1	.07, .31*	26.0	192	Silky.
548 F	...do	55,000	106,500	16.5	24.0	.22*, .11	28.0	187	Fine granular, 70 per cent; Amorphous, 30 per cent.
		49,500	102,500	20.5	34.0	.22*, .19	27.0	192	Amorphous, 50 per cent; granular 50 per cent.
549 F	3	57,000	107,000	19.5	37.2	.20*, .19	25.0	207	Silky.
555 F	3	54,000	98,500	19.0	40.3	.10, .28*	24.0	187	Do.
582 F	3	55,000	97,500	13.5	46.2	.22*, .05	29.0	212	Fine silky.
845 F	6	59,000	103,500	20.0	46.2	.09, .31*	23.5	179	Silky.

Forged steel from Watertown Arsenal smith shop—Continued.

EXPERIMENTAL TESTS FOR STUDENT OFFICERS.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore.	Brinell.	
	Lbs.	*Lbs.*	*P. ct.*	*P. ct.*	*In. In.*			
A-2	63,000	97,500	26.5	54.6	0.16, 0.37*	26.0	.....	Fine silky.
B-2	60,000	98,500	25.0	51.9	.19, .31*	26.0	.....	Do.
C-2	57,000	95,000	26.0	51.9	.34,* .18	26.0	.....	Do.
D-2	62,000	99,000	25.0	51.9	.34,* .16	27.0	.....	Do.
A-3	70,500	116,000	19.5	43.3	.10, .29*	33.0	.....	Do.
B-3	70,500	115,000	20.0	46.2	.09, .31*	33.0	.....	Do.
C-3	73,500	118,000	18.0	43.3	.08, .28*	32.0	.....	Do.
D-3	77,500	120,000	18.5	46.2	.12, .25*	34.0	.....	Do.
E-3	65,000	103,500	8.0	9.5	.07, .09*	31.0	.....	Silky, 90 per cent; fine granular, 10 per cent.
A-4	70,000	113,000	18.0	46.2	.07, .29*	30.0	.....	Fine silky.
B-4	91,000	129,500	13.5	34.0	.20,* .07	36.0	.....	Silky.
C-4	79,500	120,000	17.5	43.3	.22,* .13	34.0	.....	Fine silky.
D-4	96,500	132,000	9.0	24.0	.04, .14*	37.5	.....	Fine granular, silky spot at circumference.
E-4	81,000	118,500	6.5	9.5	.06, .07*	35.0	.....	Fine granular, 70 per cent; amorphous, 30 per cent.
A-5	82,000	115,000	16.0	46.2	.04, .28*	32.0	.....	Fine silky.
B-5	75,000	108,000	17.5	43.3	.28,* .07	30.0	.....	Do.
C-5	83,500	120,000	18.0	37.1	.10, .26*	33.0	.....	Do.
D-5	81,500	123,500	9.5	24.0	.14,* .05	36.0	.....	Silky oblique.
E-5	86,000	105,000	5.0	9.5	.07,* .03	36.0	.....	Amorphous, 95 per cent; fine granular, 5 per cent.
A-6	59,500	91,000	27.5	57.2	.20, .35*	25.0	.....	Fine silky, cup shaped.
B-6	65,500	94,500	23.5	49.1	.12, .35*	26.0	.....	Fine silky.
C-6	66,000	95,500	26.5	49.1	.37,* .16	29.0	.....	Do.
D-6	62,000	93,000	30.0	62.2	.38,* .22	25.5	.....	Fine silky, serrated.
E-6	67,000	92,500	8.5	13.2	.10,* .07	26.0	.....	Dull silky, 90 per cent; fine granular, 10 per cent.
A-7	57,500	92,500	27.5	54.6	.39,* .16	25.0	.....	Fine silky.
B-7	59,500	91,500	26.0	43.3	.19, .33*	25.0	.....	Do.
C-7	59,500	91,500	26.5	43.3	.22, .31*	25.5	.....	Do.
D-7	57,500	90,000	28.5	54.6	.18, .39*	27.0	.....	Fine silky, cup shaped.
E-7	57,500	92,500	23.0	34.0	.21, .25*	25.5	.....	Silky.
A-8	44,500	82,000	27.5	43.3	.19, .36*	24.0	.....	Dull silky.
B-8	44,500	82,000	25.5	40.3	.19, .32*	26.0	.....	Dull silky, trace of granulation.
C-8	44,500	82,500	26.0	40.3	.34,* .18	24.0	.....	Dull silky.
D-8	44,000	81,500	27.0	43.3	.24, .30*	20.0	.....	Do.
E-8	40,000	80,000	10.5	9.5	.12,* .09	21.5	.....	Fine granular.
A-9	46,000	96,500	21.0	34.0	.13, .29*	25.0	.....	Fine granular, 70 per cent; dull silky, 30 per cent.
B-9	50,000	97,500	20.0	30.7	.26,* .14	25.0	.....	Fine granular, 85 per cent; dull silky, 15 per cent.
C-9	47,500	95,500	22.0	34.0	.23,* .21	24.5	.....	Fine granular, 80 per cent; dull silky, 20 per cent.
D-9	47,000	95,000	20.0	34.0	.28,* .12	24.0	.....	Fine granular, 60 per cent; dull silky, 40 per cent.
E-9	52,500	92,000	5.5	5.7	.04, .07*	26.5	.....	Fine granular.
A-10	47,000	93,500	22.5	40.3	.13, .32*	23.5	.....	Silky, trace of granulation.
B-10	47,000	94,000	22.5	40.3	.29,* .16	24.0	.....	Dull silky.
C-10	46,000	94,000	22.5	30.7	.23,* .22	25.0	.....	Fine granular, silky spot at circumference.
D-10	48,000	96,500	22.5	37.2	.15, .30*	25.0	.....	Dull silky.
E-10	47,500	93,000	7.5	5.7	.08,* .07	24.5	.....	Fine granular.
S.O.O	56,500	117,500	14.0	16.9	.08, .20*	29.0	.....	Granular, 80 per cent; dull silky, 20 per cent.
S.O.A-1	94,500	160,000	11.0	27.4	.05, .17*	44.0	.....	Granular, 85 per cent; dull silky, 15 per cent.
S.O.A-2	58,000	121,500	16.0	27.4	.10, .22*	31.0	.....	Granular, 80 per cent; dull silky, 20 per cent.
S.O.A-3	49,000	112,000	15.0	16.9	.12, .18*	31.0	.....	Granular, 90 per cent; dull silky, 10 per cent.
S.O.B-1	126,500	171,000	8.5	13.3	.06, .11*	45.0	.....	Fine granular.
S.O.B-2	66,500	127,000	14.0	27.4	.09, .19*	32.0	.....	Granular, 70 per cent; dull silky, 30 per cent.
S.O.B-3	89,500	109,000	11.5	24.0	.18,* .05	29.0	.....	Granular, 80 per cent; dull silky, 20 per cent.
S.O.C-1	50,000	102,500	18.5	30.7	.11, .26*	28.0	.....	Fine granular, amorphous spot at center.
S.O.C-2	48,500	100,000	20.0	34.0	.29,* .11	28.0	.....	Fine granular, 50 per cent; amorphous, 50 per cent.
S.O.C-3	54,000	111,500	17.5	24.0	.19,* .16*	29.5	.....	Fine granular, amorphous spot at circumference.

Forged steel from Watertown Arsenal smith shop—Continued.

Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore.	Brinell.	
	Lbs.	*Lbs.*	*P. ct.*	*P. ct.*	*In. In.*			
S.O.D-1..	52,500	107,000	17.5	30.7	0.25,*0.10	27.5	.....	Fine granular, 50 per cent; amorphous, 50 per cent.
S.O.D-2..	53,500	107,000	16.0	27.4	.23,* .09	27.5	.....	Fine granular, amorphous spot at center.
S.O.D-3..	51,000	101,500	19.5	34.0	.11, .28*	26.0	.....	Amorphous, fine granular at circumference.
S.O.E-1 .	100,500	160,500	12.5	34.0	.05, .20*	43.0	302	Fine granular, 80 per cent; dull silky, 20 per cent.
S.O.E-2 .	59,000	116,500	18.0	34.0	.25*, .11	28.0	312	Fine granular, 50 per cent; dull silky, 50 per cent.
S.O.E-3 .	44,000	97,500	19.0	37.2	.17, .21*	25.5	192	Fine granular, 75 per cent; dull silky, 25 per cent.
S.O.F-1 .	116,500	162,000	10.0	24.0	.15*, .05	40.5	311	Fine granular, 80 per cent; dull silky, 20 per cent.
S.O.F-2 .	64,000	126,500	13.5	27.4	.14*, .13	30.5	255	Do.
S.O.F-3 .	51,800	112,700	14.0	21.8	.10, 18*	.....	202	Fine granular; dull silky spot at circumference.
S.O.F-4 .	48,500	111,000	15.5	20.5	.13, .18*	27.5	217	Do.
1050-F...	77,500	101,000	22.5	43.3	.21, .24*	28.0	196	Fine silky.
1250-F...	66,000	96,000	26.0	49.1	.34*, .18	24.0	179	Fine silky; cup shaped.
1450-F...	60,500	95,000	26.0	49.1	.36*, .16	27.0	170	Fine silky.
1550-F...	51,000	93,000	25.0	43.3	.34*, .16	23.0	170	Silky.
1650-F...	53,500	96,000	24.0	43.3	.31*, .17	23.0	170	Silky; trace of granulation.
1450-18...	64,000	97,500	21.0	27.4	.15, .27*	25.0	179	Silky.
1450-19. .	79,000	126,500	7.0	9.5	.08*, .06	34.0	228	Fine granular, silky spot at circumference.
Ingot-18.	51,500	91,000	7.0	9.5	.07, .07*	25.0	187	Granular, with dark colored spot at circumference.
Ingot-19 .	64,500	99,500	4.5	5.7	.03, .06*	31.0	228	Granular, silvery luster.
Ingot-16 .	34,000	72,000	7.5	9.5	.08*, .07*	23.0	149	Do.
1450-17...	47,000	88,500	25.0	43.3	.19, .31*	25.0	166	Dull silky.
Ingot-17 .	50,500	86,000	9.0	9.5	.10*, .08	24.0	163	Fine granular; amorphous spot at circumference.
1450-20...	89,500	140,500	6.0	9.5	.07*, .05	38.5	269	Fine granular.
Ingot-20 .	72,500	109,500	3.5	1.8	.03, .04	32.0	248	Granular; silvery luster.
1450-21...	87,000	120,000	20.0	49.1	.30*, .10	36.0	241	Fine silky.
Ingot-21 .	65,000	88,000	2.0	1.8	.03*, .01	34.5	207	Granular; silvery luster.
1450-22...	67,500	96,500	28.0	62.3	.41*, .15	28.0	187	Fine silky; serrated.
Ingot-22 .	62,000	88,500	8.0	20.5	.05, .11*	27.0	179	Amorphous, 90 per cent; granular, 10 per cent.
1450-23...	61,500	91,500	28.5	49.1	.28*, .29*	25.0	179	Fine silky.
Ingot-23 .	52,000	88,000	10.0	13.3	.12*, .08	26.0	179	Granular; silvery luster.
1450-24...	61,000	91,500	24.5	43.3	.25*, .24*	23.5	170	Fine silky.
Ingot-24 .	50,000	83,000	10.0	16.9	.07, .13*	23.5	170	Amorphous; trace of granulation.
1450 F-25.	44,000	91,500	25.0	37.2	.17, .33*	27.0	163	Dull silky, 70 per cent; granular, 30 per cent.
Ingot-25 .	42,000	82,000	6.5	5.7	.07*, .06	25.5	159	Granular, dark-colored spot at circumference.
1450-26...	45,000	84,000	30.0	54.6	.42*, .18	25.0	149	Dull silky; cup shaped.
Ingot-26 .	46,000	82,000	25.5	34.0	.32*, .19	25.5	159	Dull silky.
S.O.....	58,000	93,500	15.0	24.0	.18*, .12	22.5	163	Dull silky, with light spot at circumference.
S.O.F....	54,000	87,000	25.5	40.3	.17, .34*	23.0	163	Silky.
S.O.A....	44,500	88,500	24.5	37.2	.28*, .21*	24.0	166	Do.
S.O.A-1..	54,000	99,000	23.0	40.3	.20, .26*	25.0	183	Silky trace of granulation.
S.O.A-2..	68,500	115,500	17.5	40.3	.15, .20*	30.5	228	Silky.
S.O.A-3..	47,000	88,000	25.0	43.3	.32*, .18	24.0	166	Do.

FORGED STEEL RECEIVED ON PURCHASE ORDERS.

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
							Shore.	Brinell.	
		Lb.	*Lb.*	*P. ct.*	*P. ct.*	*In.* *In.*			
P. O. 9425–$\frac{7}{8}$		49,500	68,500	35.0	64.6	0.44*, 0.26	27.0	.....	Fine silky.
P. O. 92425–2$\frac{11}{16}$		49,500	74,000	29.5	51.9	.35*, .24	28.0	.....	Do.
P. O. 8484–11 D. M.		48,000	112,500	20.0	37.1	.20*, .20*	31.0	.....	Silky, 20 per cent; fine granular, 80 per cent.
P. O. 9072–2$\frac{1}{2}$	3	51,000	95,000	25.0	40.3	.18, .32*	29.0	.....	Fine silky.
P. O. 9424–1$\frac{1}{4}$		63,000	94,500	27.0	51.9	.19, .35*	29.0	.....	Do.
P. O. 9424–1$\frac{3}{8}$		60,500	106,000	22.0	37.1	.20, .24*	30.0	.....	Silky.
P. O. 9424–2$\frac{3}{8}$		53,500	99,500	23.0	40.3	.31*, .15	29.0	.....	Do.
P. O. 9915–1$\frac{5}{16}$	3	51,500	105,000	23.0	46.2	.32*, .14	.....	.....	Do.
P. O. 9915–2$\frac{1}{2}$	3	42,500	93,500	24.0	37.1	.20, .28*	.....	.....	Silky; trace of granulation.
P. O. 689	3	70,000	117,000	22.5	49.1	.28*, .17	32.0	.....	Fine silky.
P. O. 1420	2	36,000	83,500	20.0	27.4	.14, .26*	26.5	166	Dull silky; trace of granulation.
P. O. 1420	3	33,900	58,800	32.5	62.7	.24, .49*	17.5	90	Fine silky.
P. O. 1093–2	2	70,500	111,000	22.5	49.1	.14, .31*	28.0	202	Do.
P. O. 1420	2	37,000	89,500	17.0	16.9	.20*, .14	27.0	163	Fine granular, amorphous spot at circumference.
P. O. 1420	2	33,500	58,500	38.0	62.3	.50*, .26	20.0	105	Fine silky.
P. O. 1702	.....	50,500	99,500	21.5	40.3	.13, .30*	27.0	179	Dull silky.
P. O. 2043	3	54,000	104,500	18.5	37.2	.10, .27*	29.0	202	Dull silky; trace of granulation.
P. O. 2557–3	3	53,500	97,500	24.5	43.3	.31, .18	26.5	179	Silky.

[Inch section in which fracture occurred marked thus *.]

BRONZE FOR ORDNANCE WORK.

BRONZE FROM WATERTOWN ARSENAL FOUNDRY.

[The inch in which fracture occurred is marked thus,*.]

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore sclero-scope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In. In.*			
746	3	44,400	10.0	11.6	0.06, 0.14*	22.5	.....	Light and lemon yellow.
762	4	63,400	28.0	31.6	.25, .31*	31.0	.....	Light yellow.
769	4	65,400	27.0	29.5	.26, .28*	22.0	.....	Do.
770	3	61,800	27.0	29.5	.24, .30*	21.0	.....	Do.
782	3	61,800	24.5	27.4	.22, .27*	22.5	.....	Do.
811	3	60,200	22.0	29.4	.18, .26*	22.0	.....	Do.
825	3	60,200	16.0	20.8	.14, .18*	23.0	.....	Do.
838	3	64,000	23.0	25.2	.20, .26*	32.5	.....	Do.
844	3	60,600	40.0	39.6	.41, .39	20.0	.....	Do.
849	3	60,200	40.0	37.7	.45, .35	20.0	.....	Do.
856	3	62,400	22.5	18.6	.25*, .20	26.0	.....	Do.
861	3	61,400	21.0	23.0	.18, .24*	23.0	.....	Do.
868	3	64,200	19.5	18.6	.17, .22*	25.0	.....	Do.
869	3	61,200	21.0	23.0	.24*, .18	25.0	.....	Do.
872	3	62,600	23.0	25.2	.26*, .20	24.0	.....	Do.
873	3	64,400	23.0	25.2	.25*, .21	26.0	.....	Do.
874	3	62,200	20.0	18.6	.23*, .17	24.0	.....	Do.
889	3	62,000	25.0	27.4	.29*, .21	24.0	.....	Do.
902	4	63,600	26.0	29.5	.26*, .26*	24.0	.....	Do.
909	3	58,000	10.0	16.3	.10*, .10*	27.0	.....	Light yellow; silvery spot at circumference.
930	3	64,600	15.0	18.6	.15, .15	28.0	.....	Light yellow.
933	3	64,800	29.0	27.4	.32*, .26	24.0	.....	Do.
945	3	64,000	13.0	18.6	.14*, .12	28.0	.....	Do.
948	3	63,800	17.5	23.0	.15, .20*	27.0	.....	Do.
951	3	63,200	16.0	23.0	.18, .14	28.0	.....	Do.
954	3	62,200	24.5	25.2	.22, .27*	23.0	.....	Do.
967	3	59,200	21.5	27.4	.17, .26*	23.0	.....	Light yellow and lavender.
970	3	62,000	18.0	20.8	.21*, .15	23.5	.....	Light yellow.
972	3	56,600	12.5	18.6	.09, .16*	27.0	.....	Do.
988	3	62,540	22.5	20.9	.19, .26*	21.0	.....	Do.
1005	3	59,410	17.5	16.5	.14, .21*	21.0	.....	Do.
1013	3	63,330	25.5	27.5	.23, .28*	21.5	.....	Do.
1019	3	62,060	15.5	20.8	.17*, .14	22.0	.....	Do.
1025	3	65,690	27.5	27.4	.25*, .30*	22.0	.....	Do.
1031	3	60,600	14.0	14.0	.12, .16*	32.0	.....	Do.
1038	3	55,800	15.0	18.6	.17*, .13	26.0	.....	Light yellow; two blowholes $\frac{1}{8}$ inch diameter near circumference.
1041	4	65,000	25.0	27.4	.23, .27*	27.0	.....	Light yellow.
1045	3	59,200	13.5	16.3	.15*, .12	29.0	.....	Do.
1050	3	48,400	12.5	11.6	.15*, .10	26.0	.....	Light yellow and lavender.
1058	3	61,400	13.0	16.3	.14*, .12	27.5	.....	Light yellow.
1062	4	67,200	35.0	33.6	.38*, .32	26.0	.....	Do.
1063	3	59,800	17.5	20.8	.15, .20*	27.0	.....	Light yellow and lavender.
1070	3	57,800	16.5	14.0	.19*, .14	27.0	.....	Light yellow.
1076	3	62,400	18.5	20.8	.16, .21*	26.0	.....	Do.
1081	3	62,200	20.0	20.8	.18, .22*	25.0	.....	Do.
1088	3	57,200	23.5	18.6	.19*, .28*	23.0	.....	Light yellow and lavender.
1094	3	55,800	12.5	16.3	.14*, .11	27.0	.....	Light yellow and lavender; white spot $\frac{1}{16}$ inch diameter at circumference.
1100	3	57,800	15.0	18.6	.13, .17*	26.0	.....	Do.
1109	3	47,400	8.0	16.3	.08*, .08*	25.0	.....	Light yellow and lavender; white spot $\frac{1}{8}$ inch diameter at circumference.
1116	3	43,400	10.0	11.6	.07, .13*	23.0	.....	Light yellow and golden yellow.
		46,600	12.5	16.3	.10, .15*	22.0	.....	Do.
1121	3	59,200	12.5	14.0	.14*, .11	25.0	.....	Light yellow and lavender.
1130	3	61,400	12.0	16.3	.14*, .10	25.0	.....	Do.
1135	3	46,200	11.0	11.6	.07, .15*	23.0	.....	Golden yellow and lavender.
1145	3	62,200	23.0	23.0	.23*, .23*	23.5	.....	Light yellow and lavender.
1150	3	58,800	13.5	14.0	.15, .13	22.0	.....	Do.
1157	3	59,000	15.0	16.3	.13, .17*	23.5	.....	Light yellow.
1159	3	63,000	22.0	20.8	.21, .23*	24.5	.....	Do.
1169	3	60,400	17.0	18.6	.16, .18*	23.0	.....	Do.

Bronze from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore scleroscope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In.* *In.*			
1177	3	57,800	13.0	16.3	0.13*, 0.13	23.0	.....	Light yellow and lavender.
1187	3	62,200	16.5	14.0	.18, .15	.....	.....	Light yellow.
1195	3	58,000	21.0	18.6	.26, .16	.....	.....	Do.
1205	3	60,600	20.0	16.4	.22, .18	.....	.....	Do.
1210	3	59,200	18.0	20.8	.18*, .18*	.....	.....	Light yellow and lavender.
1215	3	50,200	3.0	3.4	.04*, .02	.....	.....	Light yellow and golden; Coarse grained.
1267	3	60,600	17.0	18.6	.16, .18	.....	.....	Light yellow.
1315	3	58,400	14.0	14.0	.16, .12	.....	.....	Do.
1320	3	63,000	17.0	16.3	.19, .15	.....	.....	Do.
1324	3	58,200	13.0	16.4	.11, .15*	.....	.....	Light yellow and lavender.
1329	3	55,800	9.0	11.6	.11*, .08	.....	.....	Do.
1341	3	39,400	7.5	6.7	.09*, .06	.....	.....	Light brown, golden yellow spots.
		60,400	15.5	18.6	.18*, .13	.....	.....	Light yellow.
1343	3	55,800	10.5	11.6	.12*, .09	.....	.....	Light yellow and lavender.
1355	3	59,200	13.5	14.0	.11, .16*	.....	.....	Do.
1361	3	60,000	21.5	18.6	.23, .20	.....	.....	Light yellow.
1379	3	56,200	13.5	16.4	.15*, .12	.....	.....	Do.
1385	3	58,600	19.0	18.6	.21*, .17	.....	.....	Light yellow and lavender.
1393	3	52,800	5.0	6.7	.07*, .03	.....	.....	Light yellow.
1404	3	62,800	20.5	23.0	.22*, .19	.....	.....	Do.
1422	3	54,600	12.0	14.0	.09, .15*	.....	.....	Light yellow and lavender.
1436	4	63,600	22.0	23.0	.24*, .20	.....	.....	Uniform light yellow.
1454	3	62,800	21.0	23.0	.23*, .19	.....	.....	Light yellow and lavender.
1464	3	44,000	9.5	11.6	.11*, .08	.....	.....	Light yellow and lemon yellow.
1467	4	64,200	38.5	33.6	.41*, .36	.....	.....	Uniform light yellow.
1487	4	66,000	36.5	35.7	.39*, .34	.....	.....	Do.
1497	3	45,000	11.5	11.6	.14*, .09	.....	.....	Lavender and lemon yellow.
1499	4	64,800	38.0	35.7	.37, .39	.....	.....	Uniform light yellow.
1531	3	54,200	14.5	16.3	.18*, .11	.....	.....	Light yellow and lavender.
1543	4	64,400	35.0	31.6	.36*, .34	.....	.....	Light yellow.
1551	4	65,000	36.5	31.6	.40*, .33	.....	.....	Do.
1560	4	64,200	26.0	25.2	.23, .29*	.....	.....	Light yellow, golden yellow spots.
1571	4	64,000	32.5	29.5	.36*, .29	.....	.....	Light yellow.
1579	4	66,400	19.0	20.8	.16, .22*	.....	.....	Light yellow, golden yellow spots.
1582	4	64,200	37.5	33.6	.37*, .38*	.....	.....	Light yellow.
1590	4	65,000	39.0	37.1	.36, .42*	.....	.....	Do.
1593	4	66,800	36.5	31.6	.37, .36*	.....	.....	Do.
1598	4	63,400	34.5	31.6	.34, .35*	.....	.....	Light yellow, silvery spot near circumference.
1613	4	63,600	43.0	39.6	.44*, .42*	.....	.....	Light yellow.
1632	4	64,000	36.0	31.6	.37*, .35	.....	.....	Do.
1670	4	67,200	29.0	29.5	.31*, .27	.....	.....	Do.
1682	4	64,000	40.0	31.6	.37, .43*	.....	.....	Do.
1714	4	65,400	40.5	37.7	.43*, .38*	.....	.....	Do.
1737	4	64,000	40.5	37.7	.38, .43*	.....	.....	Do.
1751	4	66,800	38.0	35.7	.36, .40*	.....	.....	Do.
1764	4	63,400	35.0	35.7	.35*, .35*	.....	.....	Do.
1772	3	63,400	21.0	20.8	.21*, .21*	.....	.....	Do.
1817	4	66,800	40.0	35.7	.40*, .40*	.....	.....	Uniform light yellow.
1832	3	60,400	21.5	23.0	.23*, .20	.....	.....	Light yellow and lavender.
1842	3	60,200	20.5	20.8	.23*, .18	.....	.....	Do.
1849	3	64,000	17.0	18.6	.18*, .16	.....	.....	Light yellow.
1860	3	66,000	23.0	18.6	.25*, .21	.....	.....	Do.
1888	4	64,400	36.0	31.6	.35*, .37*	.....	.....	Do.
1889	3	63,600	21.0	25.1	.23*, .19	.....	.....	Do.
1932	3	64,400	20.5	23.0	.24*, .17	.....	.....	Light yellow and lavender.
1980	3	59,000	12.0	17.9	.09, .15*	.....	.....	Do.
2021	3	59,200	30.5	27.4	.31*, .30	.....	.....	Do.
2039	4	63,800	40.0	37.7	.42*, .38	23.0	.....	Light yellow.
2044	3	61,000	42.5	37.7	.42*, .43*	24.0	.....	Do.
2069	4	64,000	30.5	25.2	.29, .32*	24.0	.....	Light yellow and lavender.
2080	3	62,800	35.0	35.7	.33, .37*	22.0	.....	Light yellow.
2095	4	68,200	33.0	29.5	.30, .33*	22.0	.....	Do.
2107	4	69,000	37.0	35.6	.37*, .37*	26.0	.....	Do.
2117	3	63,000	28.5	27.3	.26, .31*	21.0	.....	Do.
2125	3	60,400	30.0	27.3	.26, .34*	22.0	.....	Do.
2143	3	60,200	21.0	23.0	.25*, .17	24.0	.....	Light yellow and lavender.
2170	4	66,800	31.5	29.5	.33*, .30	24.0	.....	Light yellow.
2176	3	56,400	25.0	23.0	.29*, .21	21.0	.....	Do.

Bronze from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore sclero-scope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In. In.*			
2197	4	59,300	20.0	25.2	0.22*, 0.18	.....	.....	Light yellow.
		61,000	24.0	27.4	.27*, .21	21.0	.....	Do.
2245	4	65,300	41.5	37.7	.42*, .41	.....	.....	Do.
2257	4	54,800	18.5	23.0	.22*, .15	2.30	.....	Do.
		43,600	12.5	14.0	.18*, .07	23.0	.....	Light yellow and lemon yellow.
		64,000	33.5	33.8	.28, .39*	28.0	.....	Light yellow.
2266	4	65,700	36.0	33.6	.27, .45*	.....	.....	Do.
2275	3	64,000	22.0	23.0	.24*, .20	23.0	.....	Do.
2284	3	61,800	26.0	23.0	.29*, .23	20.0	.....	Light yellow oblique.
2293	3	64,800	34.0	29.5	.35*, .33	20.0	.....	Light yellow.
2300	3	63,200	20.0	23.0	.18, .22*	22.0	.....	Do.
2347	4	64,200	41.0	37.7	.39, .43*	21.0	.....	Light yellow oblique.
2385	4	67,200	36.5	35.7	.39*, .34	22.0	.....	Light yellow.
2426	4	62,400	44.0	39.6	.43, .45*	22.0	.....	Do.
2431	4	65,200	38.5	33.8	.45*, .32	20.0	.....	Light yellow oblique.
2472	3	64,600	29.5	25.2	.32*, .27	22.0	.....	Light yellow.
2476	3	60,800	15.0	14.0	.19*, .11	22.0	.....	Light yellow and lavender.
2478	3	65,800	24.5	23.0	.23, .26*	22.5	.....	Light yellow.
2483	4	64,400	39.5	35.7	.37, .42*	21.0	.....	Do.
2520	4	66,800	36.0	31.6	.40*, .32	22.0	.....	Do.
2521	3	62,800	25.5	25.2	.23, .28*	21.0	.....	Do.
2559	3	63,400	21.5	23.0	.20, .23*	22.0	.....	Light yellow and lavender.
2589	4	64,800	39.5	33.8	.36, .43*	21.0	.....	Light yellow oblique.
2590	4	67,600	31.5	31.6	.30, .33*	26.0	.....	Light yellow.
2594	4	66,800	34.5	33.8	.32, .37*	24.0	.....	Do.
2595	4	73,800	25.0	25.2	.21, .29*	31.0	.....	Do.
2596	4	61,400	41.0	37.7	.45*, .37	30.0	.....	Do.
2597	4	66,400	38.5	37.7	.38, .39*	31.0	.....	Do.
2600	4	66,400	30.5	29.5	.27, .34*	30.0	.....	Do.
2601	4	68,200	34.0	33.8	.29, .39*	31.0	.....	Do.
2603	4	67,600	22.5	25.2	.25*, .20	32.0	.....	Do.
2604	4	67,800	16.5	18.6	.14, .19*	24.0	.....	Do.
2605	4	61,200	10.5	14.0	.09, .12*	23.0	.....	Do.
		68,200	21.0	23.0	.21*, .21*	29.0	.....	Do.
2606	4	64,600	17.5	16.3	.18*, .17	23.0	.....	Do.
2611	4	71,600	26.0	25.2	.26*, .26*	30.0	.....	Do.
2612	4	65,200	28.0	29.5	.29*, .27	27.0	.....	Do.
2614	3	60,800	20.5	20.8	.18, .23*	26.0	.....	Do.
2679	4	64,600	34.5	33.8	.38*, .31	33.0	.....	Do.
2681	4	69,200	20.5	23.0	.20*, .21*	28.0	.....	Do.
2682	4	65,800	32.5	31.6	.28, .37*	26.0	.....	Do.
2683	4	71,600	19.5	20.8	.20*, .19	26.0	.....	Do.
2686	4	68,600	30.0	27.4	.28*, .22	24.0	.....	Do.
2687	4	71,400	29.0	29.5	.30*, .28*	27.0	.....	Do.
2693	4	68,600	30.5	27.4	.31*, .30	29.0	.....	Do.
2694	4	69,000	29.5	27.4	.31*, .28*	28.0	.....	Do.
2695	4	70,200	22.0	23.0	.22*, .22*	26.0	.....	Do.
2698	4	67,000	26.5	25.2	.29*, .24	24.0	.....	Do.
2699	4	67,400	30.0	29.5	.33*, .27	24.5	.....	Do.
2700	4	71,200	25.0	25.2	.27*, .23	29.5	.....	Do.
2703	4	67,200	20.5	20.8	.22*, .19	27.0	.....	Do.
2704	4	69,000	19.0	20.8	.18, .20*	27.0	.....	Do.
2705	4	68,600	26.0	23.0	.38*, .14	28.0	.....	Do.
2706	4	70,600	21.0	23.0	.21*, .21*	28.0	.....	Do.
2707	4	63,800	17.5	14.9	.18, .17	29.0	.....	Do.
2708	4	64,600	29.5	27.4	.30*, .29*	27.5	.....	Do.
2710	3	58,000	17.5	17.8	.16, .19*	25.0	.....	Do.
2779	4	62,000	18.0	20.1	.20*, .16	27.0	.....	Do.
2780	4	63,400	25.5	22.4	.26*, .27*	26.5	.....	Do.
2781	4	61,600	21.0	23.0	.21*, .21*	21.0	.....	Light yellow and lemon yellow.
2782	4	67,400	27.5	27.4	.28*, .27*	22.0	.....	Light yellow.
2785	4	63,600	28.0	27.4	.26, .30*	21.0	.....	Do.
2786	4	64,400	24.0	25.2	.24*, .24*	21.0	.....	Do.
2787	3	62,000	29.5	27.4	.32*, .27	20.5	.....	Light yellow oblique.
2861	4	65,600	34.0	31.6	.34*, .34*	21.0	.....	Light yellow.
2862	4	57,000	13.0	16.3	.16*, .10	22.0	.....	Do.
		68,800	24.0	24.0	.21, .27*	25.0	.....	Do.
2863	4	63,800	19.5	20.8	.19*, .19*	23.0	.....	Do.
2864	4	52,600	17.0	18.6	.19*, .15	21.0	.....	Light yellow and lemon yellow.
		62,800	29.5	27.4	.28, .31*	20.0	.....	Light yellow.

Bronze from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore scleroscope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In. In.*			
2865	4	50,500	8.0	16.9	0.09*, 0.07	21.0	.....	Light yellow and lemon yellow spot at circumference.
		56,200	13.5	16.3	.13, .14*	21.0	.....	Light yellow.
		64,400	24.0	24.1	.22, .26*	25.0	.....	Do.
2866	4	65,400	26.5	25.2	.24, .29*	23.0	.....	Do.
2867	4	64,000	31.5	29.5	.29, .34*	28.5	.....	Do.
2868	4	63,400	26.5	25.2	.24, .29*	23.0	.....	Do.
2869	4	67,200	26.5	27.4	.25, .28*	24.0	.....	Do.
2870	4	68,400	29.0	29.5	.26, .32*	23.5	.....	Do.
2871	4	63,200	25.0	25.2	.23, .27*	28.0	.....	Do.
2872	4	64,600	31.0	29.5	.33*, .29	30.5	.....	Do.
2873	4	64,600	27.0	25.2	.28*, .26	23.5	.....	Do.
2874	4	56,400	17.5	18.6	.16, .19*	20.5	.....	Light yellow and lemon yellow.
2875	3	60,600	7.5	11.6	.08*, .07	29.0	.....	Light yellow.
2940	4	53,800	17.0	16.0	.14, .20*	21.5	.....	Light yellow and lavender.
2941	4	51,800	13.0	16.0	.15*, .11	24.0	.....	Do.
2942	4	60,200	18.0	18.0	.20*, .16	24.0	.....	Do.
2943	4	63,600	30.5	28.0	.32*, .29	23.5	.....	Light yellow.
2944	4	62,600	29.0	26.0	.27, .31*	23.0	.....	Do.
2945	4	59,600	20.5	18.0	.22*, .19	22.5	.....	Light yellow and lavender.
2946	4	61,000	32.0	27.6	.30, .34*	23.0	.....	Light yellow.
2947	4	65,800	29.5	24.0	.28, .31*	23.0	.....	Do.
2948	4	62,200	39.5	33.8	.40*, .39*	23.0	.....	Do.
2949	4	62,400	37.5	31.6	.40*, .35	22.0	.....	Do.
2970	4	61,000	26.0	27.4	.29*, .23	23.0	.....	Do.
2971	4	65,000	37.0	33.8	.34, .40*	22.0	.....	Do.
2972	4	64,500	31.0	30.7	.29, .33*	18.5	.....	Do.
2973	4	59,000	25.5	21.0	.25, .26*	24.0	.....	Light yellow, golden yellow spots.
2974	4	63,400	31.5	25.4	.29, .34*	23.0	.....	Light yellow.
2975	4	63,600	39.0	37.8	.38, .40*	25.0	.....	Do.
2976	4	62,600	41.5	39.8	.41*, .42*	25.0	.....	Do.
2977	4	63,800	33.5	29.6	.35*, .32	22.0	.....	Do.
2978	4	63,800	28.5	25.4	.30*, .27	22.5	.....	Do.
2979	3	59,000	13.5	18.0	.12, .15*	24.0	.....	Light yellow and lavender.
3039	4	61,600	24.5	26.0	.26*, .23	24.5	116	Light yellow.
3040	4	64,200	29.5	28.0	.32*, .27	26.0	116	Do.
3041	4	63,800	36.0	31.6	.38*, .34	24.5	116	Do.
3042	3	58,600	15.0	18.0	.14, .16*	25.0	118	Do.
3096	3	56,600	9.5	14.0	.07, .12*	27.0	118	Light yellow and lavender.
3104	3	58,000	8.0	9.5	.07, .09*	22.0	121	Light yellow.
3162	3	58,200	20.0	24.0	.22*, .18	23.5	103	Light yellow and lavender.
3216	3	59,400	22.0	24.0	.19, .25*	23.0	103	Do.
3236	3	57,800	11.0	14.0	.13*, .09	25.0	126	Do.
3294	3	57,400	14.0	14.0	.17*, .11	23.0	126	Do.
3317	3	58,200	19.5	24.0	.19, .20*	24.0	105	Do.
3325	3	57,200	13.0	14.0	.15*, .11	23.5	121	Do.
3351	3	59,600	15.5	16.0	.18*, .13	21.5	112	Do.
3403	3	65,200	18.0	20.8	.15, .21*	25.0	116	Do.
3428	3	61,200	16.0	18.6	.17*, .15*	24.0	128	Do.
3456	3	65,200	26.0	24.0	.28*, .24	23.0	124	Do.
3514	3	57,000	15.0	18.0	.14*, .16*	22.0	121	Do.
3534	3	60,600	18.0	18.6	.17, .19*	20.5	124	Light yellow.
3556	3	58,800	10.0	11.6	.12*, .08	21.5	131	Light yellow and lavender.
3576	3	58,800	12.5	11.6	.08, .17*	22.0	128	Do.
3602	3	62,200	20.5	20.8	.22*, .19	20.0	121	Light yellow.
3647	3	59,400	14.0	11.6	.13, .15	21.0	116	Light yellow and lavender.
3671	3	61,000	15.0	18.6	.16*, .14	21.5	121	Light yellow.
3697	3	65,000	18.0	18.6	.19*, .17	21.0	128	Do.
3722	3	61,000	15.0	14.0	.13, .17*	23.5	126	Light yellow and lavender.
3744	3	60,600	16.5	20.8	.19*, .14	22.0	121	Light yellow.
3766	4	64,400	35.5	31.6	.40*, .31	21.0	118	Do.
3770	4	63,600	35.5	31.6	.39, .32	21.0	109	Do.
3773	4	60,400	49.5	45.3	.49*, .50*	19.0	107	Uniform light yellow.
3789	4	61,800	46.0	41.6	.51*, .41	20.5	109	Do.
3798	3	61,000	16.5	20.8	.19*, .14	26.0	126	Light yellow and lavender.
3801	3	64,800	28.5	27.4	.30*, .27	22.0	121	Do.
3810	4	61,000	46.5	43.5	.43*, .50*	17.5	109	Uniform light yellow.
3826	4	60,800	21.0	27.4	.23*, .19	22.0	116	Light yellow with golden yellow spots.
3827	3	56,800	19.5	25.2	.17, .22*	21.5	112	Light yellow.
3839	4	61,800	46.5	45.3	.48*, .45*	20.5	109	Light yellow oblique.

Bronze from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore scleroscope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In. In.*			
3849	3	67,400	27.5	25.2	0.29*, 0.26	21.5	121	Light yellow.
3854	4	61,400	49.0	45.3	.47*, .51*	19.5	103	Light yellow oblique.
3860	4	62,600	47.5	45.3	.48, .47	19.0	103	Uniform light yellow.
3865	4	62,400	46.0	45.3	.43, .49*	19.5	107	Do.
3867	4	62,800	45.0	41.6	.46*, .44	19.5	107	Light yellow oblique.
3873	4	63,600	44.5	39.6	.45*, .44*	20.0	103	Light yellow.
3879	4	64,000	47.0	47.2	.46*, .48*	20.5	107	Do.
3885	4	63,400	48.5	49.0	.43, .54	20.5	107	Do.
3891	3	60,400	15.5	16.3	.18*, .13	22.0	116	Light yellow and lavender.
3897	4	64,400	45.0	43.5	.46*, .44*	20.5	107	Light yellow.
3901	4	62,200	49.5	49.0	.58*, .41	20.0	107	Do.
3905	4	65,400	42.5	39.6	.42*, .43*	21.0	112	Light yellow oblique.
3910	4	63,800	42.0	27.4	.40*, .44*	21.0	105	Do.
3912	4	61,600	46.0	41.6	.42, .50*	21.0	103	Do.
3916	4	63,800	44.0	39.6	.44*, .44*	21.0	107	Do.
3920	3	60,000	17.0	18.6	.16, .18*	20.5	116	Light yellow and lavender.
3931	4	63,800	45.5	41.6	.52*, .39	20.5	103	Light yellow oblique.
3934	4	64,400	45.0	47.2	.48*, .42	21.0	109	Light yellow.
3939	4	64,400	42.5	41.6	.40, .45*	21.0	112	Light yellow oblique.
3944	4	64,200	43.5	39.6	.45*, .42	21.0	107	Light yellow.
3948	4	65,000	41.0	35.7	.44*, .38	21.5	112	Do.
3953	4	64,800	42.5	41.6	.44*, .21	21.0	109	Light yellow oblique.
3959	4	64,000	45.0	41.6	.41, .49*	22.5	107	Light yellow.
3962	4	64,000	43.5	33.8	.43*, .44*	21.0	107	Light yellow oblique.
3966	4	61,600	50.0	49.0	.42, .48*	21.0	103	Do.
3968	4	66,600	42.5	35.7	.38, .47*	21.0	114	Do.
3972	4	65,000	44.0	45.3	.43*, .45*	23.5	112	Light yellow.
3974	4	62,800	49.0	47.2	.47*, .50*	23.5	103	Do.
3977	4	64,400	45.0	45.3	.44*, .46*	21.0	99	Do.
3981	4	66,000	44.0	45.3	.40, .48*	21.5	112	Do.
3983	4	64,400	45.0	47.2	.47,* .43	25.0	107	Do.
3985	4	66,800	44.0	45.3	.44*, .44*	26.0	114	
3989	4	63,200	47.0	47.2	.49*, .45	25.5	107	Do.
3991	4	66,800	41.0	39.6	.40, .42*	26.0	112	Do.
3993	4	65,000	44.5	39.6	.50*, .39	23.0	112	Do.
3997	4	63,000	46.0	39.6	.50*, .42	23.0	107	Light yellow oblique.
3999	4	64,200	43.5	39.6	.48*, .39	23.0	107	Do.
4002	4	65,400	34.0	31.6	.38*, .30	22.0	112	Light yellow.
4006	4	62,600	48.5	45.3	.50*, .47*	22.0	107	Light yellow oblique.
4008	4	65,600	45.0	41.6	.47*, .43*	22.0	112	Do.
4011	4	64,800	45.0	41.6	.43, .47*	22.0	116	Do.
4015	4	61,600	46.5	39.6	.47*, .46*	21.0	107	Do.
4018	4	65,200	47.0	45.3	.47*, .47*	21.5	116	Light yellow.
4025	4	63,600	47.5	45.3	.48,* .47*	21.0	112	Light yellow oblique.
4029	4	63,000	50.0	50.7	.45, .55*	20.0	107	Light yellow.
4033	3	70,000	17.0	16.3	.20,* .14	24.0	131	Do.
4061	3	65,800	18.0	18.6	.16, .20*	23.0	116	Light yellow and lavender.
4069	3	63,800	17.5	20.8	.16, .19*	24.0	131	Do.
4099	4	65,400	34.0	27.4	.34, .34*	21.0	116	Light yellow.
4101	4	65,200	44.5	39.6	.41, .48*	23.0	116	Light yellow oblique.
4104	3	63,400	12.0	14.0	.12*, .12	26.0	131	Light yellow.
4141	4	63,200	39.5	31.6	.35, .44*	25.0	112	Uniform light yellow.
4145	3	64,600	26.0	27.4	.30*, .22	24.0	126	Light yellow.
4152	4	64,200	44.0	39.6	.41*, .47*	21.0	112	Do.
4169	4	64,600	44.5	39.6	.44*, .45*	20.0	112	Do.
4187	3	67,200	13.5	16.3	.15*, .12*	22.0	131	Do.
4218	4	65,800	42.5	39.6	.42, .43*	21.0	114	Do.
4244	4	64,000	46.2	47.2	.49*, .43	22.0	116	Light yellow oblique.
4251	3	66,800	23.5	25.2	.26*, .21	25.5	131	Light yellow.
4284	3	65,800	23.0	25.2	.20, .26*	23.0	126	Do.
4301	4	64,200	44.0	42.7	.46*, .42	22.0	112	Light yellow oblique.
4308	4	69,200	38.0	35.7	.38*, .38*	22.0	121	Do.
4317	4	63,800	44.5	41.6	.46*, .43*	21.0	112	Light yellow.
4324	3	68,800	23.0	25.2	.26*, .20	21.0	131	Do.
4354	4	66,600	41.0	37.7	.39, .43*	21.0	118	Light yellow oblique.
4357	4	64,200	45.0	41.6	.42, .48*	21.0	112	Do.
4372	3	65,200	29.5	25.2	.27, .32*	23.0	121	Light yellow.
4444	4	63,600	47.0	43.5	.47*, .47*	22.5	116	Do.
4460	4	64,000	39.5	31.6	.45*, .34	22.5	107	Do.
4484	4	63,200	48.0	47.2	.49*, .47*	22.0	112	Do.
4500	4	62,200	49.5	49.0	.57*, .42	23.0	107	Do.
4516	3	64,600	21.0	23.0	.18, .24*	23.0	121	Do.
4522	3	65,400	21.0	20.8	.20, .22*	24.0	124	Light yellow and lavender.
4528	4	62,200	50.5	50.7	.55*, .46*	20.0	105	Light yellow.

Bronze from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore scleroscope.	Brinell.	
		Lbs. per sq. in.	*P. ct.*	*P. ct.*	*In. In.*			
4538	4	62,800	44.5	39.6	0.49*, 0.40	26.0	109	Light yellow.
4550	4	64,000	40.0	35.7	.44*, .36	20.0	112	Light yellow oblique.
4561	4	63,000	49.0	50.7	.53*, .45	20.0	112	Do.
4575	4	62,800	47.0	45.3	.49*, .45*	20.0	103	Do.
4585	4	62,200	49.5	52.5	.51*, .48*	20.5	107	Do.
4600	4	62,800	46.0	45.3	.45*, .47*	20.0	107	Do.
4613	4	63,400	46.0	47.2	.48*, .44*	20.0	107	Do.
4645	4	63,200	46.0	47.2	.48*, .44*	20.0	105	Do.
4665	4	63,200	43.5	43.5	.38, .49*	20.0	112	Do.
4680	4	60,000	21.5	25.2	.17, .26*	20.5	112	Light yellow with three golden yellow spots.
4681	4	62,200	48.0	47.2	.48*, .48*	19.5	107	Light yellow oblique.
4683	4	62,000	48.0	45.3	.47*, .49*	19.0	107	Do.
4705	4	62,800	45.0	43.5	.44*, .46*	19.0	112	Do.
4720	4	62,600	48.0	47.2	.47*, .49*	20.5	107	Do.
4732	3	60,000	43.0	41.6	.51*, .35	19.0	97	Light yellow.
4742	3	59,200	38.5	35.7	.38, .39*	18.5	99	Do.
4749	3	69,000	29.5	27.4	.30*, .29*	22.0	126	Do.
4771	3	63,600	15.0	20.8	.13, .17*	23.0	121	Light yellow and lavender.
4781	3, 4	68,200	28.0	25.2	.30*, .26	22.5	121	Light yellow.
4801	3	64,600	28.5	27.4	.28*, .29*	22.5	116	Do.
4810	3	65,200	21.5	25.2	.23*, .20	22.0	121	Do.
4821	4	61,000	46.0	41.6	.48*, .44	18.5	103	Do.
4825	4	60,600	49.0	45.3	.53, .45	22.0	101	Do.
4831	4	62,200	49.5	50.7	.45, .54	21.0	107	Do.
4843	4	60,600	42.0	37.7	.41*, .43*	19.0	107	Do.
4845	3	58,500	13.0	20.5	.15*, .11	17.5	118	Do.
4857	4	60,200	44.5	41.6	.44*, .45*	20.5	103	Light yellow oblique.
4859	3	64,000	23.0	24.0	.26*, .20	17.5	116	Light yellow.
4884	4	62,500	41.5	46.2	.46*, .37	17.0	103	Do.
4886	3	66,000	22.5	25.2	.20, .25*	21.0	126	Light yellow and lavender.
4904	4	33,000	2.5	14.0	.02, .03	18.0	103	Light yellow and golden yellow.
	4	35,600	13.5	26.3	.03, .24*	18.0	94	Do.
	4	49,500	18.5	27.4	.20*, .17	16.5	95	Do.
	4	61,000	44.0	43.3	.33, .55*	18.0	103	Light yellow.
4906	4	64,200	45.0	45.3	.45*, .45*	19.5	112	Light yellow oblique.
4908	4	62,600	45.5	43.5	.45*, .46*	20.0	109	Do.
4984	4	63,000	44.5	41.6	.47*, .42	20.0	109	Do.
5074	4	64,200	44.5	39.6	.42*, .47*	20.0	112	Do.
5098	4	63,400	40.5	35.7	.36, .45*	20.5	109	Do.
5105	4	64,700	45.5	45.2	.44, .47*	20.0	112	Do.
5154	4	63,200	46.0	43.5	.45*, .47*	29.5	112	Do.
5161	4	63,400	47.0	45.3	.54*, .40	20.0	112	Light yellow.
5168	4	63,000	40.0	35.7	.41*, .39*	19.0	109	Light yellow oblique.
5175	4	61,600	49.5	52.5	.49*, .50*	18.0	103	Light yellow.
5177	4	66,400	37.5	33.8	.40*, .35	20.5	116	Light yellow oblique.
5179	4	62,000	42.5	43.5	.42*, .43*	24.0	103	Do.
5182	4	57,600	52.0	54.2	.60*, .44	24.0	99	Light yellow.
5245	4	60,600	41.5	39.6	.45*, .38	24.5	103	Do.
5273	4	62,400	43.5	39.6	.48*, .39	27.0	109	Light yellow oblique.
5283	4	60,400	45.5	41.6	.50*, .41	27.0	105	Do.
5286	4	62,800	45.0	43.5	.43*, .47*	26.0	109	Light yellow.
5325	4	62,000	43.5	39.6	.41, .46*	23.0	105	Light yellow oblique.
5392	4	62,000	44.5	39.6	.45*, .44	28.0	107	Do.
5428	4	63,000	43.5	39.6	.47*, .40	27.0	105	Light yellow.
5466	4	63,600	40.0	39.6	.42*, .38	24.0	112	Do.
5469	4	61,000	43.5	39.6	.41, .46*	22.0	105	Light yellow oblique.
5471	4	61,200	41.5	39.6	.48*, .35	22.0	103	Light yellow.
5474	4	60,400	45.0	41.6	.45*, .45*	23.0	103	Light yellow oblique.
5484	4	60,000	44.5	41.6	.53*, .36	22.0	97	Do.
5491	4	61,600	47.5	45.3	.48*, .47*	23.0	99	Light yellow.
5499	3	63,800	14.5	18.6	.17*, .12	22.0	121	Light yellow and lavender.
5531	3	68,400	17.5	18.6	.18*, .17*	22.5	126	Do.
5551	3	64,200	17.5	16.3	.19*, .16	21.0	126	Light yellow.
5571	4	59,600	45.0	43.5	.38, .52*	19.0	95	Do.
5578	4	67,800	10.5	11.6	.09, .12*	32.0	149	Golden yellow oblique.
5583	4	60,800	47.0	43.5	.49*, .45*	20.0	103	Light yellow.
5589	3	65,400	23.0	23.0	.20, .26*	22.0	124	Do.
5609	4	62,200	41.0	37.7	.37, .45*	21.0	107	Light yellow oblique.
5648	3	64,000	25.5	25.2	.23, .28*	22.0	126	Light yellow.
5665	2, 3, 4	66,600	25.0	29.5	.29*, .21	24.0	126	Do.
5676	4	60,000	46.0	43.5	.46*, .46*	20.5	103	Light yellow oblique.

BRONZES RECEIVED ON PURCHASE ORDERS, AND EXPENDITURE ORDERS.

Marks.	Grade.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.	Hardness.		Appearance of fracture.
						Shore.	Brinell.	
		Lb.	*P. ct.*	*P. ct.*	*In. In.*			
P. O. 9283....	Tobin.....	68,500	32.5	49.1	0.33*, 0.32*	28.0	.....	Uniform light yellow, silky.
P. O. 9331....	...do.....	69,200	32.5	39.6	.35*, .30	29.0	.....	Do.
P. B. T. D. 110.	Phosphor bronze.	24,000	6.5	5.7	.08*, .05	15.0	.....	Yellow, brown, and lavender.
P. O. 9494....	Tobin.....	65,500	35.0	54.6	.45*, .25	29.0	.....	Yellow, silky.
P. O. 389.....	...do.....	62,800	30.5	26.0	.30*, .31*	.....	.....	Light yellow.
P. O. 191.....	...do.....	70,000	29.0	49.1	.28*, .30*	.....	.....	Light yellow, silky.
C. P. O. 933..	...do.....	54,200	44.5	49.0	44, .45*	22.0	.....	Do.
P. O. 1126....	...do.....	74,500	20.5	49.5	.13, .28*	33.5	.....	Light yellow.
P. O. 1270....	Tobin $1\frac{1}{8}$..	64,200	32.0	56.1	.41*, .23	27.0	.....	Do.
P. O. 1270....	Tobin $1\frac{1}{16}$.	61,200	35.0	37.8	.28, .42*	25.5	.....	Light yellow, circular seam around center.
P. O. 1126....	Tobin.....	63,000	37.0	49.1	.28, .46*	26.5	124	Light yellow, cup-shaped.
P. O. 1901....	...do.....	55,800	44.0	41.6	.37, .51*	25.0	103	Uniform light yellow, oblique.
P. O. 2259....	...do.....	61,000	37.5	39.6	.38*, .37*	25.5	118	Uniform light yellow.
P. O. 2259-1..	...do.....	66,000	24.0	62.0	.34*, .14	27.0	131	Uniform light yellow, long. Seam in center.
P. O. 2259-2..	...do.....	65,000	26.5	58.0	.33*, .20	25.0	126	Uniform light yellow.
P. O. 2342....	...do.....	57,200	31.5	29.5	.33*, .20	24.0	107	Do.
P. O. 1901....	...do.....	57,000	48.0	49.1	.55*, .41	17.0	92	Uniform light yellow, oblique.
		57,500	46.5	54.6	.56*, .37	17.0	90	Do.
Ex. O. 7975	.....	60,690	13.5	13.2	.14, .13	30.0	.....	Golden yellow.
X-7477-A....	.....	62,400	34.0	31.6	.33, .35*	19.0	107	Light yellow.
X-7477-B....	.....	19,600	1.5	2.0	.03*,0.	20.0	101	Silvery gray and golden yellow.
X-7477-C....	.....	15,800	2.0	2.0	.04*,0.	12.0	80	Do.
1260F.....	Tobin.....	60,000	11.0	13.2	.09, .13*	20.0	.....	Light yellow, seam crossing through fracture.
		56,000	12.0	17.0	.11, .13*	19.0	.....	Light yellow, with 5 seams parallel to axis.
1357F.....	...do.....	68,500	31.0	40.3	.25, .37*	22.0	.....	Light yellow.
1358F.....	...do.....	69,500	33.0	40.3	.41*, .25	24.0	.....	Do.
1359F.....	...do.....	72,500	32.0	30.7	.32*, .32*	23.5	.....	Do.
222F.....	...do.....	67,500	30.0	30.7	.27, .33*	19.5	121	Do.
478.....	...do.....	70,000	42.0	51.9	.49*, .35	20.0	121	Do.

CAST IRON FOR ORDNANCE WORK.

CAST IRON FROM WATERTOWN ARSENAL FOUNDRY.

Marks.	Grade.	Tensile strength per square inch.	Hardness.		Appearance of fracture.
			Shore scleroscope.	Brinell apparatus.	
		Lb.			
3504	2	24,400	33.5	.....	Fine granular gray.
		26,400	33.0	.....	Do.
		30,400	.....	.....	Do.
		30,200	.....	.....	Do.
3520	2	29,800	36.0	.....	Do.
		27,800	36.0	.....	Do.
3521	2	27,200	34.0	.....	Do.
3527	2	27,500	35.0	.....	Fine granular gray, fracture in neck.
3529	2	31,600	34.0	.....	Fine granular gray.
		28,800	34.0	.....	Do.
3530	2	31,600	35.0	.....	Do.
		32,800	33.0	.....	Do.
3535	2	30,300	37.0	.....	Fine granular gray, fracture in neck.
3536	2	30,000	34.0	.....	Fine granular gray.
		30,600	33.0	.....	Do.
3537	2	32,600	35.0	.....	Do.
		30,000	36.0	.....	Do.
3539	2	32,200	32.0	.....	Fine granular gray, fracture in neck.
3540	2	24,400	36.0	.....	Fine granular gray.
		27,600	33.0	.....	Do.
		29,000	.....	.....	Do.
		28,500	.....	.....	Do.
3559	2	32,800	.....	.....	Do.
3560	2	30,200	.....	.....	Do.
		32,400	.....	.....	Do.
3585	2	29,200	.....	.....	Do.
3586	2	29,800	.....	.....	Do.
		29,400	.....	.....	Do.
3587	2	30,800	.....	.....	Fine granular gray, fracture in neck.
		29,600	.....	.....	Do.
3611	2	22,500	.....	.....	Gray granular, brown spongy over half cross-section.
		31,000	.....	.....	Fine granular gray.
3612	2	25,200	.....	.....	Do.
		27,000	.....	.....	Do.
		28,500	.....	.....	Do.
		28,400	.....	.....	Do.
3613	2	30,600	.....	.....	Fine granular gray, fracture in neck.
		30,000	.....	.....	Do.
3614	2	30,600	.....	.....	Do.
		30,800	.....	.....	Do.
3669	2	29,800	.....	.....	Gray granular.
3670	2	32,800	.....	.....	Fine granular gray, fracture in neck.
		33,000	.....	.....	Do.
3671	2	31,600	.....	.....	Fine granular gray.
		30,000	.....	.....	Do.
3683	2	33,600	.....	.....	Do.
3684	2	28,000	.....	.....	Do.
		28,200	.....	.....	Do.
3685	2	28,200	.....	.....	Do.
		26,600	.....	.....	Do.
3691	2	30,000	.....	.....	Do.
3692	2	27,200	.....	.....	Granular gray.
		26,800	.....	.....	Do.
		27,400	33.0	.....	Fine granular gray.
		30,200	33.5	.....	Do.
3693	2	31,800	.....	.....	Do.
		29,000	.....	.....	Do.
3701	2	32,300	36.0	.....	Do.
3702	2	28,800	.....	.....	Do.
		27,200	.....	.....	Do.
		27,600	36.0	.....	Do.
		26,400	36.0	.....	Do.

Cast iron from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength per square inch.	Hardness.		Appearance of fracture.
			Shore scleroscope.	Brinell apparatus.	
		Lb.			
3703	2	31,000	36.0	.....	Fine granular gray.
		27,600	33.0	.....	Do.
3709	2	30,600	39.0	.....	Do.
3710	2	32,000	35.0	.....	Do.
		31,200	36.0	.....	Do.
3711	2	31,600	34.0	.....	Do.
		32,200	35.0	.....	Do.
3715	2	33,000	33.0	.....	Do.
3716	2	32,400	34.0	.....	Do.
		31,400	33.0	.....	Do.
3726	2	25,600	31.0	.....	Do.
3727	2	27,400	33.0	179	Do.
3728	2	27,600	34.0	174	Do.
3736	2	36,600	38.0	.....	Do.
3737	2	29,200	33.0	.....	Do.
		28,600	34.0	.....	Do.
3750	2	30,000	35.0	.....	Do.
3751	2	32,600	35.0	.....	Do.
		32,800	35.0	.....	Do.
3757	2	30,100	34.0	.....	Do.
3759	2	30,600	36.0	.....	Do.
		30,400	36.0	.....	Do.
3761	2	31,400	31.0	.....	Do.
3762	2	27,500	.....	.....	Do.
		29,700	.....	.....	Do.
3775	2	29,200	34.0	.....	Do.
3776	2	31,600	.....	.....	Do.
		32,000	.....	.....	Do.
3790	2	32,300	32.0	.....	Do.
3791	2	30,200	33.0	.....	Do.
		30,800	34.0	.....	Do.
3810	2	32,700	33.0	.....	Do.
3811	2	29,400	33.0	.....	Do.
		29,000	34.0	.....	Do.
3813	2	33,400	32.0	.....	Do.
3814	2	29,800	32.5	.....	Do.
		29,800	33.0	.....	Do.
3826	2	32,100	34.0	.....	Do.
3827	2	32,400	36.0	.....	Do.
		32,000	35.0	.....	Do.
3832	2	33,400	33.0	.....	Do.
3833	2	30,000	32.0	.....	Do.
		29,800	34.0	.....	Do.
3838	2	31,300	33.0	.....	Do.
3839	2	32,600	34.0	.....	Do.
3843	2	32,000	35.0	.....	Do.
3844	2	31,200	35.0	.....	Do.
		34,800	35.0	.....	Do.
3850	.....	33,300	34.5	187	Do.
3851	1,2	32,600	35.0	183	Do.
		31,000	34.0	183	Do.
3864	2	32,600	33.0	183	Do.
3865	2	29,400	33.0	189	Do.
		31,200	32.0	189	Do.
3873	2	32,400	34.0	147	Do.
3874	2	30,800	38.0	192	Do.
		30,000	37.0	183	Do.
3880	2	31,400	35.0	187	Do.
3881	2	30,000	33.5	187	Do.
		30,200	35.0	187	Do.
3883	2	33,800	35.0	170	Do.
3884	2	30,200	34.0	170	Do.
		29,600	34.0	174	Do.
3890	2	29,500	31.0	156	Do.
3891		24,800	33.0	163	Fine granular dark gray.
		28,400	33.0	179	Fine granular gray.
		25,600	32.5	159	Do.
		29,000	33.0	179	Do.
		24,400	31.0	156	Fine granular dark gray.
		27,800	31.5	170	Do.
3924	2	31,500	36.0	170	Fine granular gray.
3949	2	31,500	32.0	170	Do.
3957	2	28,400	31.5	156	Do.
3962	2	27,100	30.0	170	Do.

Cast iron from Watertown Arsenal foundry—Continued.

Marks.	Grade.	Tensile strength per square inch.	Hardness.		Appearance of fracture.
			Shore sclero-scope.	Brinell appa-ratus.	
		Lb.			
		24,800	32.0	170	Fine granular gray.
		25,000	31.5	163	Do.
3963	2	25,800	32.0	163	Do.
		25,000	32.0	163	Do.
3969	2	26,700	30.0	163	Do.
3976	2	32,300	35.0	179	Do.
3977	2	26,500	31.0	170	Do.
		31,600	30.0	170	Do.
3978	2	30,400	33.8	170	Do.
4013	1,2	27,400	34.0	187	Do.
4014	2	29,700	31.0	166	Do.
		24,400	32.5	170	Do.
		25,500	33.0	174	Do.
4015	2	28,400	24.0	159	Do.
		30,000	28.0	159	Do.
		26,400	33.0	170	Do.
4016	2	28,800	33.5	179	Do.
		29,800	32.0	183	Do.
4022	2	28,600	30.0	170	Do.
		29,400	31.0	179	Do.
4023	2	20,000	30.0	179	Do.
		24,400	29.0	174	Do.
4024	2	28,000	29.5	179	Do.
		23,600	30.0	166	Do.
4028	1	17,800	25.0	179	Fine granular dark gray.
	1	18,000	27.0	131	Fine granular gray.
		22,600	30.0	174	Do.
4029	2	27,400	32.0	179	Do.
4033	2	28,400	34.0	179	Do.
		28,800	30.0	174	Do.
4037	2	33,000	30.0	170	Do.
		27,200	29.0	170	Do.
4039	2	26,400	30.0	156	Do.
		23,000	29.0	149	Fine granular dark gray.
		22,400	33.0	163	Do.
4040	2	27,400	32.0	170	Fine granular gray.

GUN AND TOOL STEEL FOR ORDNANCE WORK.

Gun and tool steel from Watertown Arsenal smith shop.

[Inch section in which fracture occurred is marked thus: *.]

Marks.	Grade.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.		Hardness.		Appearance of fracture.
								Shore.	Brinell.	
		Lb.	*Lb.*	*Per ct.*	*Per ct.*	*In.*	*In.*			
160 F. F-1.	Gun steel.	67,500	113,500	20.0	43.3	0.19*,	0.21*	33.0	217	Dull silky.
160 F. F-2.	...do.....	69,000	113,500	20.5	43.3	.22*,	.19*	30.5	228	Do.
345 F-2....	Tool steel A.	65,000	127,000	18.0	49.1	.07,	.29*	38.0	.....	Silky, 80 per cent; fine granular, 20 per cent.
418 F-2....	...do.....	87,500	136,500	17.5	46.2	.08,	.27*	38.0	.....	Fine granular; silky center.
775 F.....	...do.....	80,500	126,000	15.0	46.2	.26*,	.04	41.0	.....	Fine silky.
817 F.....	...do.....	88,500	122,500	14.0	20.5	.17*,	.11	42.0	.....	Fine granular, 70 per cent; amorphous spot, 30 per cent.
818 F.....	Tool steel B.	109,000	133,500	17.0	54.6	.29*,	.05	38.0	.....	Fine silky; serrated.
977 F.....	Tool steel A.	112,000	169,000	12.0	27.4	.18*,	.06	.....	.....	Fine granular; silky spot in center.
		83,000	116,500	20.5	46.2	.29*,	.12	.....	.....	Fine granular.
		120,500	138,500	19.0	54.6	.06,	.32*	40.0	.....	Fine silky; serrated.
1039 F.....	...do.....	58,000	112,000	19.0	30.7	.14,	.24*	.....	.....	Fine granular, 85 per cent; silky, 15 per cent.
1743 T.....	Gun steel.	37,500	80,500	27.5	40.3	.25*,	.30*	22.5	143	Silky.
1743 FC.....	...do.....	46,000	92,500	26.5	43.3	.29*,	.24	24.0	179	Do.
1741 FT.....	...do.....	63,000	101,000	24.0	54.6	.36*,	.12	28.5	187	Do.
1741 FC.....	...do.....	68,000	101,000	23.0	62.0	.30*,	.16	24.0	192	Fine silky.
1741 F-2C...	...do.....	70,000	107,000	20.0	58.0	.30*,	.10	23.5	207	Fine silky; cup shaped.
1744 FC.....	...do.....	72,500	112,500	20.5	49.1	.27*,	.14	30.0	217	Silky.
1744 F-2C...	...do.....	70,500	109,000	29.0	57.2	.34*,	.24	28.5	207	Fine silky; cup shaped.
1744 FT.....	...do.....	72,000	116,000	19.5	43.3	.22*,	.17	29.5	223	Silky.
1745 FC.....	...do.....	70,500	104,000	25.0	59.8	.32*,	.18	29.0	192	Silky, serrated.
1745 F-2C...	...do.....	69,500	106,500	22.5	51.9	.17,	.28*	28.0	207	Fine silky.
1745 FT.....	...do.....	55,500	101,000	21.0	49.1	.13,	.29*	28.0	187	Dull silky.
1746 FT.....	...do.....	69,000	112,500	20.5	43.3	.20*,	.21*	32.0	223	Silky.
		61,500	100,000	24.5	57.2	.13,	.36*	28.5	187	Do.
1747 FT.....	...do.....	78,500	125,000	15.5	30.7	.12,	.19*	31.0	241	Fine granular; silky center.
1748 FT.....	...do.....	67,500	110,000	20.5	46.2	.29*,	.12	31.0	217	Dull silky, trace granulation.
1749 FC-1...	...do.....	74,500	122,500	16.0	30.7	.20*,	.12	33.0	228	Do.
1749 FC-2...	...do.....	74,000	118,000	20.0	46.2	.14,	.26*	32.0	235	Dull silky.
1742 FC-1...	...do.....	49,000	103,000	14.0	34.0	.21*,	.07	23.0	179	Dull silky, 70 per cent; granular, 30 per cent.
1742 FC-2...	...do.....	81,000	128,000	16.0	43.0	.09,	.23*	32.0	248	Silky.
1743 FC-1...	...do.....	83,000	129,000	15.0	34.0	.18*,	.12	31.0	248	Silky, 50 per cent; granular, 50 per cent.
1743 FC-2...	...do.....	84,000	129,000	14.5	34.0	.14*,	.15*	31.0	255	Fine granular; silky center.
1750 FT.....	...do.....	67,000	110,500	21.0	43.3	.21*,	.21*	30.5	217	Silky trace of granulation.
	...do.....	66,000	110,000	21.0	43.3	.27*,	.15	31.0	217	Silky.
1751 FT.....	...do.....	65,500	110,000	21.5	49.1	.31*,	.12	28.0	217	Dull silky.
	...do.....	74,500	123,500	15.5	37.2	.09,	.22*	33.0	248	Dull silky, 50 per cent; fine granular, 50 per cent.

PROOF TEST OF PISTON RODS AND CHAIN FOR ORDNANCE WORK.

TEST 14704.

PROOF STRESS APPLIED TO FOUR 15-PDR. PISTON RODS.

Proof stress of 98,400-lb. tension applied to each rod.

Marks on rods.	1186		1197		1199		1196	
Applied loads.	In 10-in. gauge length.		In 10-in. gauge length.		In 10-in. gauge length.		In 10-in. gauge length.	
	Elongation.	Set.	Elongation.	Set.	Elongation.	Set.	Elongation.	Set.
Pounds.								
500	0.	0.	0.	0.	0.	0.	0.	0.
98,400	.0075	.....	.0075	.....	.0075	.....	.0075	.....
500	0.	0.	0.	0.	0.	0.	0.	0.

No permanent set. Comply with specifications.

TEST NO. 14754.

PROOF STRESS APPLIED TO TWO 12-IN. MORTAR CARRIAGE PISTON RODS FOR WATERTOWN ARSENAL, MASS.

Rods marked 12-in. mortar carr., model 1908, pilot, R. & L.

Proof stress called for 392,500 lb.

Proof stress applied, 396,000 lb., allowance being made for packing friction.

Readings taken on tension gauge of testing machine.

Elongations taken on 30-in. gauge length.

Load.	Elongations.	
	Rod R.	Rod L.
Lb.	*In.*	*In.*
0.	0.	0.
396,000	.0235	.0235
0.	.0050 (micrometer disturbed).	0.0008
	Second time.	
0.	0.	0.
396,000	.0232	.0227
0.	0.	0.

TEST 14940.

PROOF STRESS APPLIED TO TWO 14-IN. GUN TURRET PISTON RODS FOR WATERTOWN ARSENAL, MASS.

Piston rods for 14-in. gun turret mounts, model 1909.

Load of 800,000-lb. tension applied to rods with the following results.

Elongations measured on gauge length of 30 in.

Load.	Elongation in 30-in. length.	
	Rod 761.	Rod 766.
Lb.	*In.*	*In.*
5,000	0.	0.
800,000	.0197	.0197
5,000	.0006	−.0001

Requirements.

Service 525,000 lb.

TEST 14835.

PROOF STRESS APPLIED TO SIX SPRING COMPRESSOR SCREWS FOR 12-IN. MORTAR CARRIAGE, MODEL 1908, FOR WATERTOWN ARSENAL, MASS.

Marks on rods tested: 2104, 2105, 2141, 2142, 2143, and 2144.

Load of 60,000-lb. tension applied to each rod.

No sign of failure.

Required: Load of 60,000 lb.

TEST 14776.

TENSILE TESTS OF TWO PIECES OF ⅜-IN. CHAIN FOR WATERTOWN ARSENAL.

	Number of links.	Diameter of wire.	Outside width of link.	Outside length of link.	Tensile strength.
		In.	*In.*	*In.*	*Lb.*
First sample	39	0.37	1.18	1.73	6,630
Second sample	39	.37	1.21	1.73	6,324

First sample parted, fifteenth link at welded end.

Second sample parted, seventh link at welded end.

Requirements: Proof test, 3,640 lb. Average breaking strength, 7,280 lb. Safe load (ordinary), 2,427 lb.

TEST 14821.

PROOF STRESS APPLIED TO TWO PIECES OF ⅜-IN. CRANE CHAIN FOR WATERTOWN ARSENAL, MASS.

Chain received on P. O. 1515.

DIMENSIONS.

Marks.	Number of links.	Diameter of wire.	Outside width of links.	Length over all before test.	Length over all after test.	Elongations.
		In.	*In.*	*In.*	*In.*	*In.*
	39	0.37	1.18–1.22	38.49	39.19	0.70
Tag marked "Rejected"	39	.37	1.16–1.24	38.25	38.92	.67

Proof stress of 3,640-lb. tension was applied to each chain without damage to chains.

REQUIREMENTS.

⅜-in. wire, $3\frac{1}{2}$-in. pitch, $1\frac{1}{4}$ in. outside width of link. Proof test of 3,640 lb., average breaking strength 7,280 lb., ordinary safe load of 2,427 lb.

TEST 14959.

PROOF STRESS APPLIED TO TWO (2) PIECES OF ⅜-IN. STEEL CHAIN FOR WATERTOWN ARSENAL, MASS.

	Requirements.	Sample 1.	Sample 2.
Number of links	39	40	40.
Diameter of wire	⅜ in.	0.40 in.	0.40 in.
Length of link over all	$1\frac{33}{32}$ in.	Minimum, 1.74 in.	Minimum, 1.75 in.
		Maximum, 1.85 in.	Maximum, 1.87 in.
Inside length of link	$\frac{31}{32}$ in.	Minimum, 0.93 in.	Minimum, 0.92 in.
		Maximum, 1.00 in.	Maximum, 1.03 in.
Inside width of link	½ in.	Minimum, 0.53 in.	Minimum, 0.54 in.
		Maximum, 0.57 in.	Maximum, 0.57 in.
Outside width of link	$1\frac{1}{4}$ in.	Minimum, 1.35 in.	Minimum, 1.33 in.
		Maximum, 1.41 in.	Maximum, 1.39 in.
Proof stress	3,640 lb.	3,713 lb.	3,713 lb.

Requirements: No deviations from the above dimensions can be allowed.

A proof stress of 3,713 lb. tension was applied to each chain.

MISCELLANEOUS TESTS FOR ORDNANCE WORK.

TEST 14690.

TENSILE TEST OF SEAMLESS BRASS TUBE FOR WATERTOWN ARSENAL, MASS. P. O. 9095.

Direction of drawing, perpendicular (right angles) to axis of specimen.

Marks.	Width.	Thickness.	Sectional area.	Tensile strength.		Elongation in 8 inches.	
				Load.	Stress per square inch.		
None.	*In.* 1.50	*In.* .285	*Sq. in.* .428	*Lb.* 16,300	*Lb.* 38,100	*In.* 1.98	*Per cent.* 24.7

After fracture.			Contraction of area.	Remarks.
Width.	Thickness.	Sectional area.		
In. 1.26	*In.* .21	*Sq. in.* .264	*Per cent.* 38.3	Fracture 4.6 in. inside gauge mark.

TEST NO. 14795.

TUBE AND FRICTION TESTS FROM A PIECE OF 7-PLY ½-IN. PNEUMATIC HOSE FOR WATERTOWN ARSENAL, WATERTOWN, MASS.

The 12-in. sample represents 400 ft. of ½-in. 7-ply hose, received on P. O. 1068.

TUBE TEST.

Length of sample over all, 6 in.

Width of sample, 1 in.

A gauge length of 2 in. was laid off on sample. The sample was then stretched until the gauge marks were 6 in. apart and held in this position for 10 minutes.

Distance between gauge marks after sample had rested for 10 minutes, 2.25 in.

Permanent set, 0.25 in. Complies with the specifications.

REQUIRED FOR TUBE TEST.

Distance between gauge marks after sample had rested 10 minutes not to be greater than 2¼ in.

Permanent set not to be more than 0.25 in.

FRICTION TEST.

Length of samples, 1 in.
Two samples tested.
First sample unwound 2.80 in. in 10 minutes.
Second sample unwound 2.90 in. in 10 minutes.

REQUIRED FOR FRICTION TEST.

Fabric must not unwind at a greater rate of speed than 6 in. in 10 minutes.

TEST 14809.

HARDNESS TEST ON A BEVEL GEAR BLANK FOR 14-INCH-GUN TURRET FOR WATERTOWN ARSENAL, MASS.

Gear blank received from machine shop February 16, 1912.
Marks on blank, 1019, 37_1B.
Hardness taken on both sides of the gear with Brinell's hardness instrument, and also with the Shore scleroscope.
Results of hardness as follows: Brinell's instrument, 302 to 340; Shore scleroscope, 54 to 56.
Forged steel specimens have a hardness by the Brinell test of about 200, and by the scleroscope of about 30.

TEST 14822.

TENSILE TEST OF A STRAIN INSULATOR FOR WATERTOWN ARSENAL, MASS.

The insulator consists of two malleable-iron castings with one-half in. eyes at one end of each. At the other end the two castings locked together and were covered with a composition ball two and one quarter in. in diameter, the composition ball forming the insulation.
Tensile strength, 6,426 lb.
Fractured the composition ball into 9 principal fragments.
Composition covering removed and test continued.
At 4,896 lb. fractured the malleable-iron casting near the base which was covered by the composition ball.

TEST 14895.

COMPRESSIVE TESTS OF STEEL BALLS FOR WATERTOWN ARSENAL, MASS.

Balls tested between hardened steel faces. Number of balls tested 3.

Nominal size.	Diameter of balls.	Required load.	Ultimate strength.
In.	*In.*	*Lb.*	*Lb.*
$\frac{1}{8}$	0.1242 to 0.1248	1,300	1,677
$\frac{1}{8}$	.1247 to .1251	1,300	3,698
$\frac{1}{4}$	.2503	5,200	5,529

TEST 14955.

TENSILE TESTS OF STEEL SPECIMENS TAKEN FROM BROKEN RAIL FROM TRACK IN YARD OF WATERTOWN ARSENAL.

For location of specimens see photograph. Nos. 1 and 2 refer to specimens taken from head of rail, No. 3 specimens taken from junction of web and base of rail.

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.	
			Load.	Stress per square inch.	Load.	Stress per square inch.		
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*In.*	*P. ct.*
B 1	0.505	0.20	14,100	70,500	25,900	129,500	0.17	8.5
B 2	.505	.20	14,800	74,000	25,900	129,500	.24	12.0
B 3	.505	.20	14,100	70,500	26,000	130,000	.30	15.0
D 1	.505	.20	14,400	72,000	25,800	129,000	.24	12.0
D 2	.505	.20	14,000	70,000	25,700	128,500	.25	12.5
D 3	.505	.20	14,100	70,500	25,900	129,500	.29	14.5
F 2	.505	.20	15,100	75,500	26,100	130,500	.20	10.0
F 3	.505	.20	14,100	70,500	25,900	129,500	.30	15.0

Marks.	Elongation in inch sections.	Diameter at fracture.	Contraction of area.	Hardness.		Appearance of fracture.
				Brinell.	Shore scleroscope.	
	In. *In.*	*In.*	*P. ct.*			
B 1	0.09*, 0.08*	0.48	9.5	235	33.5	Fine granular.
B 2	.10, .14*	.46	16.9	255	33.0	Do.
B 3	.17*, .13	.44	24.0	248	32.5	Do.
D 1	.14*, .10	.47	13.3	248	33.5	Do.
D 2	.14*, .11	.46	16.9	241	32.0	Do.
D 3	.17*, .12	.44	24.0	241	33.0	Do.
F 2	.08, .12*	.47	13.3	248	33.0	Do.
F 3	.13, .17*	.44	24.0	241	32.0	Do.

TEST 14713.

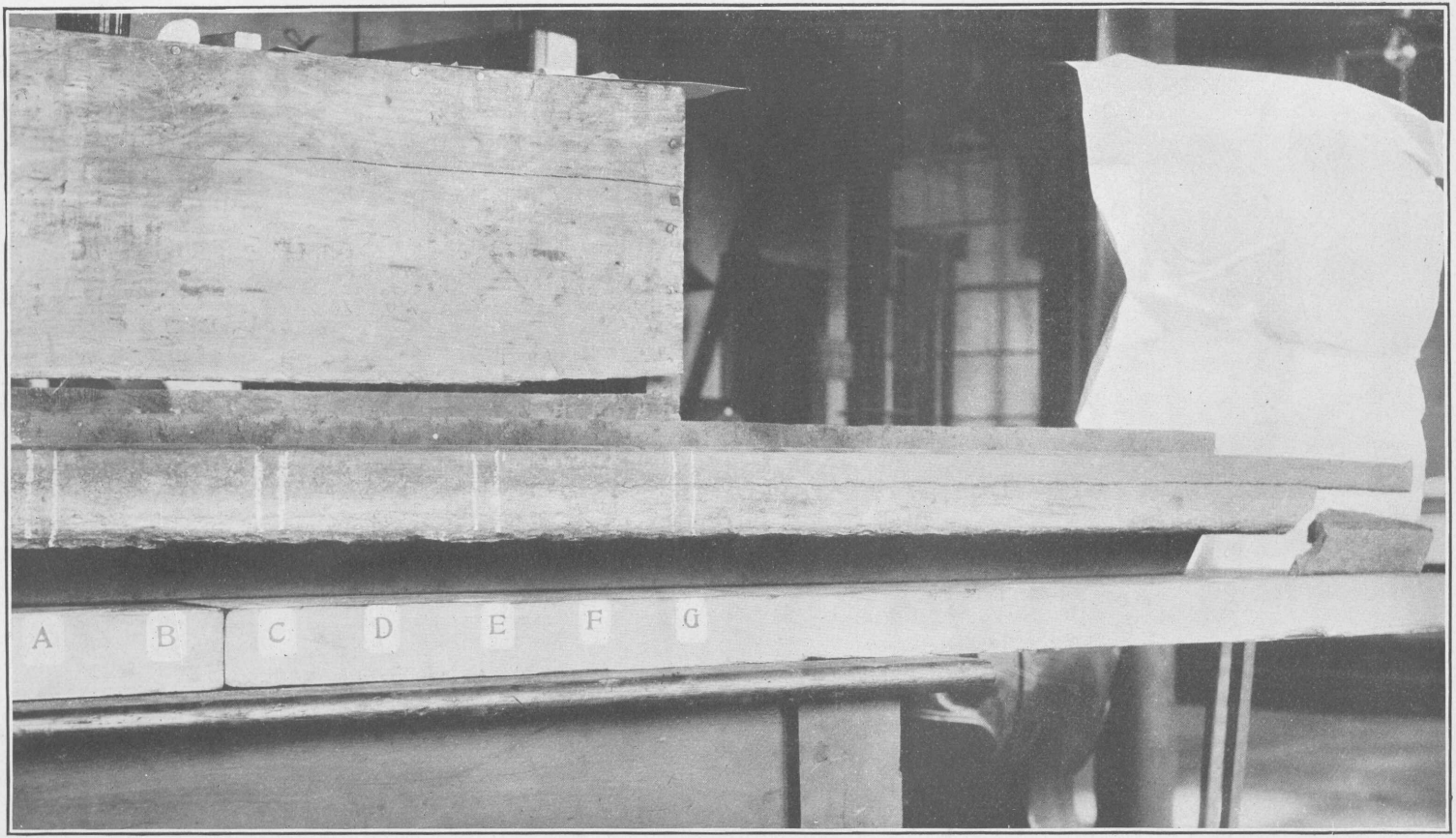
REPORT UPON THE STRENGTH OF TEETH IN PAWL AND RACK OF 14-IN. D. C., MODEL OF 1907.

A section of the rack was cut off about 14 in. long, and the width reduced to about that of the rack teeth. This piece of rack and pawl was then held in the gripping jaws of the testing machine.

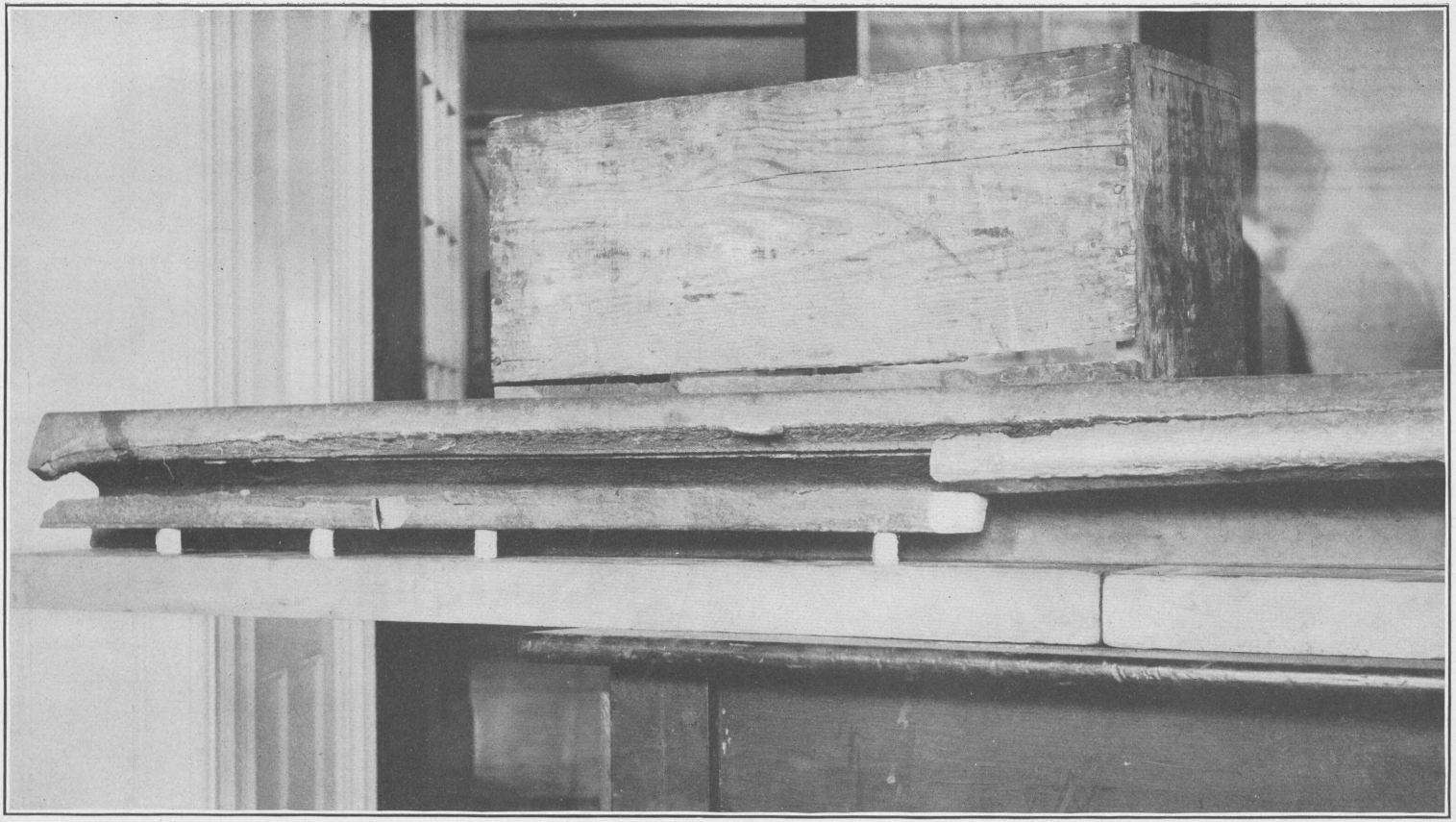
The teeth were engaged in the same relative position that they occupy in the carriage. The center line of the testing machine passed through the center of the pinhole in the pawl, and the center of the bearing surfaces of the engaged teeth.

The diagonal line in Photograph 1200–B was used as a guide in setting the pieces.

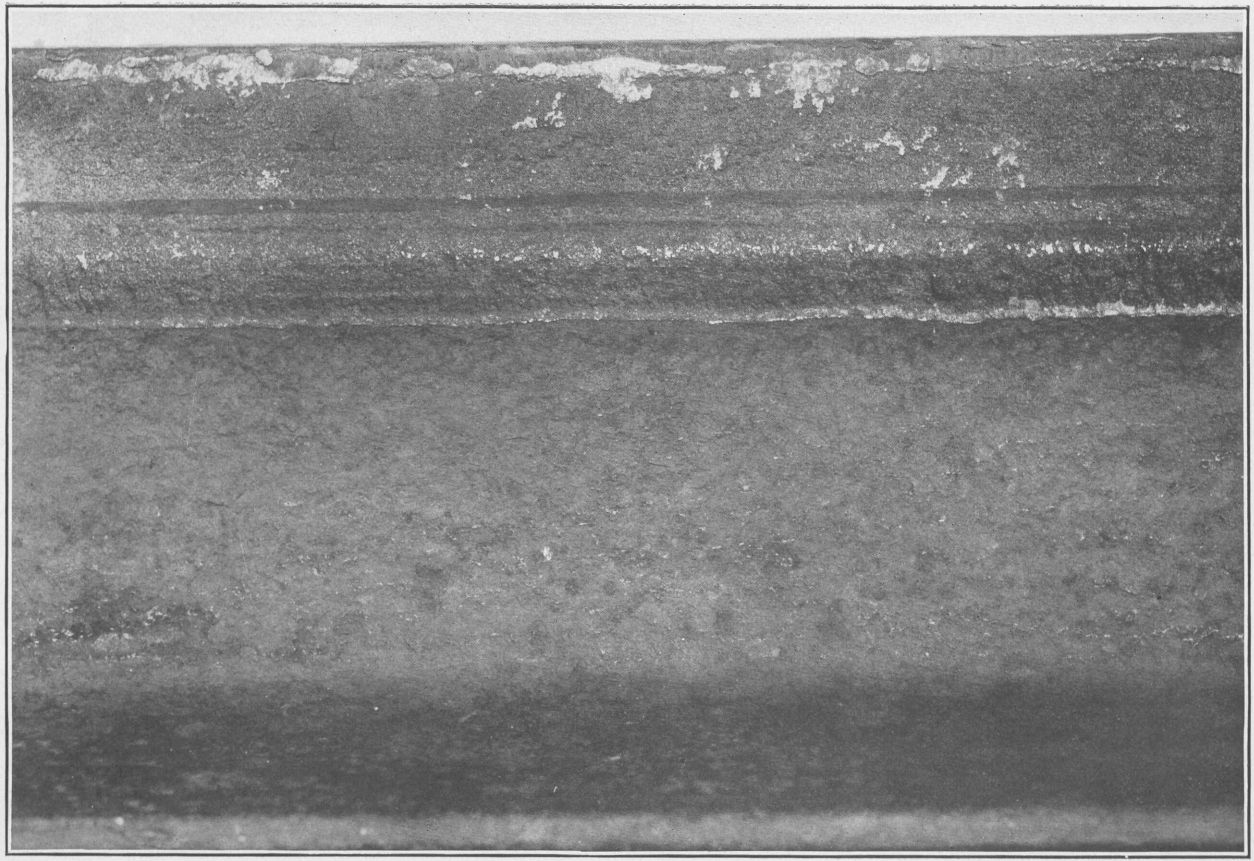
The load was applied gradually without noticeable effect until the teeth began to bend. The inclined surfaces which resulted caused the pawl and rack to separate about ¼ in., due chiefly to springing of the piston rod of the testing machine.



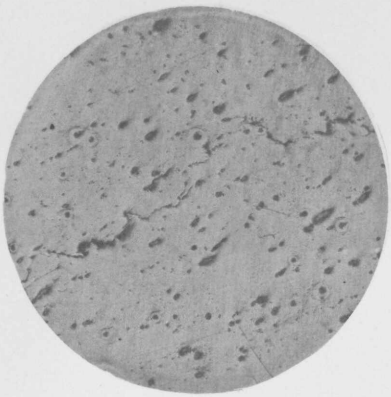
LOCATION OF TEST SPECIMENS.



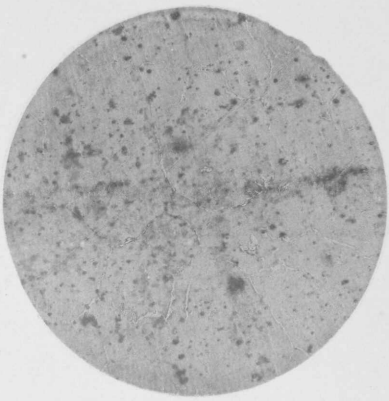
FRACTURED RAIL.



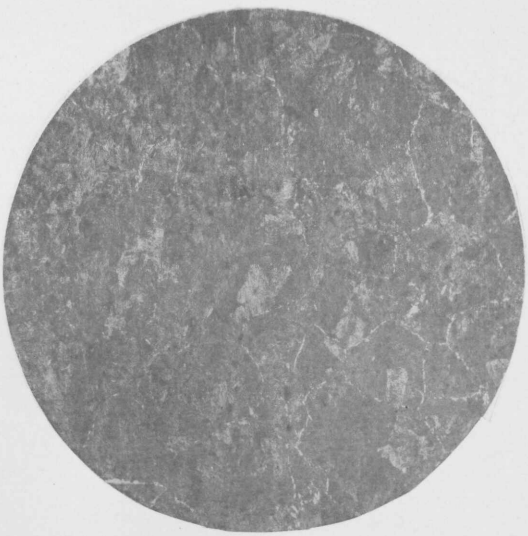
SHOWING SURFACE OF FRACTURE.



NO.1. SECTION A. UNETCHED. X50.



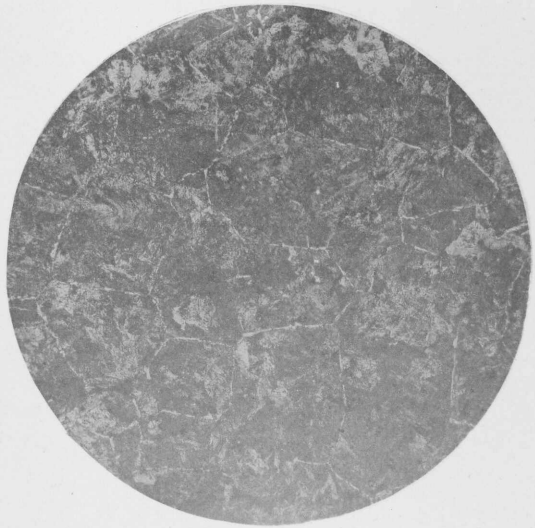
NO.2. SECTION E. UNETCHED. X50.



NO.3. SECTION A. ETCHED. X50.

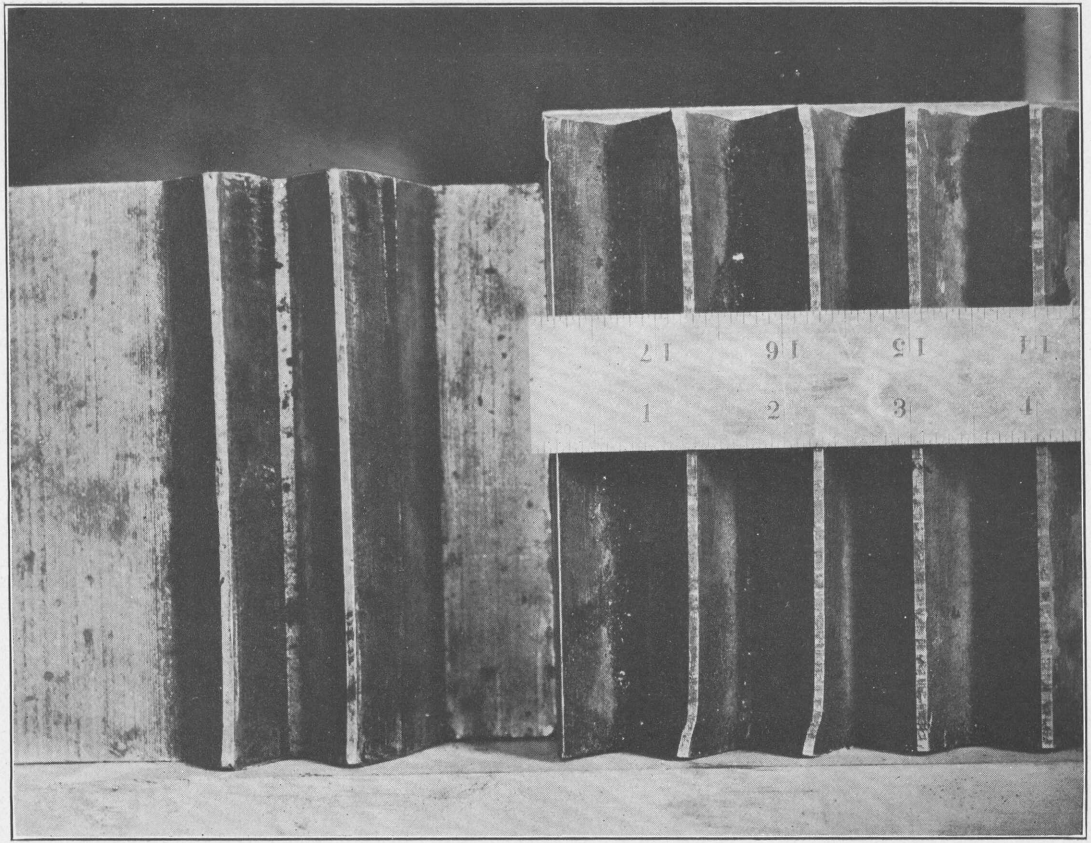


NO. 4. SECTION A. ETCHED. X 50.

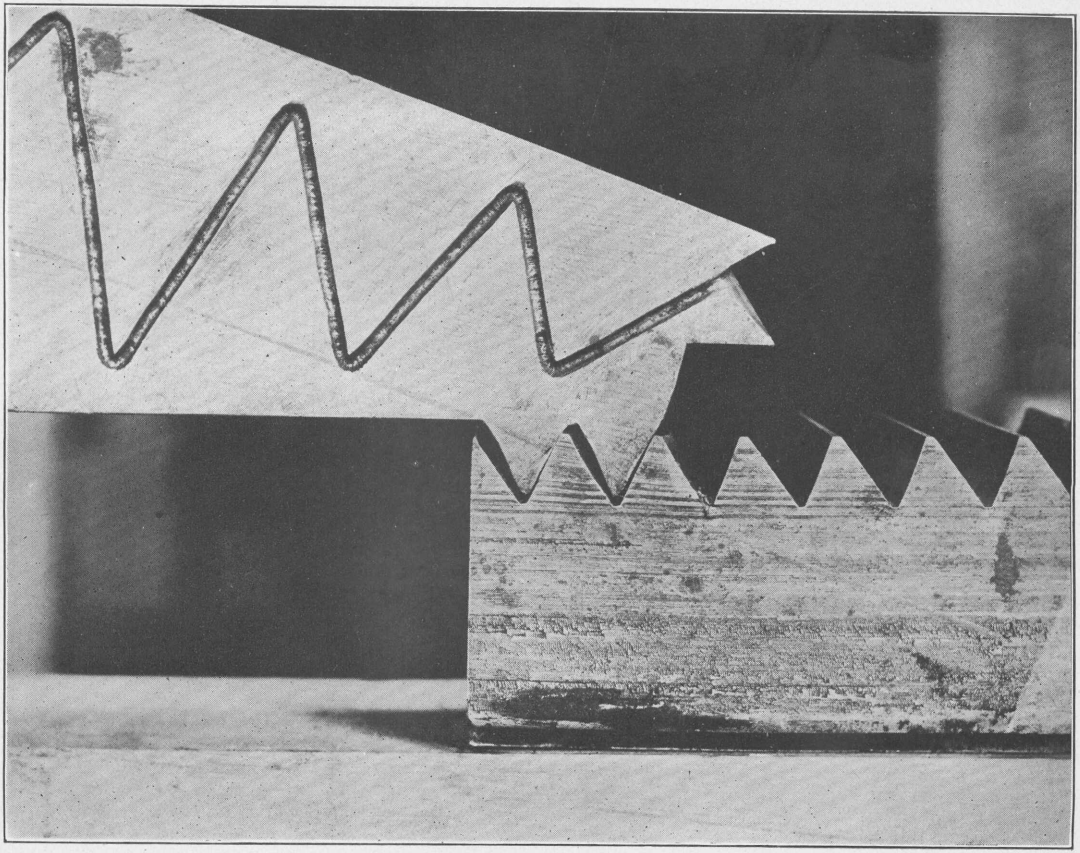


NO. 5. SECTION E. X 50.

HELIOTYPE CO., BOSTON



PHOTOGRAPH 1201B.



PHOTOGRAPH 1200B.

A load of 324,000 lb. was reached, then the test discontinued. The teeth of the rack were displaced 0.23 in. at the points as shown by photograph 1201–B.

The deformation of the pawl teeth could not well be measured, but the photographs show it quite clearly, especially by the tool marks in 1200–B.

It is believed that the ultimate strength of these teeth was reached. To cause greater deformation in the carriage it would be necessary to lock the pawl into its engaged position.

TEST 14735.

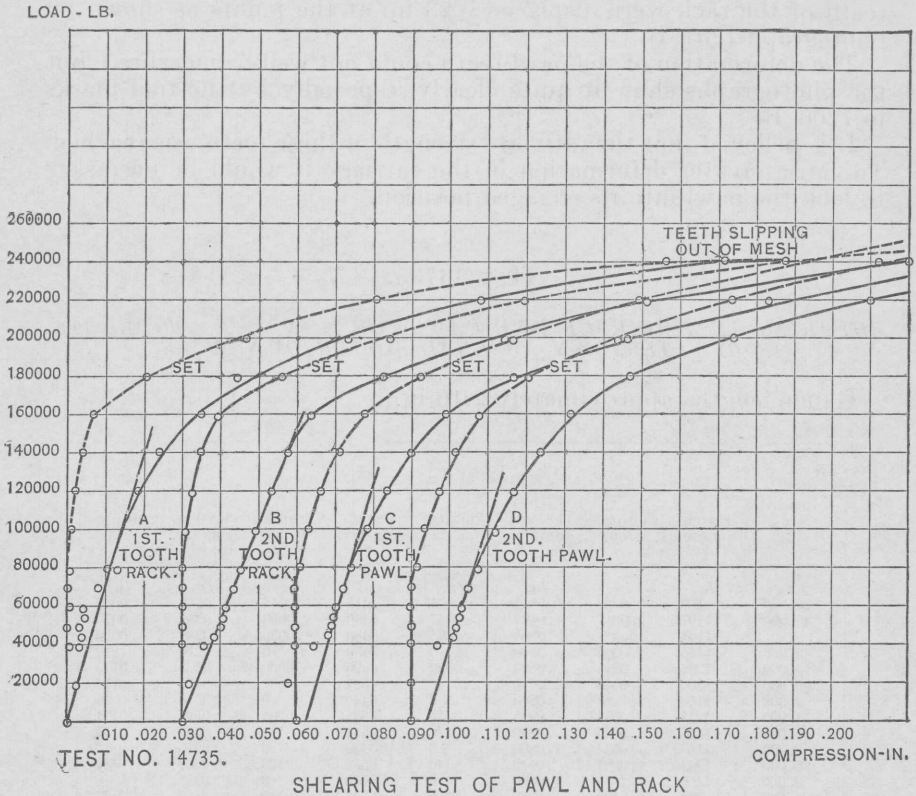
SHEARING TEST OF RACK AND PAWL FOR 14-IN. D. C., MODEL 1907, FOR WATERTOWN ARSENAL, WATERTOWN, MASS.

Gauge lengths approximately 2.10 in.

Load.	A.		B.		C.		D.	
	Extensometer.	Compression.	Extensometer.	Compression.	Extensometer.	Compression.	Extensometer.	Compression.
Lb.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
20,000	0.1189	0.0029	0.0821	0.0021	0.0415	−0.0015	0.0218	0.0008
40,000	.1197	.0037	.0867	.0067	.0480	.0050	.0280	.0070
	.1198	.0038	.0865	.0065	.0480	.0050	.0280	.0070
2,000	.1165	.0005	.0800	0	.0430	0	.0210	0
45,000	.1200	.0040	.0892	.0092	.0520	.0090	.0325	.0115
50,000	.1200	.0040	.0910	.0110	.0527	.0097	.0332	.0122
2,000	.1160	0	.0800	0	.0430	0	.0210	0
55,000	.1211	.0051	.0915	.0115	.0538	.0108	.0341	.0131
60,000	.1205	.0045	.0920	.0120	.0541	.0111	.0349	.0139
2,000	.1163	.0003	.0800	0	.0430	0	.0210	0
70,000	.1241	.0081	.0940	.0140	.0559	.0129	.0362	.0152
2,000	.1160	0	.0800	0	.0430	0	.0210	0
80,000	.1268	.0108	.0960	.0160	.0580	.0150	.0387	.0177
	.1298	.0138						
2,000	.1168	.0008	.0802	.0002	.0442	.0012	.0222	.0012
100,000	.1308	.0148	.0997	.0197	.0620	.0190	.0432	.0222
2,000	.1168	.0008	.0812	.0012	.0446	.0036	.0250	.0040
120,000	.1349	.0189	.1039	.0239	.0670	.0240	.0485	.0275
2,000	.1182	.0022	.0832	.0032	.0500	.0070	.0287	.0077
140,000	.1402	.0242	.1085	.0285	.0732	.0302	.0550	.0340
2,000	.1200	.0040	.0860	.0060	.0542	.0112	.0330	[1].0120
	.1200	.0040	.0852	.0052	.0530	.0100	.0327	.0117
160,000	.1465	.0305	.1143	.0343	.0825	.0395	.0633	.0423
2,000	.1230	.0070	.0900	.0100	.0610	.0180	.0393	.0183
180,000	.1610	.0450	.1330	.0530	.1000	.0570	.0786	.0576
2,000	.1370	.0210	.1065	.0265	.0757	.0327	.0520	.0310
200,000	.1900	.0740	.1645	.0845	.1298	.0868	.1060	.0850
2,000	.1630	.0470	.1350	.0550	.1000	.0570	.0750	.0540
220,000	.2245	.1085	.2020	.1220	.1667	.1237	.1410	.1200
2,000	.1975	.0815	.1700	.0900	.1330	.0900	.1050	.0840
240,000	.2880	.1720	.2710	.1910	.2110	.1680	.1700	[2].1490
2,000	.2730	.1570	.2380	.1580	.1770	.1340	.1440	.1230

[1] Specimens rested one hour under initial load.
[2] Teeth slipped out of mesh showing an opening of 0.15 in.

NOTE.—A is the distance from a fixed point on the rack to a point on the 1st tooth of the rack measured parallel to the direction of the load. Similarly B is the distance to the point of the second tooth and C and D are similar distances measured on the 1st and 2d teeth of the pawl.



SHEARING TEST OF PAWL AND RACK
14-IN. D. C. CARRIAGE, MODEL OF 1907.

HOLLOW-DECK STANCHIONS.

TEST 14715.

TENSILE TESTS ON 5-IN. HOLLOW DECK STANCHIONS, ¼-IN. WALLS, FOR NEW YORK NAVY YARD, NEW YORK.

Stanchions 6 ft. 6 in. in length, fitted with drop forged heads and heels.

No.	Manner of fastening head and foot.	Tensile strength.	Manner of failure.
		Lb.	
1	Special fitting	43,000	Fractured the pipe or tubing in thread, at edge of head or foot, 1¾ in. from end.
2	do	56,900	Do.
3	Screwed on taper thread	118,000	Sheared the thread. At 117,000 lb. threads begin to come out.
4	do	107,900	Bent the head or foot and sheared the thread.
5	Shrunk on and riveted	162,200	Sheared two rivets and split the pipe or tubing longitudinally at the two rivet holes.
6	Screwed on parallel thread	163,100	Fractured the pipe or tubing 5¾ in. from end.
7	Shrunk on	107,000	Drew head ½ in. and foot ⅜ in. from pipe or tubing.
8	do	120,400	Drew head or foot 4¼ in. from pipe or tubing. Carried away portion of tubing.
9	Screwed on parallel thread	197,900	Fractured the pipe or tubing 5¾ in. from end. Diameter of tubing after fracture, outside 5 in., inside 4.25 in., ⅜ in. thick.
10	Shrunk on and riveted	175,200	Sheared one rivet and split the pipe or tubing longitudinally at the two rivet holes.
11	Welded	221,600	Fractured the pipe or tubing 13 in. from end. Diameter of tubing at point of fracture, outside 4.75 in., inside 4.15 inches.
12	do	209,200	Fractured the pipe or tubing 13 in. from end. Elongation of tubing measured on two gauged lengths including $\frac{1}{10}$-in. opening at fracture as follows:
			After fracture....84.20 in. 78.30 in.
			Before fracture....80.35 in. 74.45 in.
			Elongation.... 3.85 in. 3.85 in.

Sharp snapping sounds occurred at the following loads: 66,900 lb., 78,000 lb., and 81,100 lb.

STEEL SPECIMENS FOR COMPARISON OF TESTING MACHINES.

TEST 14717.

TENSILE TESTS OF THREE STEEL SPECIMENS FOR SPRINGFIELD ARMORY, SPRINGFIELD, MASS.

For standardizing testing machine at armory with large machine at Watertown Arsenal.

[Inch section in which fracture occurred is marked thus *.]

Diameter.	Sectional area.	Elastic limit.		Tensile strength.	
		Load.	Stress per square inch.	Load.	Stress per square inch.
In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0.505	0.20	12,600	63,000	19,900	99,500
.505	.20	14,400	72,000	21,100	105,500
.505	.20	13,100	65,500	20,200	101,000

Elongation in 2 inches.		Elongation of inch sections.	Diameter at fracture.	Contraction of area.	Appearance of fracture.
In.	*P. ct.*	*In.* *In.*	*In.*	*P. ct.*	
0.55	27.5	0.17, 0.38*	0.32	59.8	Fine silky; cup shaped.
.51	25.5	.12, .39*	.32	59.8	Fine silky.
.56	28.0	.19, .37*	.34	54.6	Do.

TEST 14733.

TENSILE TESTS OF FIVE STEEL SPECIMENS FOR CALIBRATION OF THE EMERY TESTING MACHINE, BETHLEHEM STEEL CO.

Steel specimens taken from bar of forged steel (either No. 1 or No. 2), furnished by the Bethlehem Steel Co. Tested on 800,000-lb. machine.

[Inch section in which fracture occurred is marked thus *.]

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.	
			Load.	Stress per square inch.	Load.	Stress per square inch.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
D 2676– 2	0.5048	0.20014	7,400	36,974	13,822	69,062
D 2676– 4	.5048	.20014	7,400	36,974	13,750	68,703
D 2676– 6	.5050	.20030	7,400	36,944	13,740	68,597
D 2676– 8	.5050	.20030	7,400	36,944	13,755	68,672
D 2676–10	.5051	.20038	7,500	37,430	13,810	68,920

Marks.	Elongation in 2 inches.		Elongations inch sections.		Diameter at fracture.	Contraction of area.	Appearance of fracture.
	In.	*P. ct.*	*In.*	*In.*	*In.*	*P. ct.*	
D 2676– 2	0.75	37.5	0.29,	0.46*	0.31	62.29	Fine silky.
D 2676– 4	.74	37.0	.44,*	.30	.30	64.68	Fine silky; cup shaped.
D 2676– 6	.76	38.0	.34,	.42*	.31	62.32	Fine silky.
D 2676– 8	.74	37.0	.49,*	.25	.30	64.71	Do.
D 2676–10	.76	38.0	.43,*	.33	.30	64.72	Do.

TEST 14823.

TENSILE TEST OF STEEL SPECIMENS FOR CALIBRATING EMERY-TESTING MACHINE AT SOUTH BETHLEHEM, PA., FOR W. D. GREETHAM, UNITED STATES NAVY, INSPECTOR OF ORDNANCE.

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.	
			Load.	Stress per square inch.	Load.	Stress per square inch.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Z 2768	0.5052	0.20043	8,400	41,910	13,500	67,358
Z 2784	.5052	.20043	11,700	58,379	21,400	106,760

Marks.	Elongation in 2 inches.		Elongation of inch sections.		Diameter at fracture.	Contraction of area.	Appearance of fracture.
	In.	*P. ct.*	*In.*	*In.*	*In.*	*P. ct.*	
Z 2768	0.74	37.0	0.34,	0.40	0.32	59.8	Fine silky.
Z 2784	.44	22.0	.21	.23	.39	40.3	Silky.

TEST 14823.

TENSILE TEST OF STEEL SPECIMENS FOR CALIBRATION OF EMERY-TESTING MACHINE AT SOUTH BETHLEHEM, PA., FOR W. D. GREETHAM, UNITED STATES NAVY, INSPECTOR OF ORDNANCE.

Marks, Z 2764.
Diameter, 0.5047 in.
Sectional area, 0.20012 sq. in.
Gauged length, 2 in.

Applied loads.		Elongations.		Remarks.
Load.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,020	5,094	0.	0.	
2,040	10,194	.0003	.00015	
5,100	25,485	.0014	.00070	
6,120	30,581	.0018	.00090	
6,324	31,601	.0020	.00100	
6,528	32,620	.0021	.00105	
6,732	33,640	.0022	.00108	
6,936	34,660	.0022	.00110	
7,140	35,679	.0023	.00115	
7,344	36,698	.0025	.00123	
7,548	37,720	.0025	.00125	
7,752	38,736	.0026	.00130	
7,956	39,755	.0028	.00138	Elastic limit.
8,160	40,778	.0345	.01725	
8,364	41,795	.0362	.01810	
8,568	42,812	.0387	.01935	
13,566	67,789	.....	.....	Tensile strength.

Elongation of inch sections, 0.36, 0.35 in.
Elongation after fracture, 0.71 in. = 35.5 per cent.
Diameter at fracture, 0.32 in.
Contraction of area, 59.8 per cent.
Position of fracture, at the middle.
Appearance of fracture, fine silky; cup shaped.

TEST 14823.

Marks, Z 2773.
Diameter, 0.5052 in.
Sectional area, 0.20044 sq. in.
Gauged length, 2 in.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,020	5,089	0.	0.	
2,040	10,179	.0002	.00008	
5,100	25,446	.0009	.00045	
6,120	30,533	.0013	.00065	
6,324	31,552	.0014	.00070	
6,528	32,707	.0015	.00075	
6,732	33,590	.0016	.00080	
6,936	34,605	.0017	.00083	
7,140	35,622	.0018	.00088	
7,344	36,640	.0018	.00090	
7,548	37,660	.0019	.00095	
7,752	38,675	.0020	.00100	
7,956	39,695	.0021	.00105	
8,160	40,715	.0022	.00108	
8,364	41,730	.0023	.00115	
8,568	42,750	.0025	.00123	Elastic limit.
8,670	43,258	.0042	.00210	
8,772	43,763	.0456	.02280	
8,976	44,782	.0469	.02345	
13,668	68,193	.....	.....	Tensile strength

Elongation after fracture, 0.71 in. in 2 in. = 35.5 per cent.
Elongation of inch sections, 0.49,* 0.22 in.
Diameter at fracture, 0.32 in.
Contraction of area, 59.8 per cent.
Position of fracture, 1.25 in. from the neck.
Appearance of fracture, fine silky; cup shaped.

TEST 14823.

Marks, Z 2780.
Diameter, 0.5050 in.
Sectional area, 0.20030 sq. in.
Gauged length, 2 in.

Applied loads.		Elongations.		Remarks.
Total.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,020	5,092	0.	0.	
2,040	10,185	.0004	.00020	
6,120	30,555	.0019	.00095	
8,160	40,740	.0026	.00130	
9,180	45,834	.0030	.00150	
9,384	46,852	.0031	.00155	
9,588	47,870	.0032	.00160	
9,792	48,890	.0033	.00165	
9,996	49,910	.0034	.00170	
10,200	50,923	.0035	.00175	
10,403	51,940	.0036	.00180	
10,608	52,960	.0037	.00183	
10,812	53,980	.0038	.00188	
11,016	55,000	.0039	.00195	
11,220	56,019	.0040	.00200	
11,424	57,041	.0041	.00203	
11,628	58,059	.0042	.00210	
11,830	59,064	.0044	.00220	Elastic limit.
12,036	60,710	.0167	.00835	
12,240	61,110	.0172	.00860	
21,521	107,450	.....	.....	Tensile strength.

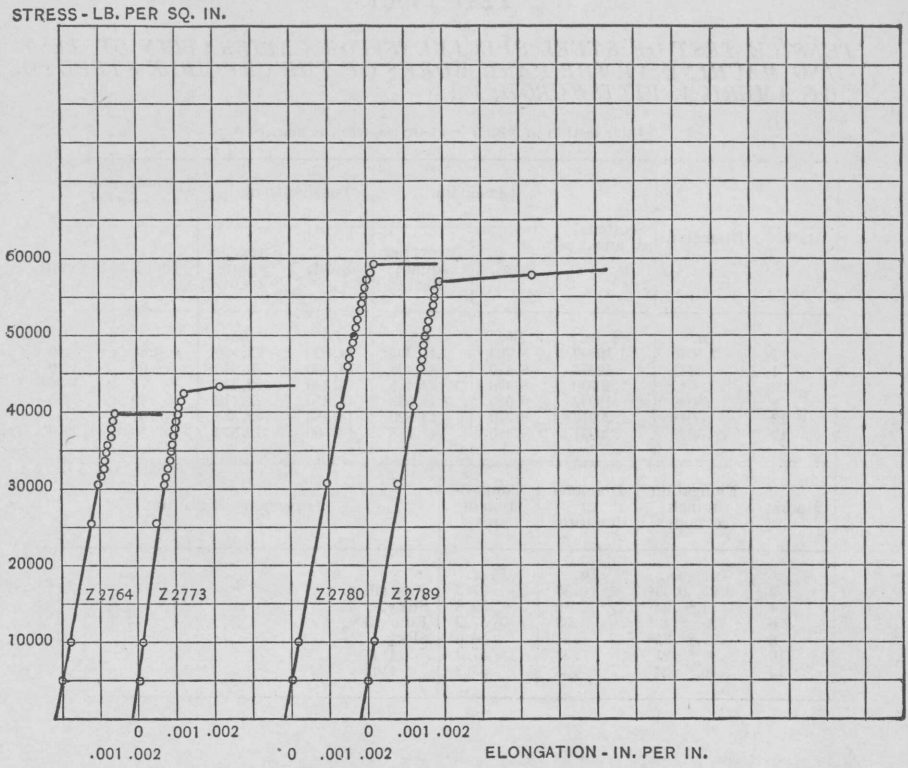
Elongation after fracture, 0.44 in. in 2 in. = 22 per cent.
Elongation of inch sections, 0.29,* 0.15 in.
Diameter at fracture, 0.39 in.
Contraction of area, 40.3 per cent.
Position of fracture, 1 in. from the neck.
Appearance of fracture, silky.

TEST 14823.

Marks, Z 2789.
Diameter, 0.5053 in.
Sectional area, 0.20060 sq. in.
Gauged length, 2 in.

Applied loads.		Elongations.		Remarks.
Load.	Per square inch.	In 2 inches.	Per inch.	
Lb.	*Lb.*	*In.*	*In.*	
1,020	5,085	0.	0.	
2,040	10,170	.0003	.00015	
6,120	30,510	.0016	.00080	
8,160	40,682	.0024	.00120	
9,180	45,768	.0028	.00140	
9,384	46,780	.0029	.00145	
9,588	47,800	.0030	.00148	
9,792	48,820	.0030	.00150	
9,996	49,836	.0031	.00155	
10,200	50,850	.0032	.00160	
10,403	51,870	.0033	.00163	
10,608	52,890	.0034	.00170	
10,812	53,900	.0035	.00175	
11,016	54,920	.0036	.00178	
11,220	55,935	.0036	.00180	
11,424	56,960	.0038	.00190	Elastic limit.
11,576	57,710	.0087	.00435	
11,830	58,950	.0140	.00700	
12,036	60,010	.0149	.00745	
12,240	61,020	.0163	.00815	
21,622	107,690	.....	.....	Tensile strength.

Elongation after fracture, 0.45 in. in 2 in. = 22.5 per cent.
Elongation of inch sections, 0.19, 0.26* in.
Diameter at fracture, 0.39 in.
Contraction of area, 40.3 per cent.
Position of fracture, 1.25 in. from the neck.
Appearance of fracture, silky.



TEST NO. 14823.

TENSILE TEST OF STEEL SPECIMEN
FOR INSPECTOR OF ORDNANCE U.S.N. AT SO. BETHLEHEM, PENN.

TEST 14861.

TENSILE TEST OF STEEL SPECIMENS FOR CALIBRATION OF TESTING MACHINE AT THE PARK WORKS OF THE CRUCIBLE STEEL CO. OF AMERICA, PITTSBURGH, PA.

[Inch section in which fracture occurred is marked *.]

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.	
			Load.	Stress per square inch.	Load.	Stress per square inch.	Inch.	Per cent.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*		
2	0.5046	0.19999	8,260	41,302	14,590	72,960	0.68	34.0
4	.5043	.19974	8,470	42,408	14,590	73,046	.68	34.0
6	.5045	.19990	8,470	42,418	14,480	72,440	.72	36.0
8	.5039	.19942	9,080	45,532	14,380	72,110	.69	34.5
10	.5048	.20013	8,770	43,820	14,480	72,355	.67	33.5
12	.5049	.20021	8,360	41,758	14,590	72,872	.70	35.0

Marks.	Elongation in inch sections.	Diameter at fracture.	Contraction of area.	Appearance of fracture.
	In. *In.*	*In.*	*P. ct.*	
2	0.25, 0.43*	0.33	57.2	Fine silky.
4	.44,* .24	.32	59.8	Silky.
6	.29, .43*	.33	57.2	Fine silky.
8	.37,* .32*	.34	54.6	Silky.
10	.46,* .21	.33	57.2	Do.
12	.46,* .24	.33	57.2	Do.

TEST 14947.

TENSILE TEST OF SIX STEEL SPECIMENS FOR TITUSVILLE FORGE CO., TITUSVILLE, PA.

These six specimens are in connection with the standardizing of the new Riehlé 150,000-lb. testing machine at the Titusville Forge Co., Titusville, Pa.

[Inch section in which fracture occurred is marked thus *.]

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.	
			Load.	Stress per square inch.	Load.	Stress per square inch.	Inch.	Per cent.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*		
2	0.5040	0.19951	13,770	69,024	16,116	80,775	0.39	19.5
4	.5049	.20023	13,872	69,280	16,116	80,480	.39	19.5
6	.5039	.19942	13,770	69,045	16,014	80,310	.39	19.5
8	.5045	.19990	13,566	67,862	16,116	80,625	.40	20.0
10	.5049	.20023	13,668	68,262	16,014	79,980	.40	20.0
12	.5044	.19980	13,770	68,920	16,014	80,160	.40	20.0

Marks.	Elongation in inch sections.		Diameter at fracture.	Contraction of area.	Hardness.		Appearance of fracture.
					Brinell method.	Shore scleroscope.	
	In.	*In.*	*In.*	*P. ct.*			
2	0.30,*	0.09	.33	57.1	166	29.0	Fine silky; cup shaped.
4	.30,*	.09	.32	59.8	163	28.5	Fine silky.
6	.30,*	.09	.32	59.6	163	30.0	Do.
8	.32,*	.08	.32	59.7	163	28.0	Do.
10	.09	.31*	.32	59.8	163	29.0	Do.
12	.27,*	.13	.32	59.7	163	29.0	Do.

Elastic limit not well defined.

TEST 14949.

TENSILE TESTS OF THREE STEEL SPECIMENS FOR BUILDERS IRON FOUNDRY, PROVIDENCE, R. I.

For use in calibrating testing machines at their works and at Brown University, in connection with Builders Iron Foundry contract for 12-in. M. C., Model 1896 M111.

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.	
			Load.	Stress per square inch.	Load.	Stress per square inch.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	0.7973	0.49938	21,930	43,915	37,128	74,324
3	.7982	.50020	23,154	46,290	36,800	73,540
5	.7981	.50012	23,562	47,115	36,414	72,808

Elongation in 8 inches.		Diameter at fracture.	Contraction of area.	Hardness.		Appearance of fracture.
Inches.	Per cent.			Brinell method.	Shore method.	
		In.	*P. ct.*			
2.06	25.75	0.57	48.9	118	29.0	Fine silky.
1.95	24.37	.59	45.3	126	28.0	Do.
1.97	24.62	.58	47.2	118	28.5	Fine silky; cup shaped.

CORDAGE—MANILA ROPE—STEEL WIRE ROPE.

TEST 14697.

TENSILE TESTS OF SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL.

Samples prepared for testing with eye splices at the ends. Splices wet 7 hours before testing. Length between splices, 5 to 6 feet.

From bale No.	Nominal circumference.	Actual—		Sectional area.	Tensile strength.	
		Circumference.	Diameter.		Load.	Stress per square inch.
	In.	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*
1	8.00	8.90	2.90	6.61	48,400	7,320
2	8.00	9.10	2.87	6.47	44,500	6,880
3	8.00	9.00	2.95	6.83	43.700	6,400
4	8.00	8.95	2.90	6.61	45,100	6,820

From bale No.	Length of sample.	Weight of sample.	Breaking length.[1]	Parted.
	Ft. in.	*Lb.*	*Ft.*	
1	17 10	34	25,300	1 strand at the splice.
2	18 4	34	24,000	Do.
3	18 1	34	23,200	Do.
4	17 11	33	24,300	Do.

[1] The "breaking length" is a term which is in use in Germany in reference to material of which it is difficult to obtain the cross-sectional area accurately, such as paper, leather, rope, etc. It is the length in feet which a specimen must have in order to break of its own weight when suspended by one end, and is computed by dividing the ultimate tensile strength in pounds by the weight of the specimen in pounds per foot of length.

The merit of this determination lies in its definiteness and, in the case of material purchased by weight, in the fact that "loading" the material carries its own penalty.

TEST 14698.

ADDITIONAL TESTS ON MANILA ROPE.

No.	Nominal—		Actual—		Sectional area.	Tensile strength.	
	Diameter.	Circumference.	Diameter.	Circumference.		Load.	Stress per square inch.
	In.	*In.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Sq. in.*
1	$\frac{3}{8}$	.....	0.37	1.35	0.108	1,220	11,300
2	.....	5.00	1.80	5.65	2.54	22,100	8,700
3	.....	11.00	3.85	11.85	11.64	71,300	6,130

No.	Length of sample.	Weight of sample.	Breaking length.	Parted.
	Ft. in.	*Lb.*	*Ft.*	
1	17 9	$\frac{3}{4}$	28,900	1 strand 17 in. from the splice.
2	18 4	14	28,900	1 strand at the splice.
3	18 4	65	20,100	Do.

TEST 14699.

TENSILE TEST OF ONE SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wet 7 hours before testing. Length between splices about 6 feet.

Actual.		Sectional area.	Tensile strength.		Length of sample.	Weight of sample.	Breaking length.	Parted.
Circumference.	Diameter.		Load.	Stress per square inch.				
In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*	*Ft.*	*Lb.*	*Ft.*	
9.90	3.20	8.04	49,800	6,200	19	46	20,600	1 strand at middle of length.

TEST 14716.

TENSILE TEST OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Rope received on P. O. 9427.

Length, circumference, and diameter taken while under stress of 2,600-pound tension. Circumference and diameter taken at three places.

	Circumference.	Diameter.
	In.	*In.*
North end	10.85	3.45, 3.42 3.47, 3.35
Center	10.90	3,34, 3.35
South end	10.90	3.36, 3.48

Sample prepared for testing with eye splices at the ends.
Length between ends of splices: 3 ft. 9 in.
Length from inside to inside of eyes: 6 ft. 7 in.
Splices wet 15½ hours before testing.

Nominal circumference.	Average.		Sectional area.	Length of sample.	Weight of sample.	Breaking length.	Tensile strength.		Parted.
	Circumference.	Diameter.					Load.	Stress per square inch.	
In.	*In.*	*In.*	*Sq. in.*	*Ft. In.*	*Lb. oz.*	*Ft.*	*Lb.*	*Lb.*	
11	11.85	3.85	11.64	18 10	65 12	20,750	73,500	6,320	1 strand at first tuck.

TEST 14719.

TENSILE TEST OF ONE SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wetted seven hours before testing. Length between splices, 6 ft. 4½ in.

Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Load.	Tensile strength per square inch.	Parted.
Ft. In. 19 5	*Lb.* 17	*Ft.* 27,754	*In.* 6.05	*In.* 1.94 to 2	*Sq. in.* 2.96	*Lb.* 24,300	*Lb.* 8,209	1 strand 17 in. from end of splice.

TEST 14769.

TENSILE TESTS OF SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, WATERTOWN, MASS.

Prepared for testing with eye splices at the ends. Splices wetted 2½ to 4½ hours before testing. Length between splices, 6 ft. 3 in.

P. O. No.	Length of sample.	Weight of sample.	Breaking length.	Nominal circumference.	Average.	
					Circumference.	Diameter.
	Ft. In.	*Lb. oz.*	*Lb.*	*In.*	*In.*	*In.*
492 (bale 1)	18 4	3 5	34,800	2½	2.60	0.85
492 (bale 2)	18 9	3 5½	37,600	2½	2.68	.85
621 (bale 1)	18 1	3 2	36,400	2½	2.70	.85
621 (bale 2)	18 3	3 4	37,000	2½	2.70	.85
492	18 7	4 2	37,800	3	3.20	1.08
524	18 5	4 13½	33,800	3	3.20	1.08
492 (bale 1)	18 1	13 0	34,600	5	5.60	1.79
492 (bale 2)	19 2	13 10	36,400	5	5.65	1.83
492 (bale 3)	18 8	13 0	36,000	5	5.85	1.86

P. O. No.	Sectional area.	Tensile strength.		Parted.
		Load.	Stress per square inch.	
	Sq. in.	*Lb.*	*Lb.*	
492 (bale 1)	0.567	6,300	11,100	1 strand 8 in. from splice.
492 (bale 2)	.567	6,700	11,800	1 strand 22 in. from splice.
621 (bale 1)	.567	6,300	11,100	1 strand at the splice.
621 (bale 2)	.567	6,600	11,600	Do.
492	.916	8,400	9,170	2 strands at the middle.
524	.916	8,900	9,710	1 strand at the splice.
492 (bale 1)	2.51	24,900	9,920	1 strand at the middle.
492 (bale 2)	2.63	25,900	9,840	1 strand 8 in. from splice.
492 (bale 3)	2.71	25,100	9,260	1 strand 28 in. from splice.

TEST 14781.

TENSILE TESTS OF 11-IN. 3-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

The tests were for the purpose of determining the relative value of preparing the ends for testing.

Both samples were from the same coil of rope. One sample was prepared with eye splices at the ends. The splices of this sample were wet 17 hours before testing. The other sample was 10 ft. 6 in. long over all. The ends were bent around a diameter of 6 in. and brought back on the standing part of rope for a length of 42 in. and ends of rope knotted. The length between the inside of bend where the two parts of rope came together and the knots were parceled with 3-strand tarred hemp rope 0.63 in. diameter and 2.06 in. circumference; over this it was again served with 3-strand tarred hemp rope 0.36 in. diameter and 1.10 in. circumference. The entire sample was then wrapped around with strips of canvas 4 in. wide, the strips overlapping each other.

This sample was prepared at the Charlestown Navy Yard, Boston, Mass., and is said to be the Navy Department's method of preparing specimens of rope for test purposes.

Sample with eye splices at the ends:

Length of sample at 2,500-lb. tension, 10 ft.
Weight of sample, 35 lb. 8 oz.
Breaking length, 17,350 ft.
Nominal circumference, 11 in.
Average circumference, 11.70 in.
Average diameter, 3.85 in.
Sectional area, 11.64 sq. in.
Length between ends of splices, 24 in.
Tensile strength: 81,600 lb. = 7,010 lb. per sq. in.
Parted: 1 strand in the splice.

Sample prepared at Charlestown Navy Yard, with ends parceled and served:

Length of sample over all, 126 in.
Length at each end, parceled and served, 42 in.
Rope from same coil as spliced sample.
Sectional area, 11.64 sq. in.
At 66,200 lb. one end parceled and served, slipped.
Tensile strength: = 92,300 lb. = 7,920 lb. per sq. in.
Parted: 2 strands at back side of pin.

TEST 14831.

TENSILE TESTS OF THREE SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Samples prepared for testing with eye splices at the ends. Splices wet six hours before testing. Length between splices 5 ft. 7 in. to 6 ft. 6 in.

P. O.	Nominal size.	Length of sample.	Weight of sample.	Breaking length.	Circumference.
		Ft. in.	*Lb. oz.*	*Ft.*	*In.*
1486	¾ in. diameter.	18 00	00 13½	25,600	1.35
1457	6 in. circumference.....	17 11½	19 00	25,330	6.70
1457	8 in. circumference.....	17 11	34 00	18,380	9.00

Nominal size.	Diameter.	Sectional area.	Tensile strength.		Parted.
			Load.	Stress per square inch.	
	In.	*Sq. in.*	*Lb.*	*Lb.*	
¾ in. diameter..	0.43	0.145	1,200	8,270	1 strand 6 inches from end of splice.
6 in. circumference.	2.25	3.98	26,800	6,730	1 strand 17 inches from end of splice.
8 in. circumference.	2.93	6.74	34,900	5,170	1 strand 22 inches from end of splice.

REQUIREMENTS.

Rope 1 in. and over in diameter must have a tensile strength of not less than 7,000 lb. per sq. in.

Rope less than 1 in. in diameter must have a tensile strength of not less than 9,000 lb. per sq. in.

TEST 14846.

TENSILE TEST OF A SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wet 2½ hours before testing. Length between splices = 6 ft.

P. O.	Nominal size (circumference).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength.	
								Load.	Stress per square inch.
	In.	*Ft.*	*Lb. oz.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*
1617	3	18	4 8	30,000	3.07	1.04	0.849	7,500	8,840

PARTED.

P. O. 1617. 1 strand 13 in. from end of splice.

REQUIRED.

Rope 1 in. and over in diameter must have a tensile strength not less than 7,000 lb. per square inch.

TEST 14846.

TENSILE TESTS OF THREE SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Samples prepared for testing with eye splices at the ends. Splices wet 2½ hours before testing. Length between splices = 6 ft.

	P. O.	Nominal size.	Length of sample.	Weight of sample.	Breaking length.	Circumference.
			Ft. in.	*Oz.*	*Ft.*	*In.*
Bale 1..	1579	⅜-in. diameter.	18 3	12½	25,750	1.28
Bale 2..	1579	.....do.....	18 3	12	24,980	1.25
Bale 3..	1579	.....do.....	18 1	11	31,100	1.25

	P. O.	Diameter.	Sectional area.	Tensile strength.		Parted.
				Load.	Stress.	
		In.	*Sq. in.*	*Lb.*	*Lbs. per sq. in.*	
Bale 1..	1579	0.40	0.126	1,100	8,720	1 strand, 21 in. from end of splice.
Bale 2..	1579	.39	.119	1,025	8,610	1 strand, 12 in. from end of splice.
Bale 3..	1579	.40	.126	1,180	9,360	1 strand, 33 in. from end of splice.

REQUIRED.

Rope 1 in. and over in diameter must have tensile strength not less than 7,000 lb. per sq. in., and rope less than 1 in. diameter not less than 9,000 lb. per sq. in. in tensile strength.

TEST 14853.

TENSILE TESTS OF A SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wet 4½ hours before testing. Length between splices = 6 ft.

P. O.	Nominal size (circumference).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength (required, 7,000 pounds).		Parted.
								Load.	Stress.	
	In.	*Ft. in.*	*Lb.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lbs. per sq. in.*	
1457	8	17 9	34	19,270	9	3	7.07	36,900	5,220	1 strand 10 in. from end of splice.

TEST 14853.

TENSILE TESTS OF SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Specimens prepared for testing with eye splices at the ends. Splices were wet 4½ hours before testing. Length between splices, 6 ft.

	P. O.	Nominal size (circumference).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength (required, 7,000 lbs.).		Parted.
									Load.	Stress per square inch.	
		In.	*Ft. in.*	*Lb.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*	
1	1,683	8	18 1	35	22,600	8.85	2.90	6.60	43,800	6,640	1 strand in the splice.
2	1,683	8	17 9	33	18,350	8.85	2.90	6.60	34,100	5,170	1 strand 7 in. from end of splice.

TEST 14880.

TENSILE TESTS OF SAMPLES OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Samples prepared for testing with eye splices at the ends. Splices wet 4½ hours before testing. Length between splices, 6 ft.

	P. O.	Nominal size (circumference).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength (required, 7,000 lbs.). Load.	Tensile strength (required, 7,000 lbs.). Stress per square inch.	Parted.
		In.	*Ft. in.*	*Lb.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*	
1	1,745	8	18	36	23,550	8.75	2.92	6.70	47,100	7,029	1 strand 14 in. from end of splice.
2	1,745	8	17 10	35	20,120	8.95	2.95	6.83	39,500	5,783	1 strand 25 in. from end of splice.

TEST 14906.

TENSILE TEST OF SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wet 15 hours before testing. Length between splices, 6 feet.

P. O.	Nominal size (diameter).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength (required, 7,000 pounds). Load.	Tensile strength (required, 7,000 pounds). Stress per square inch.	Parted.
	In.	*Ft. in.*	*Lb.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*	
1457	2⅞	18 3	36	26,000	9.02	2.98	6.97	51,300	7,360	1 strand 12 in. from end of splice complies with the requirements.

TEST 14936.

TENSILE TEST OF SAMPLE OF THREE-STRAND MANILA ROPE FOR WATERTOWN ARSENAL, MASS.

Sample prepared for testing with eye splices at the ends. Splices wet 3½ hours before testing. Length between splices, 6 feet.

P. O.	Nominal size (diameter).	Length of sample.	Weight of sample.	Breaking length.	Circumference.	Diameter.	Sectional area.	Tensile strength.			Parted.
								Load.	Required.	Results.	
									Stress per square inch not less than—	Stress per square inch.	
	In.	*Ft. in.*	*Lb.*	*Ft.*	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	
1683	2⅜	18 5	34	31,500	9.00	2.97	6.93	58,300	7,000	8,412	One strand 18 in. from end of splice.
1457	2⅜	18 7	38	26,300	9.10	2.99	7.02	53,900	7,000	7,678	Do.

TEST 14784.

TENSILE TEST OF A PIECE OF ⅜-IN. STEEL WIRE ROPE FOR FOUNDRY CRANE AT WATERTOWN ARSENAL, MASS.

Length of specimen, 60.50 in. = 6 ft. ½ in.
Diameter of rope, 0.38 in.
Number of strands, 6.
Number of wires per strand, 19
Diameter of wire, 0.024 in.
Core or center, hemp.
Tensile strength = 8,990 lb.
Parted, 3 strands at lead grips.

TEST 14791.

TENSILE TESTS OF A PIECE OF ½-IN. STEEL ROPE FOR WATERTOWN ARSENAL.

Represents 410 ft., received January 24, 1912.
Length of specimen, 121 in. = 10 ft. 1 in.
Diameter of rope, 0.47 in.
Number of strands, 8.
Number of wires per strand, 19.
Diameter of wires, 0.019 to 0.029 in.
Core or center, hemp or sisal.

TWO TESTS MADE ON SPECIMEN.

	Tensile strength.	Parted.
	Lb.	
First test.....	14,700	4 strands at edge of lead jaws.
Second test.....	14,900	Do.

TEST 14797.

TENSILE TEST OF A PIECE OF ¾-INCH STEEL WIRE ROPE FOR WATERTOWN ARSENAL, MASS.

Rope received on P. O. 7454.
Rope prepared for test with closed sockets at the ends.
Length of specimen, 71 in. = 5 ft. 11 in.
Diameter of rope, 0.82 in.
Number of strands, 6.
Number of wires per strand, 41.
Diameter of wires, 4 = 0.014; 37 = 0.036.
Core, hemp.
Tensile strength, 33,400 lb.
Parted, three strands at edge of socket.

TEST 14830.

TENSILE TESTS OF SAMPLES OF STEEL WIRE ROPE FOR WATERTOWN ARSENAL, MASS.

Rope received from storehouse.
Rope prepared for test with closed sockets at the ends.

DIMENSIONS.

P. O.	Nominal size (diameter).	Length between sockets.	Diameter of rope.	Number of strands.	Number of wires.	Diameter of wires.		Core.
						Strands.	Inches.	
	In.	*Ft. in.*	*In.*					
1563	$\frac{3}{8}$	9 7	0.39	6	37	.....	0.017	Hemp.
1255	$\frac{1}{2}$	9 7	.53	8	19	6	.022	Sisal or hemp.
						13	.030	
1563	$\frac{9}{16}$	9 $7\frac{1}{2}$	.57	8	19	.....	.030	Do.
1660	$\frac{9}{16}$	9 4	.61	6	37	.....	.028	Hemp.
7454	$\frac{3}{4}$	5 5	.81	6	41	6	.015	Do.
						35	.035	

Nominal size.	Tensile strength.	Parted.	Required.
In.	*Lb.*		*Lb.*
$\frac{3}{8}$	12,400	6 strands at socket	10,600
$\frac{1}{2}$	18,900	7 strands at socket	19,000
$\frac{9}{16}$	24,800	2 strands 30 in. from end of socket	24,000
$\frac{9}{16}$	26,700	1 strand 36 in. from end of socket	24,600
$\frac{3}{4}$	42,200	3 strands 13 in. from end of socket	35,000

TEST 14921.

TENSILE TESTS OF $\frac{9}{16}$ AND $\frac{3}{4}$ IN. STEEL WIRE ROPE FOR WATERTOWN ARSENAL.

Rope received from storehouse on P. O. 1910.
Rope prepared for test with closed sockets at the ends.

$\frac{9}{16}$-IN. EXTRA PLIABLE HOISTING ROPE PLOUGH STEEL.

	Size diameter.	Length between sockets.	Number of strands.	Number of wires per strand.	Diameter of wire.	Core.	Breaking strength.
	In.	*Ft. in.*			*In.*		
Required.....	$\frac{9}{16}$	.....	6	37	.....	Hemp...	Not less than 12½ net tons.
Results.....	0.61	9 8½	6	37	0.027	...do....	26,700 lb.

Parted: Two strands 13 in. from end of socket. Complies with requirements.

¾-IN. EXTRA PLIABLE HOISTING ROPE PLOUGH STEEL.

	Size diameter.	Length between sockets.	Number of strands.	Number of wires per strand.	Diameter of wire.	Core.	Breaking strength.
	In.	*Ft. in.*			*In.*		
Required....	¾	.....	6	37	.....	.....	Not less than 23 net tons.
Results.....	0.80	9 5½	6	37	0.035	Hemp ..	45,500 lb.

Parted: Four strands at end of socket.

TEST 14777.

TENSILE TEST OF A MARLINE COVERED WIRE ROPE BRIDLE FOR USE WITH SEACOAST ARTILLERY TARGETS FOR WATERTOWN ARSENAL, MASS.

The bridle consists of a piece of five-strand, 19 wires per strand, wire rope, covered with marline. Diameter of rope 0.83 in., circumference 2.66 in., measurements over marline covering. Rope was bent around a galvanized thimble $2\frac{1}{2}$ in. diameter by 4 in. long (inside measurements) and the two parts of rope at the small end of thimble served for $2\frac{1}{4}$ in. with tarred hemp. At the other end the two parts of rope have galvanized thimbles $2\frac{1}{2}$ in. diameter by 4 in. long spliced in. The splices were tapered and served for $10\frac{1}{2}$ in. with tarred hemp. Through the galvanized thimbles were galvanized rings 4 in. inside diameter of $\frac{3}{4}$ stock. The galvanized rings passed through $\frac{3}{4}$-in. galvanized eyebolts 15 in. long with washers and nuts at the end.

Length of bridle over all 220 in. = 18 ft. 4 in.

Elongations measured on both parts of bridle on a gauge length of 100 in.

DETAILS OF ELONGATION.

Applied load.	Stress per square inch.	Elongations on 100 in. lengths.	
		A.	B.
Lb.	*Lb.*	*In.*	*In.*
200	185	0.05	0.15
400	369	.07	.17
600	555	.08	.21
800	740	.08	.24
1,000	924	.14	.24
2,000	1,845	.20	.35
3,000	2,772	.30	.45
4,000	3,695	.40	.46
5,000	4,610	.47	.52
6,000	5,540	.53	.63
7,000	6,460	.61	.69
8,000	7,395	.70	.82
9,000	8,320	.81	.90
10,000	9,240	.96	1.00
11,000	11,600	1.02	1.14
12,000	11,080	1.10	1.15

At 12,900 lb. (11,900 lb. per sq. in.) the galvanized ring on A length fractured.

Appearance of fracture: Fibrous 70 per cent, granular 30 per cent.

TEST OF ROPE IN BRIDLE.

The test was continued until the rope parted. A fixture passed through the two galvanized thimbles at one end and through the galvanized thimble where the rope was bent around at the other end, or at middle of length of rope. At 36,600 lb. (33,800 lb. per sq. in.) the five strands of rope parted at the middle of rope, or at the bend where the rope was bent around the galvanized thimble.

TEST 14770.

TENSILE TEST OF A MANILA ROPE BRIDLE FOR USE WITH SEACOAST ARTILLERY TARGETS FOR WATERTOWN ARSENAL, WATERTOWN MASS.

The bridle consists of a piece of 3-strand manila rope 4.15 in. circumference, and 1.38 in. diameter, bent around a galvanized thimble 2½ in. diameter by 4 in. long (inside measurements), and the two parts of rope at the small end of thimble served for 2¼ in. with tarred hemp.

At the other end the two parts of rope have galvanized thimbles 2½ in. diameter by 4 in. long spliced in. The splices were tapered and sewed for 10½ in. with tarred hemp. Through the galvanized thimbles were galvanized rings 4 in. inside diameter (of ¾ in. stock).

The galvanized rings passed through ¾ in. galvanized eyebolts 15 in. long with washers and nuts at the end.

DETAILS OF ELONGATIONS.

Sectional area of rope 1.496 sq. in. Total 2.992 sq. in.

Elongations measured on gauge length of 100 in. on both parts of bridle.

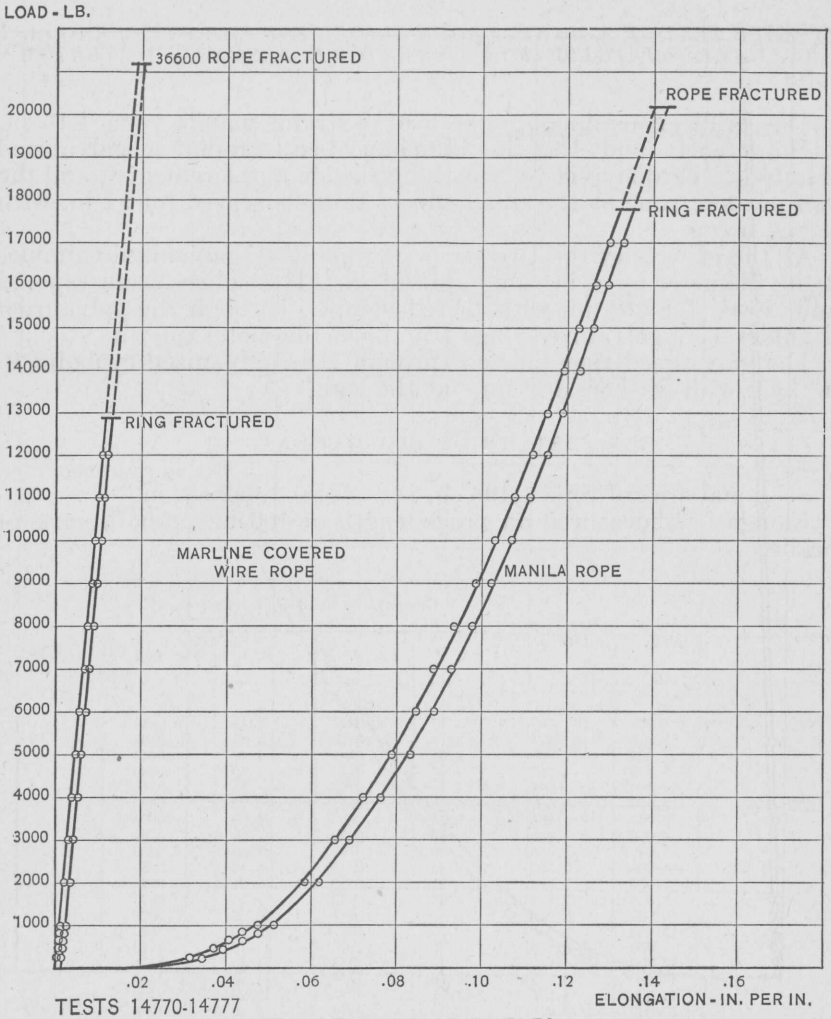
Applied load.	Stress per square inch.	Elongations on 100-inch lengths.			
		A.	Per inch.	B.	Per inch.
Lb.	*Lb.*	*In.*	*In.*	*In.*	*In.*
200	67	3.15	0.0315	3.45	0.0345
400	134	3.70	.0370	3.95	.0395
600	200	4.05	.0405	4.40	.0440
800	267	4.45	.0445	4.80	.0480
1,000	334	4.85	.0485	5.15	.0515
2,000	668	5.85	.0585	6.20	.0620
3,000	1,003	6.55	.0655	6.90	.0690
4,000	1,336	7.20	.0720	7.60	.0760
5,000	1,668	7.90	.0790	8.30	.0830
6,000	2,002	8.45	.0845	8.85	.0885
7,000	2,340	8.85	.0885	9.25	.0925
8,000	2,674	9.35	.0935	9.75	.0975
9,000	3,010	9.85	.0985	10.20	.1020
10,000	3,340	10.25	.1025	10.70	.1070
11,000	3,673	10.70	.1070	11.10	.1110
12,000	4,010	11.15	.1115	11.50	.1150
13,000	4,340	11.50	.1150	11.85	.1185
14,000	4,675	11.85	.1185	12.20	.1220
15,000	5,010	12.15	.1215	12.50	.1250
16,000	5,340	12.55	.1255	12.85	.1285
17,000	5,670	12.90	.1290	13.20	.1320
17,800	5,940	.....	.....	[1]	.....

[1] Galvanized rign on B length fractured at the weld.

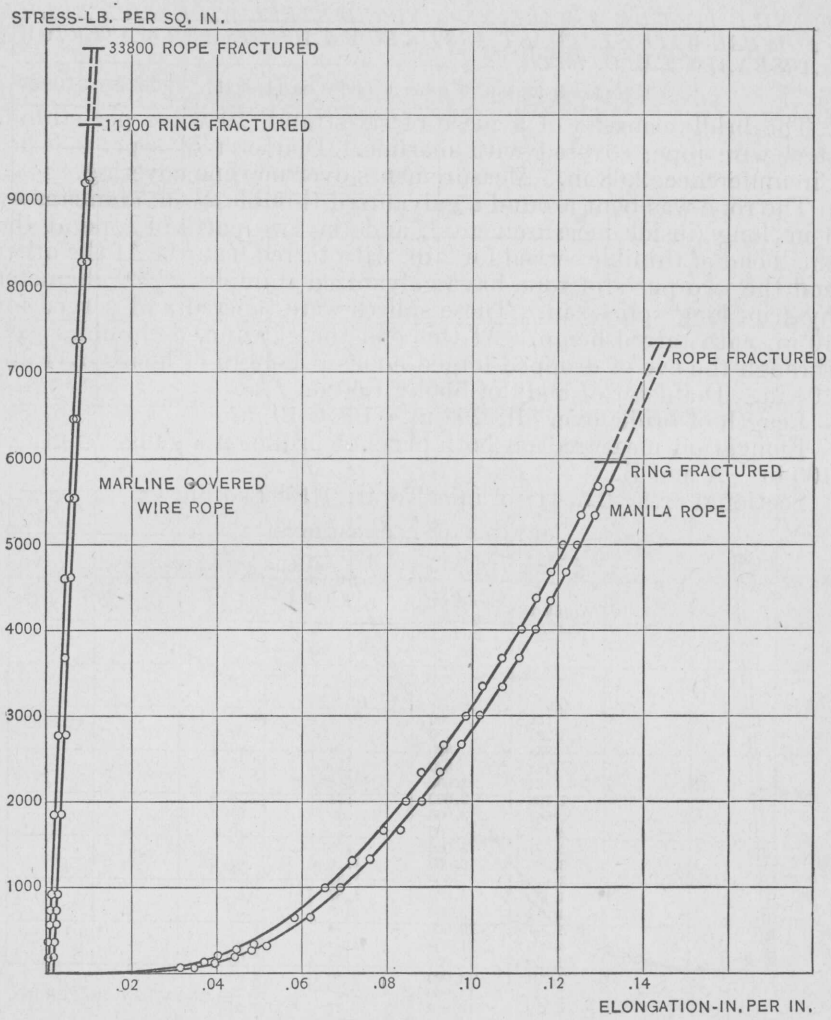
TEST OF ROPE IN BRIDLE.

The test was continued until the rope parted. A fixture was passed through the two galvanized thimbles at one end, and through the galvanized thimble where the rope was bent around at the other end or at middle of length of rope.

At 20,200 lb. (7,345 lb. per sq. in.) two strands of rope parted at middle of length of rope, or at the bend where the rope bent around the galvanized thimble.



TENSILE TESTS OF BRIDLES
FOR SEACOAST ARTILLERY TARGETS



TESTS NO'S 14770-14777

TENSILE TESTS OF BRIDLES FOR SEACOAST ARTILLERY TARGETS.

TEST 14951.

TENSILE TEST OF A MARLINE-COVERED STEEL WIRE ROPE BRIDLE FOR USE WITH SEACOAST ARTILLERY TARGETS FOR WATERTOWN ARSENAL. EX. O. 7829.

[1 piece 36 ft., ⅜ in. diameter, 6 x 19. Crucible steel.]

The bridle consists of a piece of six-strand, 19 wires per strand, steel wire rope, covered with marline. Diameter of rope, 0.84 in. Circumference, 2.68 in. Measurements over marline covering.

The rope was bent around a galvanized thimble 2½ in. diameter by 4 in. long (inside measurements), and the two parts of rope at the small end of thimble served for 2 in. with tarred hemp. At the other end the two parts of rope have galvanized thimbles 2½ in. diameter by 4 in. long spliced in. These splices were tapered and served for 10 in. with tarred hemp. At this end the galvanized thimbles pass through the eye of dropped forged hooks. Length of hooks over all: 10¼ in. Diameter of body of hook: 1.50 in.

Length of bridle over all: 202 in. = 16 ft. 10 in.

Elongation measured on both parts of bridle on a gauge length of 100 in. A and B.

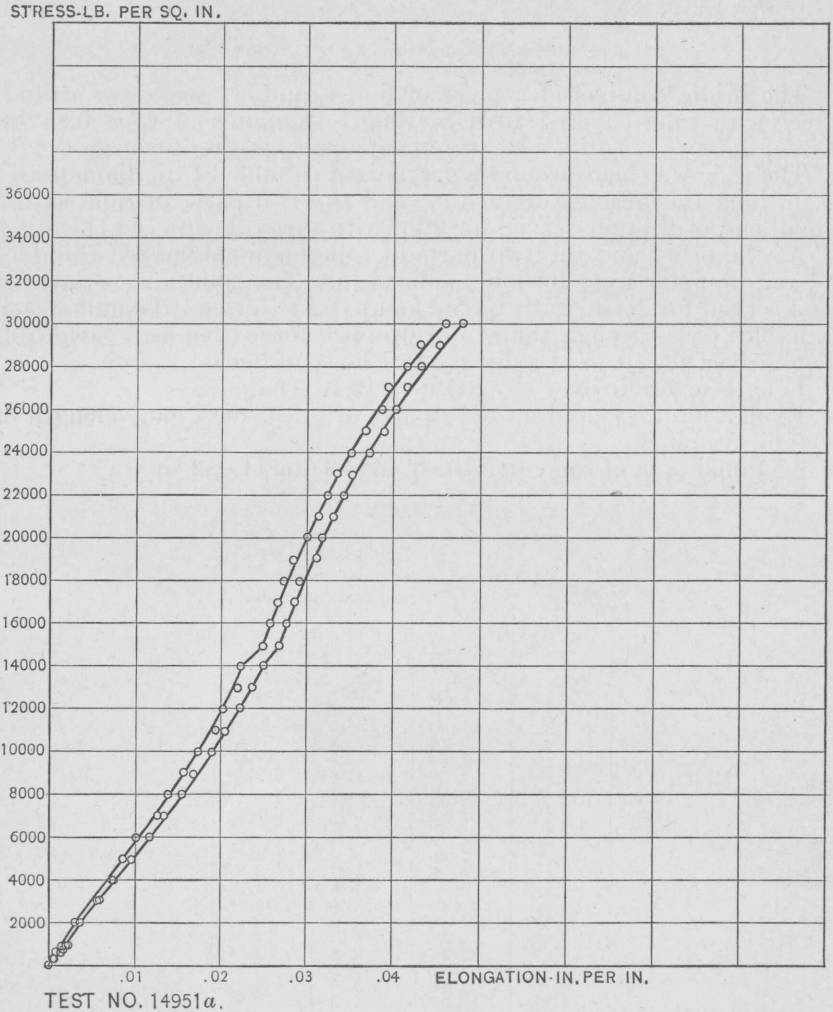
Sectional area: 0.5541 sq. in. Total: 1.1082 sq. in.

DETAILS OF ELONGATIONS.

Applied load.	Stress per square inch.	Elongations on 100-inch length.	
		A.	B.
Lb.	*Lb.*	*In.*	*In.*
111	200	0.	0.
222	400	.07	.05
333	600	.13	.06
443	800	.15	.10
554	1,000	.18	.15
1,108	2,000	.34	.28
1,663	3,000	.56	.53
2,217	4,000	.73	.70
2,771	5,000	.96	.84
3,325	6,000	1.16	1.02
3,879	7,000	1.33	1.25
4,433	8,000	1.57	1.38
4,972	9,000	1.69	1.56
5,541	10,000	1.90	1.74
6,096	11,000	2.08	1.97
6,649	12,000	2.23	2.05
7,204	13,000	2.40	2.24
7,758	14,000	2.52	2.26
8,312	15,000	2.71	2.54
8,860	16,000	2.81	2.62
9,421	17,000	2.86	2.70
9,974	18,000	2.95	2.75
10,529	19,000	3.13	2.85
11,083	20,000	3.22	3.02
11,637	21,000	3.31	3.14
12,192	22,000	3.44	3.25
12,747	23,000	3.54	3.36
13,300	24,000	3.73	3.51
13,855	25,000	3.89	3.67
14,409	26,000	4.04	3.86
14,962	27,000	4.17	3.95
15,517	28,000	4.34	4.17
16,071	29,000	4.55	4.33
16,624	30,000	4.81	4.60
16,624	30,000	.....	(1)

[1] Tensile strength.

At 16,624 lb. = 30,000 lb. per sq. in. after the elongation on parts A and B had been taken, the six strands of rope parted at the middle of the length of rope, or at the bend where the rope was bent around the galvanized thimble. At the other end two strands parted at the end of the serving on part A.



TEST NO. 14951*a*.

TENSILE TESTS OF MARLINE COVERED STEEL WIRE ROPE FOR SEACOAST ARTILLERY TARGETS.

⅜ IN. DIA. 6 STRAND OF 19 WIRE EACH CRUCIBLE STEEL

TENSILE TEST OF A MARLINE COVERED STEEL WIRE ROPE BRIDLE FOR USE WITH SEACOAST ARTILLERY TARGETS FOR WATERTOWN ARSENAL, MASS.

[1 piece 36 ft. long, ½ in. diameter. 5 x 19. Crucible Steel.]

The bridle consists of a piece of five-strand, 19 wires per strand, steel wire rope covered with marline. Diameter of rope 0.83 in. Circumference, 2.58 in. Measurements over marline covering.

The rope was bent around a galvanized thimble 2½ in. diameter by 4 in. long (inside measurements), and the two parts of rope at the small end of thimble served for 2 in. with tarred hemp.

At the other end the two parts of rope have galvanized thimbles 2½ in. diameter by 4 in. long, spliced in. The splices were tapered and served for 10 in. with tarred hemp. At this end the galvanized thimbles pass through the eye of dropped-forged hooks. Length of hooks over all, 10.25 in.; diameter of body of hooks, 1.50 in.

Length of bridle over all, 203 in. = 16 ft. 11 in.

Elongation measured on both parts of bridle on a gauge length of 100 in. A and B.

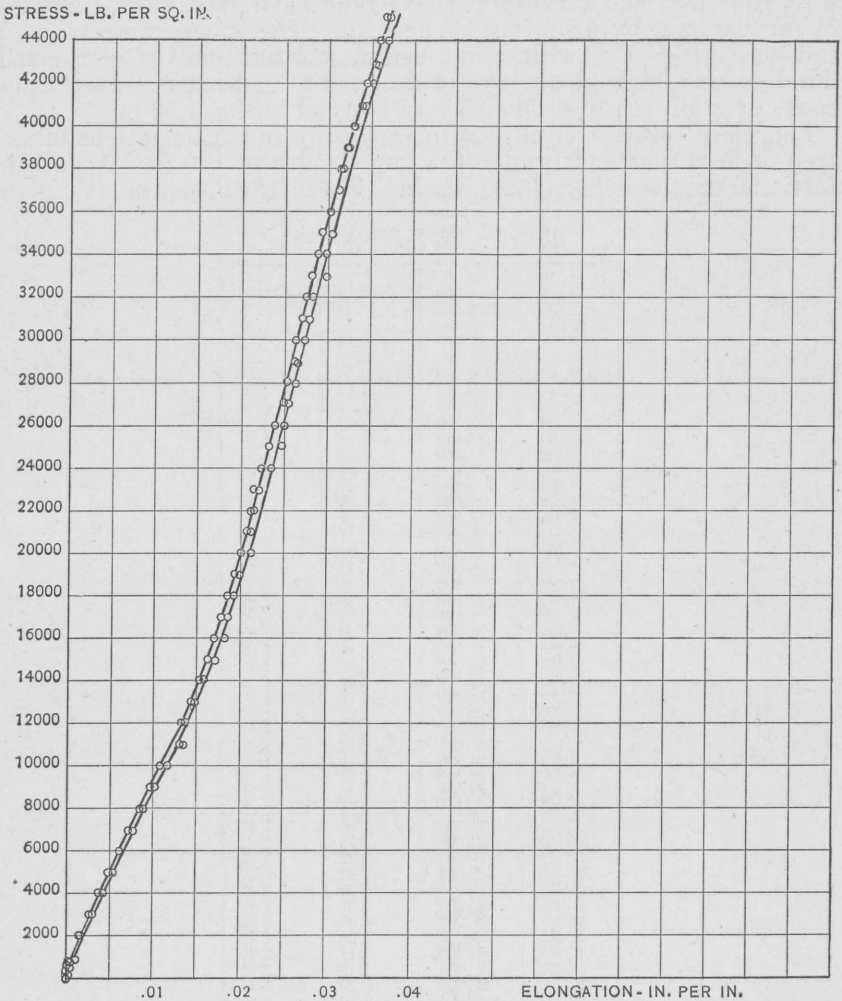
Sectional area of rope, 0.5410 sq. in. Total, 1.082 sq. in.

DETAILS OF ELONGATION.

Applied load.	Stress per square inch.	Elongations on 100-inch length.	
		A.	B.
Lb.	*Lb.*	*In.*	*In.*
108	200	0.	0.
216	400	.01	.05
325	600	.05	.02
433	800	.09	.05
541	1,000	.10	.09
1,082	2,000	.21	.15
1,623	3,000	.29	.27
2,164	4,000	.43	.39
2,705	5,000	.54	.51
3,246	6,000	.64	.60
3,787	7,000	.80	.73
4,328	8,000	.90	.88
4,869	9,000	1.04	.99
5,411	10,000	1.19	1.10
5,952	11,000	1.38	1.32
6,493	12,000	1.40	1.37
7,033	13,000	1.53	1.47
7,574	14,000	1.60	1.53
8,115	15,000	1.75	1.65
8,656	16,000	1.82	1.71
9,197	17,000	1.89	1.82
9,737	18,000	1.95	1.88
10,279	19,000	2.04	1.96
10,820	20,000	2.13	2.04
11,361	21,000	2.15	2.10
11,902	22,000	2.23	2.15
12,444	23,000	2.29	2.19
12,984	24,000	2.38	2.29
13,526	25,000	2.50	2.36
14,066	26,000	2.54	2.45
14,607	27,000	2.58	2.52
15,149	28,000	2.66	2.57
15,690	29,000	2.69	2.65
16,230	30,000	2.76	2.66
16,771	31,000	2.84	2.75
17,312	32,000	2.87	2.79
17,854	33,000	3.00	2.86
18,394	34,000	3.01	2.93
18,936	35,000	3.08	2.96
19,476	36,000	3.07	3.09
20,018	37,000	3.19	3.15
20,558	38,000	3.25	3.18
21,098	39,000	3.30	3.24
21,639	40,000	3.39	3.33
22,180	41,000	3.51	3.44
22,721	42,000	3.59	3.50
23,262	43,000	3.66	3.60
23,803	44,000	3.74	3.65
24,344	45,000	3.80	3.70
24,885	46,000	3.93	3.80
25,000	46,210	[1]	[1]

[1] Tensile strength.

At 25,000 lb. = 62,210 lb. per sq. in. four strands of the rope parted at end of serving where the galvanized thimble was spliced into rope or at hook end on part A.



TENSILE TEST OF MARLINE COVERED STEEL WIRE ROPE FOR SEACOAST ARTILLERY TARGETS.
½ IN. 5 STRANDS OF 19 WIRES EACH, CRUCIBLE STEEL

TENSILE TEST OF A MARLINE-COVERED STEEL WIRE ROPE BRIDLE FOR USE WITH SEACOAST ARTILLERY TARGETS FOR WATERTOWN ARSENAL, MASS.

[1 piece 36 ft.. ½ in. diam. 5 x 19. Plow Steel.]

The bridle consists of a piece of five strands, 19 wires per strand. steel wire rope, covered with marline. Diameter of rope, 0.82 in, Circumference of rope, 2.58 in. measured over marline covering. The rope was bent around a galvanized thimble 2½ in. diameter by 4 in. long (inside measurements), and the two parts of rope at the small end of thimble served for 2 in. with tarred hemp.

At the other end the two parts of rope have galvanized thimbles $2\frac{1}{2}$ in. diameter by 4 in. long, spliced in. The splices were tapered and served for 10 in. with tarred hemp. At this end the galvanized thimbles pass through the eye of dropped forged hooks. Length of hooks over all, $10\frac{1}{4}$ in. Diameter of body of hooks, 1.50 in.

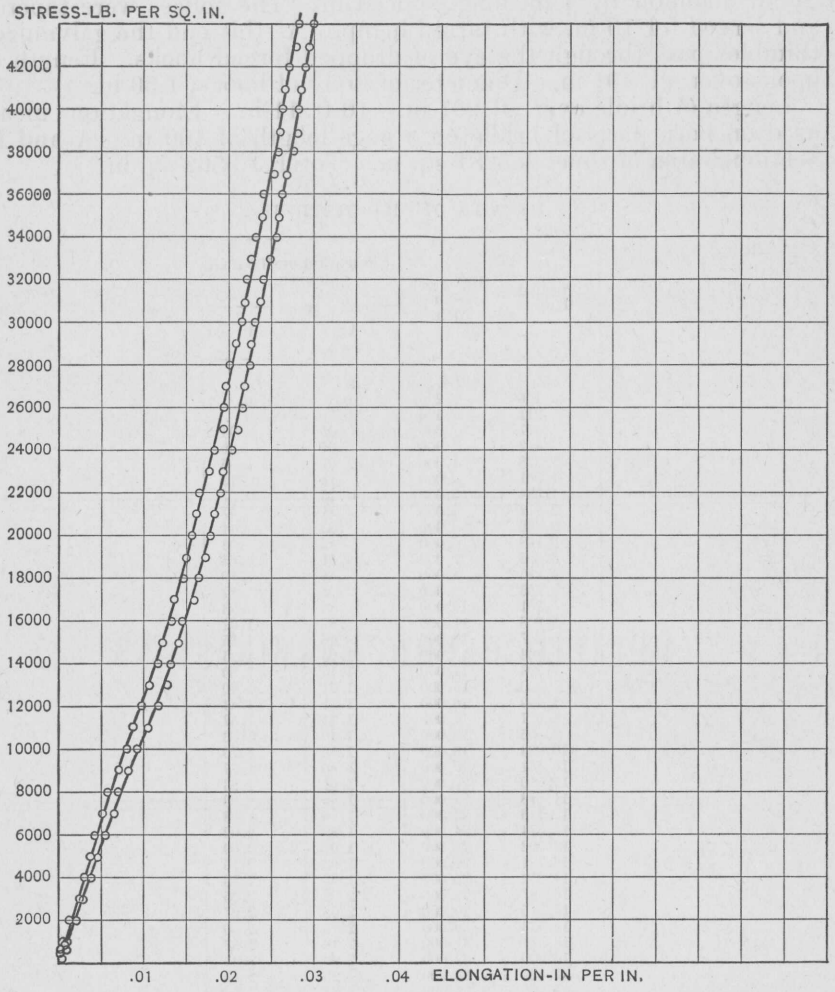
Length of bridle over all, 201 in. = 16 ft. 11 in. Elongations measured on both parts of bridle on a gage length of 100 in. A and B. Sectional area of rope: 0.5281 sq. in. Total, 1.0562 sq. in.

DETAILS OF ELONGATIONS.

Applied loads.	Stress per square inch.	Elongation on 100-inch length.	
		A.	B.
Lb.	*Lb.*	*In.*	*In.*
106	200	0.	0.
211	400	0.	0.
317	600	.05	.04
422	800	.07	.06
528	1,000	.07	.05
1,061	2,000	.13	.19
1,584	3,000	.25	.27
2,112	4,000	.31	.37
2,640	5,000	.35	.44
3,168	6,000	.42	.53
3,696	7,000	.51	.65
4,225	8,000	.58	.70
4,753	9,000	.71	.82
5,281	10,000	.80	.93
5,808	11,000	.87	1.02
6,337	12,000	.96	1.15
6,864	13,000	1.05	1.25
7,393	14,000	1.15	1.30
7,920	15,000	1.21	1.40
8,449	16,000	1.31	1.44
8,977	17,000	1.35	1.57
9,505	18,000	1.46	1.63
10,033	19,000	1.50	1.70
10,561	20,000	1.56	1.77
11,090	21,000	1.61	1.83
11,618	22,000	1.66	1.89
12,146	23,000	1.76	1.93
12,674	24,000	1.82	2.02
13,202	25,000	1.92	2.09
13,731	26,000	1.93	2.15
14,259	27,000	1.97	2.18
14,787	28,000	2.02	2.25
15,315	29,000	2.08	2.27
15,843	30,000	2.15	2.30
16,371	31,000	2.19	2.37
16,900	32,000	2.20	2.41
17,429	33,000	2.26	2.48
17,956	34,000	2.32	2.56
18,483	35,000	2.40	2.60
19,011	36,000	2.43	2.62
19,539	37,000	2.53	2.68
20,068	38,000	2.58	2.75
20,595	39,000	2.60	2.80
21,123	40,000	2.62	2.82
21,651	41,000	2.67	2.85
22,180	42,000	2.70	2.91
22,708	43,000	2.81	2.95
23,236	44,000	2.82	3.00
23,764	45,000	2.85	3.04
24,292	46,000	2.90	3.13
24,820	47,000	2.95	3.18
25,348	48,000	3.02	3.21
25,876	49,000	3.07	3.30
26,403	50,000	[1]	[1]

[1] Tensile strength.

At 26,403 lb. = 50,000 lb. per sq. in., two strands of the rope parted at end of serving where galvanized thimble was spliced into rope, or at hook end on part B.



TEST NO. 14951 *c*

TENSILE TESTS OF MARLINE COVERED STEEL WIRE ROPE FOR SEACOAST ARTILLERY TARGETS, ½-IN. DIA. 5 STRANDS OF 19 WIRES EACH, PLOW STEEL

METALLOGRAPHIC EXAMINATIONS.

REPORT ON A FRACTURED NUT.

1. A section was cut out from the nut and two sides were polished for microscopic examination. The structure shows very low carbon, a normal granular appearance indicating satisfactory heat treatment, and a fairly large amount of slag. The amount of slag is greater in the region of the fracture.

2. There evidently had been a seam in the metal which was produced at the time of rolling. The unusual amount of slag at this point prevented complete cementing of the surfaces, and it gave way along the seam when force was applied.

REPORT OF THE EXAMINATION OF BROKEN STEEL EXTRACTOR, BELONGING TO A 15-PDR. GUN, MODEL 1903.

The photograph represents the structure of the metal at point near the point of rupture. No differences could be detected in the microstructure of the metal at various points near the break by careful examination.

Scleroscope tests indicate a similar uniformity in the metal. The average hardness was 35.4, as indicated by the Shore instrument.

The structure suggests that the metal had been oil hardened and subsequently annealed, but it would be impossible to make a positive statement to this effect. The dark spots are not slag as might be thought, but are the remains of scratches which are brought out by the high magnification.

REPORT OF THE RESULTS OF AN EXAMINATION OF A SAMPLE TAKEN FROM A BROKEN EQUALIZING PIPE FROM 12-INCH MORTAR CARRIAGE, MODEL OF 1896 MI, NO. 164.

The polished section showed almost entire freedom from slag. The etched specimen showed indications of low carbon and normal structure, with the single exception that there were evidences of cold work. The ferrite granules were elongated in the direction of the rolling. Such cold work would make the metal more brittle and hard than would ordinarily be found in an annealed pipe.

CHEMICAL ANALYSIS.

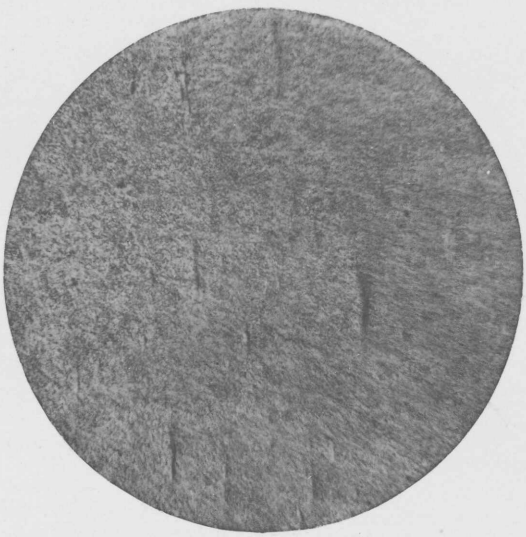
Carbon	0.20
Manganese	.49
Silicon	.005
Sulphur	.019
Phosphorus	.010

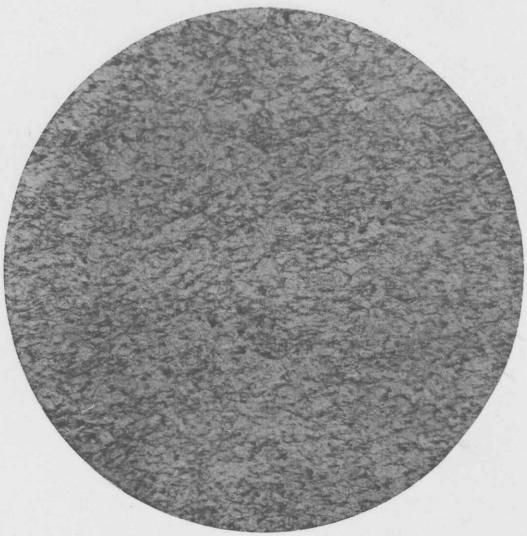
PHYSICAL TEST.

[Mean of two tests.]

Elastic limit, 64,800 lb. per sq. in.
Tensile strength, 74,200 lb. per sq. in.
Elongation in 6 in., 9.15 per cent.
Contraction of area, 51.9 per cent.

15-POUNDER EXTRACTOR. GUN MODEL 1903, No. 25. X 200.





BROKEN EQUALIZING PIPE FROM 12 IN. M. C., MOD. 1896M1. X 50.



SPECIMEN 6684-330 A.

Elevating Screw No. 3.

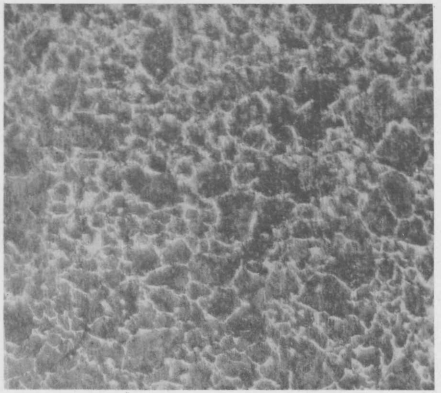


PHOTOGRAPH FROM COLLAR. X 100.

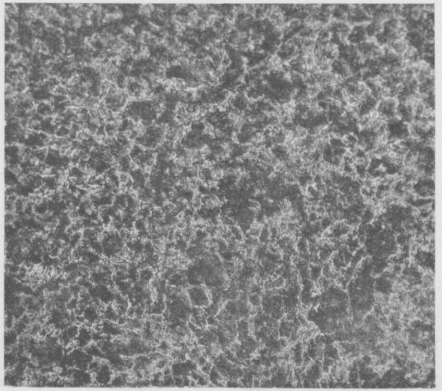


PHOTOGRAPH FROM NEAR COLLAR. X 100.

Elevating Screw No. 4.

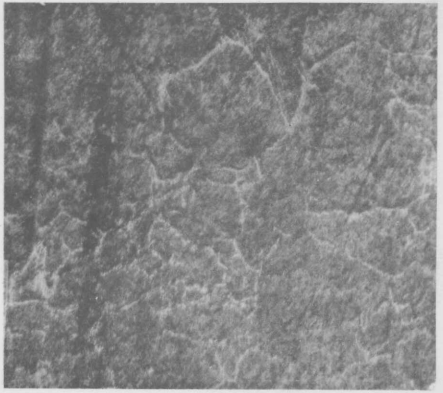


PHOTOGRAPH FROM COLLAR. X 100.

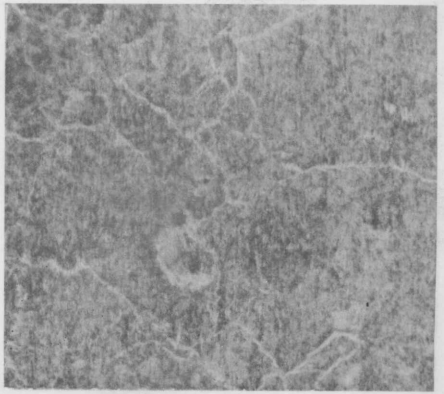


PHOTOGRAPH FROM NEAR COLLAR. X 100.

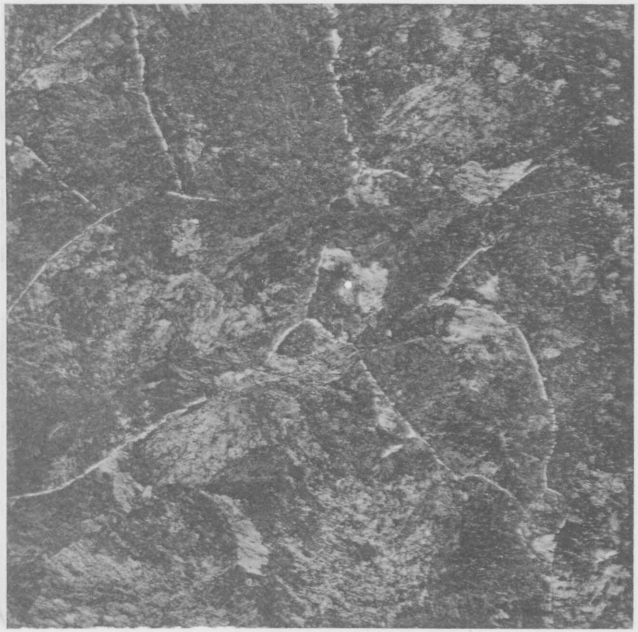
Elevating Screw No. 5.

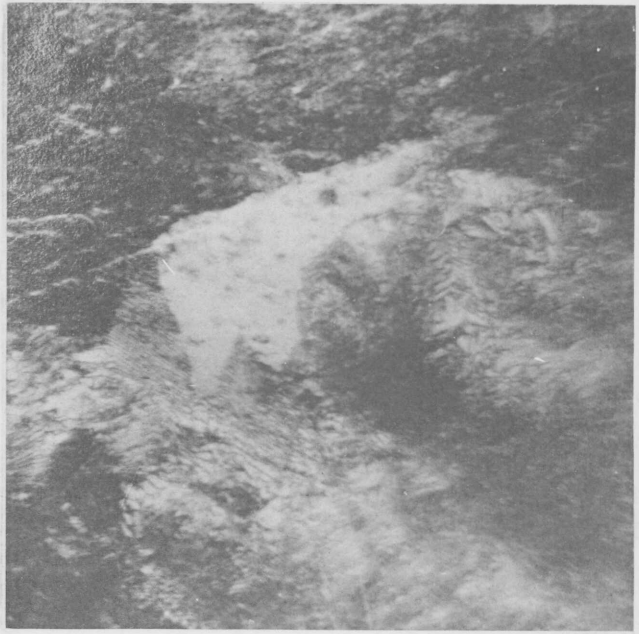


PHOTOGRAPH FROM COLLAR. X 100.



PHOTOGRAPH FROM NEAR COLLAR. X 100.





MICROPHOTOGRAPHS OF BROKEN ELEVATING SCREW NO. 1, FOR 14 IN. DISAPPEARING CARRIAGE, L. F. MODEL, 1907.

RESULTS OF AN EXAMINATION OF SPECIMENS CUT FROM THE COLLAR AND NEAR THE COLLAR OF THE ELEVATING SCREW No. 1, FOR 14-INCH DISAPPEARING CARRIAGE, L. F., MODEL 1907.

The two specimens show similar characteristics and both give evidence of having been improperly heat treated. The metal has undoubtedly been heated to a very high temperature and has been allowed to cool slowly. This is indicated by the crystallization which has taken place within each grain, by the unusual size of the grain itself, and by the presence of well-laminated perlite. The photographs show clearly the unusual grain size, and the crystallization of the grain. There is no evidence in either specimen of the metal having received any forging.

The failure of this metal was due to the improper heat treatment which it received.

REPORT OF THE RESULTS OF THE MICROSCOPICAL EXAMINATION OF ELEVATING SCREWS NOS. 3, 4, AND 5.

1. Examination of screw No. 3 shows an unusually coarse structure, indicating that the metal has been heated to a high temperature and has cooled slowly from this temperature. There is no evidence of the metal having been forged. The photographs submitted herewith show the coarsely granular structure.

2. Screw No. 5 also shows a granular structure, but the granules are not so large as in No. 3. In this screw there is evidence of the metal having been forged. The structure, however, is not so fine as might be desired. A comparison of photographs of No. 5 and No. 3 shows the differences in structure.

3. Screw No. 4 shows a fairly fine-grained structure, and shows evidence of better heat treatment than either of the other two screws. It also bears evidence of forging down to near the critical temperature.

REPORT OF THE MICROSCOPICAL EXAMINATION OF STEEL SPECIMEN MARKED "6684-330 A."

On etching the polished cross section of the bar there was developed a distinctly crystalline macrostructure, which was distributed over the field. There was also made evident a pronounced central area nearly square in section, which was slightly more crystalline than the outer area. This can be accounted for by assuming that the central area was allowed to cool more slowly than the exterior and that the exterior received more work than the interior. The square shape of the inner area would indicate that the bar was originally rectangular in cross section and that it had been forged into the circular cross section.

The photograph shows the characteristic microstructure. Such well-developed laminated perlite is an excellent indication that the metal had been heated to a very high temperature and allowed to cool extremely slowly.

Elastic limit, 39,400 lb. per square inch.

Tensile strength, 77,900 lb. per square inch.

Elongation in 8 in., 1.75 per cent.

Contraction of area, broke in threaded section.

RUBBER.

TEST 14679.

TENSILE TESTS OF COVERING RUBBER FOR WATERTOWN ARSENAL, MASS.

Length of specimen, 10 in.

Elongations taken on gauge length of 2 in.

Width.	Thickness.	Sectional area.	Tensile strength.		Elongation in 2 inches.		Marks.
			Load.	Stress per square inch.	Inches.	Per cent.	
In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*			
0.95	0.45	0.4275	273	638	3	150	Roll 1.
.90	.45	.405	300	740	2.65	132.5	Roll 2.

TEST 14689.

TENSILE TEST OF RUBBER FOR WATERTOWN ARSENAL, MASS.

Marks.	Width.	Thickness.	Sectional area.	Tensile strength.	
				Load.	Stress per square inch.
	In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*
Red foundation rubber	0.83	0.45	0.374	310	830
Covering rubber	.92	.49	.450	520	1,160

Marks.	Elongation in 2 inches.		Remarks.
	Inches.	Per cent.	
Red foundation rubber, CTA, 3189-19485, F 202B, May 29, 1911.	6.7	335	Fracture in center of gauge length.
Covering rubber, CTA, 3189-19485, F 202C, May 29, 1911.	1.0	50	Fracture ¾ in. inside gauge mark.

TEST 14707.

TENSILE TESTS OF RUBBER FOR WATERTOWN ARSENAL, MASS.

Marks.	Width.	Thickness.	Sectional area.	Tensile strength.		Elongation in 2 inches.		Remarks.
				Load.	Stress per square inch.	Inches.	Per cent.	
	In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*			
Red foundation rubber.	0.90	0.44	0.396	267	674	4.75	237.5	Fractured near center of specimens.
Covering rubber.	1.06	.50	.53	520	981	1.60	80.0	Fractured near first mark on specimens.

TEST 14731.

TENSILE TEST OF COVERING RUBBER FOR WATERTOWN ARSENAL.

Marks.	Width.	Thickness.	Sectional area.	Tensile strength.		Elongation in 2 inches.		Remarks.
				Load.	Stress per square inch.	Inches.	Per cent.	
	In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*			
$\frac{1}{8}$ covering, rubber.	0.92	0.5	0.46	255	554	0.85	42.5	Fractured on gauge mark.
$\frac{1}{16}$ covering, rubber.	.90	.63	.567	295	520	1.00	50.0	Do.

TEST 14898.

TENSILE TESTS OF COVERING RUBBER FOR WATERTOWN ARSENAL MASS.

Length of samples, 10.25 inches. Elongations taken on gauged length of 2 inches.

Marks.	Width.	Thickness.	Sectional area.	Tensile strength required, 600 pounds.		Required elongation.	Elongation in 2 inches.	
				Load.	Stress per square inch.		Inches.	Per cent.
Covering rubber:	*In.*	*In.*	*Sq. in.*	*Lb.*	*Lb.*			
$\frac{1}{16}$-inch.....	0.99	0.54	0.534	461	863	Not less than 75 per cent nor more than 150 per cent.	4.50	225
$\frac{1}{8}$-inch.....	.99	.54	.534	430	805	.....	4.40	220

TEST 14928.

TENSILE TEST OF COVERING RUBBER FOR WATERTOWN ARSENAL, MASS.

Rubber received on P. O. 1819.

Length of sample, 10 inches. Elongations taken on gauged length of 2 inches.

Kind.	Dimensions.		Sectional area.	Tensile strength.		Elongation in 2 inches.	
	Width.	Thickness.		Load.	Stress per square inch.	Inches.	Per cent.
Covering, ⅛-inch.....	*In.* 1.06	*In.* 0.56	*Sq. in.* 0.594	*Lb.* 597	*Lb.* 1,005	4.40	220

Required: Tensile strength of not less than 600 pounds per square inch. Elongation in 2 inches of not less than 75 nor more than 150 per cent.

TEST 14963.

TENSILE TEST OF COVERING RUBBER FOR WATERTOWN ARSENAL, MASS.

Length of sample over all, 12 in. Elongation taken on gauged length of 2 in.

Marks.	Width.	Thickness.	Sectional area.	Tensile load.	Strength, stress per square inch.	Elongation in 2 inches.	
	In.	*In.*	*Sq. in.*	*Lb.*	*Lb.*	*In.*	*Per ct.*
Covering ⅛.....	1.09	0.57	0.621	728	1,172	1.35	67.5

Required: Tensile strength of not less than 600 lb. per sq. in. Elongation of not less than 75 nor more than 150 per cent.

GUN CASTING.

The specimen for this test was similar to the one shown on p. 81, "Tests of Metals, etc., 1903." Its dimensions were as follows:

The circumference of the test cylinder was divided into eight equal portions by reference marks, A, B, C, and D, each 45° from the previous one in alphabetical order.

	Marks.				Average.
	A.	B.	C.	D.	
Diameter at top of cylinder (interior).....in..	28.009	27.990	27.990	27.994	27.973
Diameter at bottom of cylinder (interior).in..	28.011	27.899	27.898	27.996	
Diameter at top of cylinder (exterior).....in..	29.012	28.995	28.995	29.002	29.000
Diameter at bottom of cylinder (exterior).in..	29.010	28.995	28.992	29.000	
Length of cylinder.....in..	9.751	9.751	9.752	9.751	9.751

The maximum fiber stress in the specimen was computed by the following formula:

$$P = \frac{3\,(R_1^2 - R^2)}{4\,R_1^2 + 2\,R^2}\theta$$

in which P = pressure in the bore in lb. per sq. in.

θ = elastic limit of the material in tension in lb. per sq. in., or, in this case, the stress in the material caused by the pressure P.

R_1 = outside radius.

R = inside radius.

The elastic limit of the specimens AA14, etc., taken from this ring are 47,500; 47,000; 44,000; 45,000; average 45,750-lb. per sq. in.

Substituting the values for R_1 and R in the above formula

$$P = .035578\ \theta$$

From this the pressures corresponding to the desired stresses in the specimen were computed.

The arrangement of the apparatus for these tests was similar to that used in previous tests. (See Tests of Metals for the year 1902, p. 105, and for the year 1903, p. 79, for similar tests upon streaked and unstreaked gun hoops.) The latter of these served as a model for this test, as the specimen did not have flanges, as in the first test of streaked hoops. For the purpose of this test the cylinder was divided into 60° sections numbered from I to VI.

Measurements of the diameter were taken by an electric contact micrometer carried by a large wood frame shown in the photograph I. The conical point on the side of the specimen away from the building was held in a center punch mark in the specimen by elastic bands. The wood frame was suspended to swing freely. The micrometer point on the side next to the building was swung through a short arc horizontally and indicated contact with specimen by closing the circuit of an electric buzzer.

The conical point was placed in the center vertically and horizontally of Section III of the specimen. The micrometer touched the center of Section VI.

Internal pressure per square inch.	Fiber stress in specimen per square inch.	Micrometer.			Steel tape.		Remarks.
		Reading.	Increase in diameter.	Elongation of material per inch.	Circumference.	Elongation of material per inch.	
Lb.	*Lb.*	*In.*	*In.*	*In.*	*Ft. in.*	*Inch.*	
0	0	1.0000	0	0	7 $7\frac{3}{16}$	.....	
534	15,000	1.0000	0	0	.....	.....	
712	20,000	.9990	.0010	.0000345	.....	.....	
889	25,000	.9986	.0014	.0000483	.....	.....	
1,067	30,000	.9968	.0032	.000110	.....	.....	
1,245	35,000	.9947	.0053	.0001825	.....	.....	
534	15,000	1.0050	—.0050	—.000172	.....	.....	
1,281	36,000	.9945	.0055	.000190	.....	.....	Elastic limit.[1]
1,316	37,000	.9943	.0057	.000197	.....	.....	
1,352	38,000	.9940	.0060	.000207	.....	.....	[2]
1,388	39,000	.9933	.0067	.000232	.....	.....	
1,423	40,000	.9925	.0075	.000259	.....	.....	
534	15,000	1.0060	—.0060	—.000207	7 $7\frac{1}{4}$	.00069	
1,459	41,000	.9855	.0145	.000500	.....	.....	[3]
[Load held for 10 to 15 minutes while photographs were taken.]							
1,494	42,000	.9356	.0644	.00222	.....	.....	
534	15,000	.9450	.0550	.00190	7 $7\frac{3}{8}$	.00212	
1,530	43,000	.7950	.2050	.00707	.....	.....	
534	15,000	.7480	.2520	.00870	7 $7\frac{31}{32}$	.0086	[4]
1,565	44,000	.6650	.3350	.0115	.....	.....	
534	15,000	.6880	.3120	.0108	7 $8\frac{1}{4}$	.01165	
1,601	45,000	.4600	.5400	.0187	.....	.....	
534	15,000	.4750	.5250	.0181	7 9	.0199	
1,637	46,000	.3970	.6030	.0208	.....	.....	
534	15,000	.4300	.5700	.0197	7 $9\frac{1}{16}$	.0205	
1,708	48,000	.2930	.7070	.0244	.....	.....	
534	15,000	.3290	.6710	.0231	7 $9\frac{3}{8}$	.0241	
1,760	49,470	[5]	[5]	[5]	.....	.....	

[1] Leak A started in Sec. VI of specimen in lower right-hand corner as shown in photograph No. 2. At first, liquid escaped slowly and ran down specimen.

[2] Leak B started near the middle of Sec. III as shown in photograph No. 3. The light streak just below the conical caliper point is the liquid escaping in a very fine spray. At first this leak was almost invisible unless something held in the path of the stream made the liquid visible.

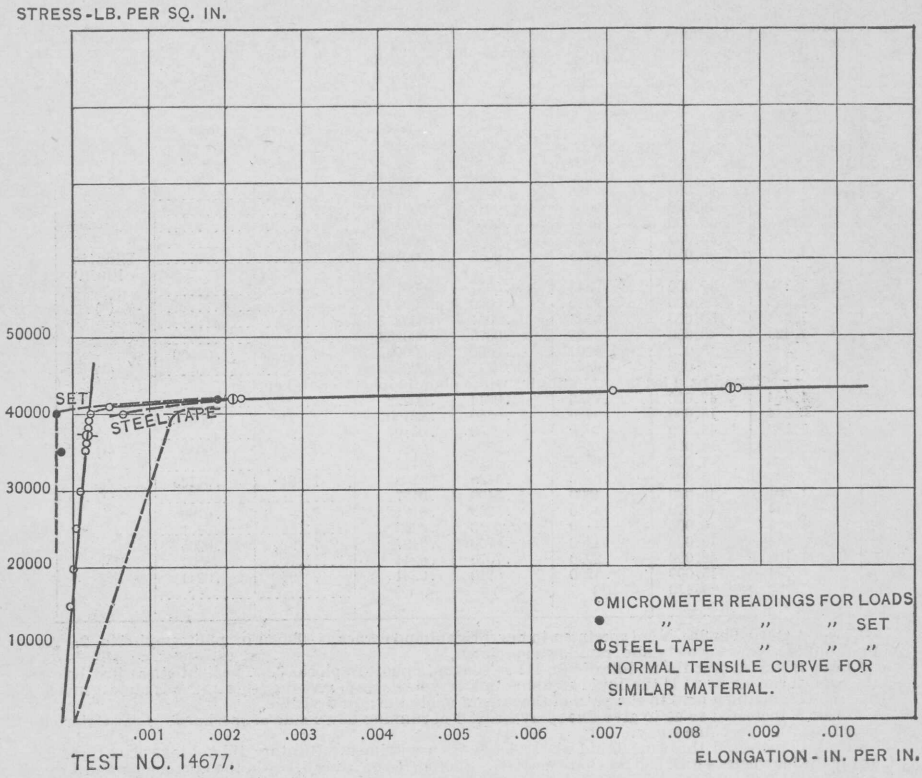
[3] Leak A increased so as to give fine spray instead of running down side of specimen. Leak C started near Leak B. Very fine spray.

[4] Leak B increased throwing liquid about 3 feet from specimen. Rupture did not take place through any of the blowholes which had previously leaked. It occurred on a line between the micrometer and Leak A in Sec. VI. The blowhole where leak A occurred can be seen just to the right of the fracture in photograph 4.

[5] Ultimate strength.

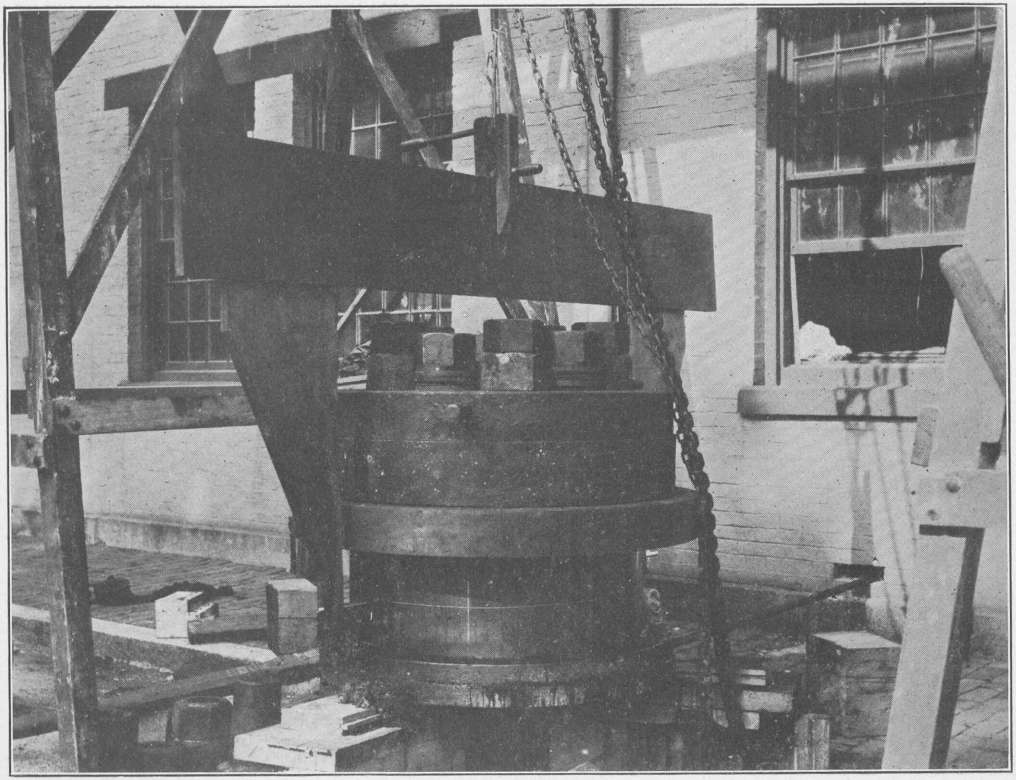
After removal from the testing fixture the edges of the fracture were $\frac{3}{4}$ inch apart.

Testing with a straight edge showed that the center of the specimen bulged so as to give a crown of 0.05 in. This was due to the frictional restraint imposed on the edge of the specimen by the testing fixture. The elongation of the material given in the fifth column of the data table is computed by multiplying the increase in diameter by π to obtain the increase in circumference and dividing by the original circumference, 91.187 in. These are then plotted in the usual stress diagram, which shows the behavior of the material very clearly. The fact that the elongations were not as large as in the usual tension test with the negative reading for the set leads to the conclusion that the specimen was not perfectly cylindrical and that the reading was taken on what was originally a long diameter. Under the internal pressure this gradually shortened, and so gave negative set readings. The very close agreement of the micrometer set readings and the tape reading for stresses above 4,000 lb. shows that at that time the specimen had reached a truly cylindrical form. The set readings for 43,000 lb. were greater than for the load, because of the stretching of the material after the load reading was taken, and before the pressure could be decreased.

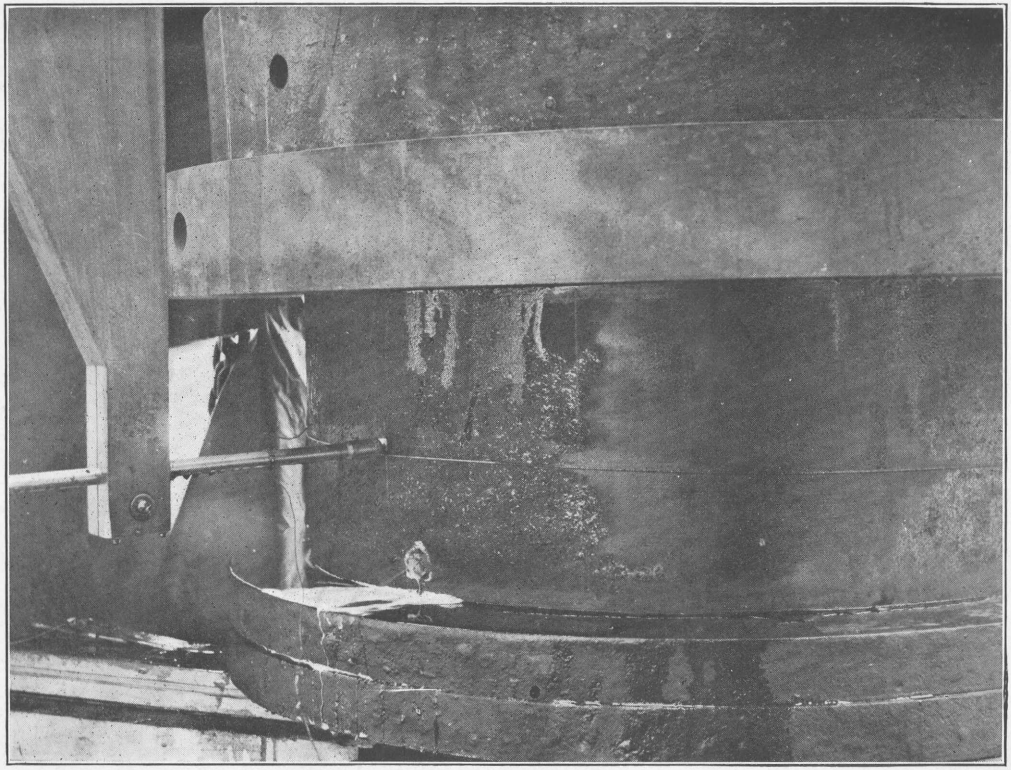


TEST NO. 14677.

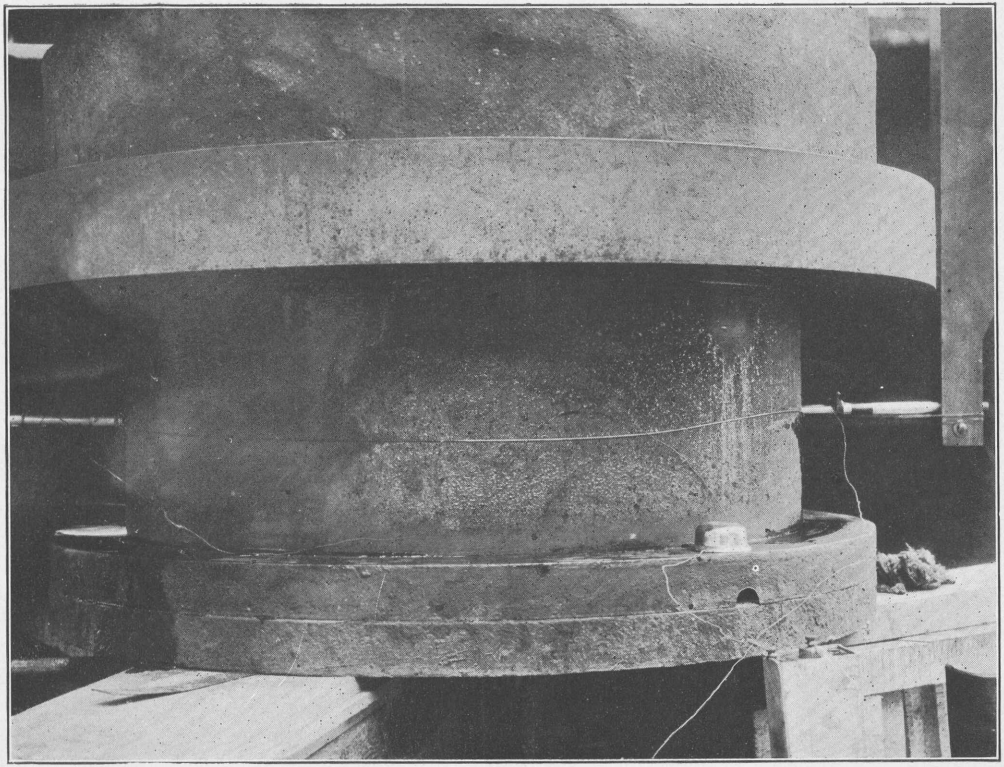
HYDROSTATIC TEST. ∽ GUN CASTINGS.



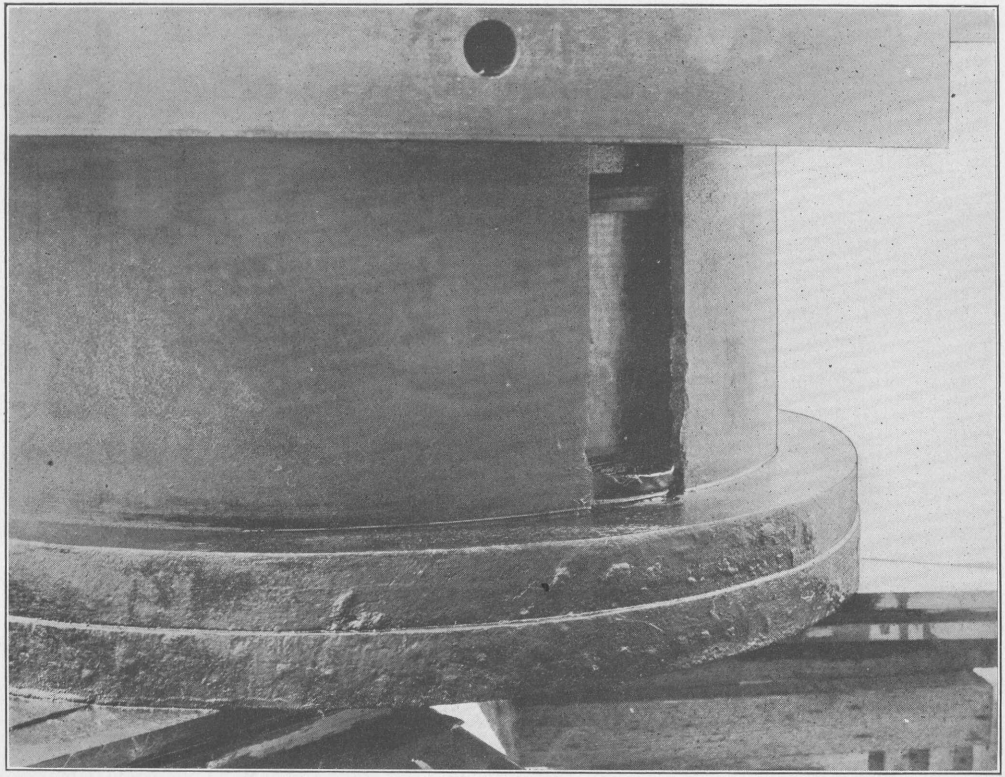
PHOTOGRAPH NO. 1.



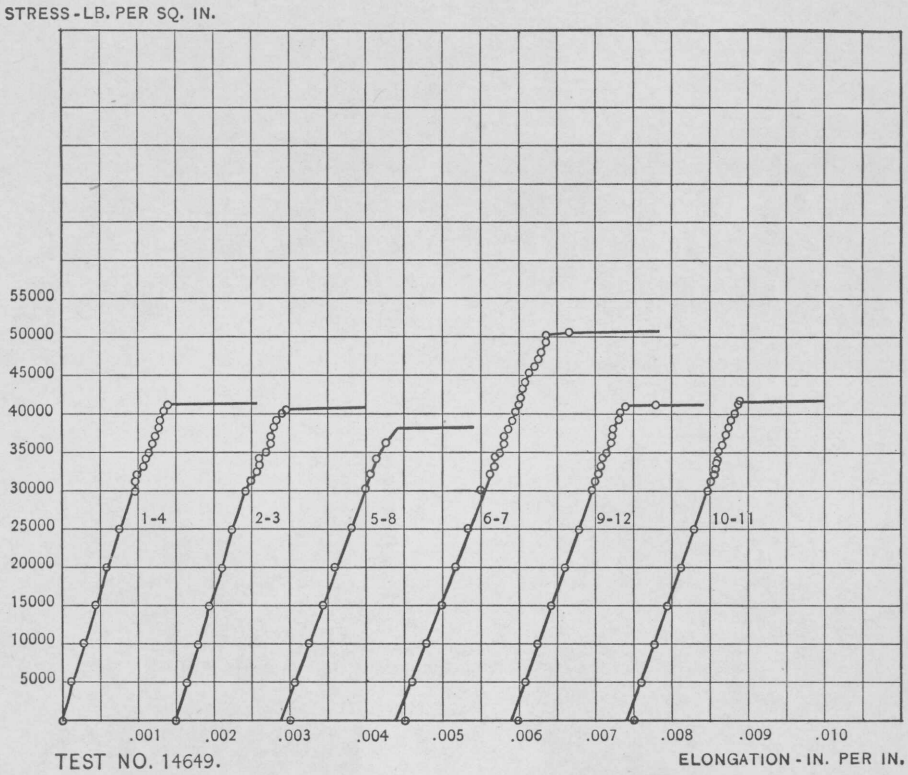
PHOTOGRAPH NO. 2.



PHOTOGRAPH NO. 3.



PHOTOGRAPH NO. 4.



TENSILE TESTS OF SPECIMENS FROM GUN CASTINGS.

BLUE AND BROWN PRINT PAPER.

TEST 14918.

TENSILE TESTS OF PHOTOGRAPHIC BROWN PRINT PAPER FOR THE CHIEF OF ORDNANCE, UNITED STATES ARMY, WASHINGTON, D. C., FOR THE ANNUAL SUPPLIES.

Strips 1 inch wide were cut from the paper in the rolled direction or longitudinally. Length of samples over all, about 7 inches. Length between clamps, 3 inches.

Marks.	Kind.	Dimensions.			Sectional area.	Load.	Required stress per square inch.	Stress obtained per square inch.
		Width.	Required thickness (about).	Thickness obtained.				
		In.	*In.*	*In.*	*Sq. in.*	*Lb. oz.*	*Lb.*	*Lb.*
A	Brown	1	0.003	0.0027	0.0027	25 2	7,000	9,300
	do	1	.003	.0027	.0027	23 12	7,000	8,790
	do	1	.003	.0027	.0027	26 2	7,000	9,670
	do	1	.003	.0027	.0027	22 1	7,000	8,170
B	do	1	.003	.0030	.0030	18 9	7,000	[1] 6,180
	do	1	.003	.0030	.0030	18 5	7,000	[1] 6,100
	do	1	.003	.0030	.0030	19 3	7,000	[1] 6,390
	do	1	.003	.0030	.0030	16 6.5	7,000	[1] 5,460
C	do	1	.003	.0025	.0025	22 2	7,000	8,850
	do	1	.003	.0025	.0025	20 6.5	7,000	8,160
	do	1	.003	.0025	.0025	23	7,000	9,200
	do	1	.003	.0025	.0025	19 8	7,000	7,800
D	do	1	.003	.0023	.0023	16 1	7,000	[1] 6,980
	do	1	.003	.0023	.0023	14 10.5	7,000	[1] 6,370
	do	1	.003	.0023	.0023	15 15.5	7,000	[1] 6,930
	do	1	.003	.0023	.0023	15 1	7,000	[1] 6,540
E	do	1	.003	.0033	.0033	19	7,000	[1] 5,750
	do	1	.003	.0033	.0033	22 5.5	7,000	[1] 6,770
	do	1	.003	.0033	.0033	21 13.5	7,000	[1] 6,610
	do	1	.003	.0033	.0033	19 3.5	7,000	[1] 5,820
F	do	1	.003	.0031	.0031	27 9	7,000	8,890
	do	1	.003	.0031	.0031	26 1.5	7,000	8,410
	do	1	.003	.0031	.0031	25 10.5	7,000	8,270
	do	1	.003	.0031	.0031	26 2	7,000	8,420
F 1	do	1	.003	.0030	.0030	28 7	7,000	9,470
	do	1	.003	.0030	.0030	27 8.5	7,000	9,170
	do	1	.003	.0030	.0030	26 7	7,000	8,810
	do	1	.003	.0030	.0030	24 7	7,000	8,140
G	do	1	.003	.0036	.0036	17 15	7,000	[1] 4,980
	do	1	.003	.0036	.0036	19 3.5	7,000	[1] 5,330
	do	1	.003	.0036	.0036	20 4	7,000	[1] 5,620
	do	1	.003	.0036	.0036	18 14	7,000	[1] 5,240
H	do	1	.003	.0047	.0047	26 3.5	7,000	[1] 5,570
	do	1	.003	.0047	.0047	25 3	7,000	[1] 5,350
	do	1	.003	.0047	.0047	25 3.5	7,000	[1] 5,360
	do	1	.003	.0047	.0047	26 6	7,000	[1] 5,610
I	do	1	.003	.0027	.0027	21 14	7,000	8,110
	do	1	.003	.0027	.0027	23 1	7,000	8,540
	do	1	.003	.0027	.0027	23 1	7,000	8,540
	do	1	.003	.0027	.0027	21 10	7,000	8,000

[1] Does not comply with the specifications.

SPECIFICATIONS.

The brown print paper shall be about 0.003 of an inch thick, and possess a tensile strength of not less than 7,000 lb. per sq. in. of section, the sample to be 1 in. wide by 3 in. long, full length, and to be cut longitudinally out of the paper, the paper to be dry when tested.

TEST 14941.

TENSILE TESTS OF BLUE-PRINT PAPER MADE FOR THE ORDNANCE OFFICE, UNITED STATES ARMY.

Marks.	Dimensions.			Sectional area.	Load.	Required stress per square inch.	Stress obtained per square inch.
	Width.	Required thickness.	Thickness obtained.				
	In.	*In.*	*In.*	*Sq. in.*	*Lb. oz.*	*Lb.*	*Lb.*
A	1	0.0042	0.0054	0.0054	22 1.5	5,000	4,080
	1	.0042	.0054	.0054	25 2.5	5,000	4,650
	1	.0042	.0054	.0054	25 7.5	5,000	4,710
	1	.0042	.0054	.0054	24 12.0	5,000	4,580
Average							[1] 4,505
B	1	.0042	.0045	.0045	28 1.5	5,000	6,230
	1	.0042	.0045	.0045	25 11.5	5,000	5,710
	1	.0042	.0045	.0045	28 15.0	5,000	6,420
	1	.0042	.0045	.0045	29 8.0	5,000	6,550
Average							6,228
C	1	.0042	.0045	.0045	22 8.0	5,000	5,000
	1	.0042	.0045	.0045	21 7.5	5,000	4,760
	1	.0042	.0045	.0045	21 6.0	5,000	4,740
	1	.0042	.0045	.0045	23 14.0	5,000	5,300
Average							[1] 4,950
D	1	.0042	.0040	.0040	28 4.0	5,000	7,050
	1	.0042	.0040	.0040	23 14.5	5,000	5,760
	1	.0042	.0040	.0040	28 2.0	5,000	7,020
	1	.0042	.0040	.0040	26 4.0	5,000	6,550
Average							6,595
E	1	.0042	.0045	.0045	27 8.5	5,000	6,110
	1	.0042	.0045	.0045	26 15.5	5,000	5,990
	1	.0042	.0045	.0045	21 12.0	5,000	4,830
	1	.0042	.0045	.0045	22 5.5	5,000	4,960
Average							5,473
F	1	.0042	.0048	.0048	26 6.5	5,000	5,490
	1	.0042	.0048	.0048	25 6.0	5,000	5,280
	1	.0042	.0048	.0048	26 10.5	5,000	5,550
	1	.0042	.0048	.0048	27 11.5	5,000	5,770
Average							5,523
F 1	1	.0042	.0045	.0045	25 10.5	5,000	5,700
	1	.0042	.0045	.0045	23 0.5	5,000	5,180
	1	.0042	.0045	.0045	20 11.0	5,000	4,580
	1	.0042	.0045	.0045	21 14.5	5,000	4,860
Average							5,080
F 2	1	.0042	.0048	.0048	23 10.5	5,000	4,920
	1	.0042	.0048	.0048	26 3.5	5,000	5,460
	1	.0942	.0048	.0048	22 5.5	5,000	4,650
	1	.0042	.0048	.0048	22 11.0	5,000	4,720
Average							4,938
G	1	.0042	.0050	.0050	24 11.0	5,000	4,930
	1	.0042	.0050	.0050	25 8.5	5,000	5,100
	1	.0042	.0050	.0050	21 7.5	5,000	4,290
	1	.0042	.0050	.0050	23 15.5	5,000	4,790
Average							4,778
H	1	.0042	.0040	.0040	26 9.5	5,000	6,640
	1	.0042	.0040	.0040	25 15.5	5,000	6,480
	1	.0042	.0040	.0040	22 14.0	5,000	5,710
	1	.0042	.0040	.0040	25 0.	5,000	6,240
Average							6,268

[1] Does not comply with the specifications.

Tensile tests of blue-print paper made for the Ordnance Office, United States Army—Con.

Marks.	Dimensions.			Sectional area.	Load.	Required stress per square inch.	Stress obtained per square inch.
	Width.	Required thickness.	Thickness obtained.				
	In.	*In.*	*In.*	*Sq. in.*	*Lb. oz.*	*Lb.*	*Lb.*
H 1	1	0.0042	0.0048	0.0048	20 5.0	5,000	4,230
	1	.0042	.0048	.0048	21 1.0	5,000	4,380
	1	.0042	.0048	.0048	19 0.5	5,000	3,960
	1	.0042	.0048	.0048	20 6.0	5,000	4,240
Average							4,203
I	1	.0042	.0046	.0046	19 4.5	5,000	4,190
	1	.0042	.0046	.0046	20 8.0	5,000	4,450
	1	.0042	.0046	.0046	19 14.0	5,000	4,310
	1	.0042	.0046	.0046	20 8.5	5,000	4,462
Average							[1] 4,353
I 1	1	.0042	.0046	.0046	19 11.0	5,000	4,270
	1	.0042	.0046	.0046	18 11.0	5,000	4,060
	1	.0042	.0046	.0046	19 11.5	5,000	4,280
	1	.0042	.0046	.0046	21 7.5	5,000	4,660
Average							[1] 4,318

[1] Does not comply with the specifications.

SPECIFICATIONS.

Paper to be about 0.0042 in. thick, 1 in. wide, and 3 in. long. Cut longitudinally from roll. Tensile strength of at least 5,000 lb. per sq. in. Paper dry when tested:

TEST 14950.

TENSILE TESTS OF BLUE AND BROWN PRINT PAPER FOR WATERTOWN ARSENAL, MASS.

Mark.	Width.	Thickness.	Sectional area.	Load.	Stress per square inch.	Kind.
	In.	*In.*	*Sq. in.*	*Lbs. oz.*	*Lb.*	
A	1	0.0049	0.0049	22 12½	4,640	Blue print.
	1	.0049	.0049	20 3	4,130	Do.
	1	.0049	.0049	24 4½	4,950	Do.
	1	.0049	.0049	25 7	5,190	Do.
Average					4,728	
B	1	.0045	.0045	25 7½	5,650	Do.
	1	.0045	.0045	26 5	5,850	Do.
	1	.0045	.0045	25 9½	5,680	Do.
	1	.0045	.0045	25 4	5,610	Do.
Average					5,698	
A–1	1	.0031	.0031	26 2	8,420	Brown print.
	1	.0031	.0031	28 9	9,210	Do.
	1	.0031	.0031	25 7	8,200	Do.
	1	.0031	.0031	25 9	8,240	Do.
Average					8,518	
B–1	1	.0030	.0030	19 8½	6,500	Do.
	1	.0030	.0030	19 15½	6,650	Do.
	1	.0030	.0030	20 9½	6,860	Do.
	1	.0030	.0030	20 12½	6,920	Do.
Average					6,733	

ANCHOR BOLTS.

TEST 14773.

TENSILE AND BENDING TESTS OF SPECIMENS FROM FOUR ANCHOR BOLTS FOR MORTAR CARRIAGES FOR CORPS OF ENGINEERS, UNITED STATES ARMY, WILMINGTON, N. C.

[Inch section in which fracture occurred is marked thus, *.]

TENSILE TEST.

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.	
			Load.	Stress per square inch.	Load.	Stress per square inch.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
X7942 A	1.129	1	41,100	41,100	65,600	65,600
X7942 B	1.129	1	38,900	38,900	60,200	60,200
X7942 C	1.129	1	40,000	40,000	62,200	62,200
X7942 D	1.129	1	41,500	41,500	62,800	62,800

Marks.	Elongation in 8 inches.		Elongations in inch sections.	Diameter at fracture.	Contraction of area.	Appearance of fracture.
	Inches.	Per cent.				
			In.	*In.*	*P. ct.*	
X7942 A	2.54	31.8	0.22, 0.27, 0.29, 0.65,* 0.36, 0.25, 0.26, 0.24	0.77	53.4	Fine silky.
X7942 B	2.56	32.0	.21 .24 .23 .29 .75* .34 .27 .23	.71	60.4	Do.
X7942 C	2.56	32.0	.23 .24 .28 .61* .46 .27 .25 .22	.74	57.0	Fine silky; cup shaped.
X7942 D	2.53	31.6	.21 .26 .27 .64* .45 .25 .24 .21	.70	61.5	Do.

BENDING TEST.

Tensile test specimen taken from each bolt, and the remainder of each bolt used for bending tests.

Specimens A, B, C, and D bent cold through 180°, and closed down on themselves without fracture on outside of bent portion.

When the pressure was released, cracks were developed at the inside of bend on all four specimens.

MISCELLANEOUS TESTS OF STEEL CASTINGS.

TEST 14953.

COLD-BENDING TESTS OF STEEL CASTINGS.

A specimen 1 in. by one-half in. shall bend cold around a diameter 1 in. without fracture on outside of bent portion, through an angle of 120° for "soft" castings, of 90° for "medium" castings.

Marks: 4–13–12.

Bent through 52° around a diameter of 2.10 in. Developed a fracture at outside of bent portion.

Marks: 4–19–12.

Bent through 90° around a diameter of 1.86 in. Fractured the specimen at bend.

TEST 14953.

TENSILE TESTS OF FOUR SAMPLES OF STEEL CASTINGS.

[Inch section in which fracture occurred is marked thus *.]

Marks.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.	
			Load.	Stress per square inch.	Load.	Stress per square inch.	Inch.	Per cent.
	In.	*Sq. in.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*		
4–13–12	0.500	0.196	6,300	32,100	11,600	59,100	0.21	10.5
4–13–12*	.498	.195	6,300	32,300	11,600	59,400	.21	10.5
4–19–12	.500	.196	6,200	31,600	12,400	63,200	.19	9.5
4–19–12*	.500	.196	6,300	32,100	12,500	63,700	.23	11.5

	Elongation in inch sections.		Diameter at fracture.	Contraction of area.	Appearance of fracture.	Hardness.	
						Shore.	Brinell.
	In.	*In.*	*In.*	*Per cent.*			
4–13–12	0.14*	0.07	0.46	15.3	Amorphous...	19.5	131
4–13–12*	.13*	.08	.46	14.8	.....do.....	19.5	131
4–19–12	.08	.11*	.47	11.7	.....do.....	20.0	137
4–19–12*	.10*	.13*	.47	11.7	.....do.....	20.0	143

Tested castings shall be of three classes, "hard," "medium," and "soft."

The minimum physical qualities required in each class shall be as follows:

	Hard castings.	Medium castings.	Soft castings.
Tensile strength, pounds per sq. in	85,000	70,000	60,000
Yield point, pounds per sq. in	38,250	31,500	27,000
Elongation, per cent, in 2 in	15.0	18.0	22.0
Contraction of area, per cent	20.0	25.0	30.0

The elastic limit given in these tests is the yield point of the material.

REPORT OF STEEL ANALYSIS.

[Steel from castings.]

Sample.	C.	Mn.	Si.	S.	P.
Marks.					
Tension 4-13-12	0.24	0.62	0.265	0.059	0.045
Tension 4-13-12	.24	.60	.260	.060	.042
Tension 4-19-12	.26	.65	.197	.058	.043
Tension 4-19-12	.25	.62	.200	.060	.045
Bending 4-13-12	.24	.63	.262	.060	.045
Bending 4-19-12	.27	.55	.203	.059	.046

PRIVATE TESTS.

PRIVATE TESTS MADE DURING THE FISCAL YEAR ENDED JUNE 30, 1912.

Date.	Material.	Name.	City and State.
1911.			
July 21	Steel	The Wyman & Gordon Co	Worcester, Mass.
Aug. 16	Semisteel	The Pickering Governor Co	Portland, Conn.
16	Cord	Tucker & Carter Rope Co	New York, N. Y.
26	Concrete cubes	Henry W. Hayes	Boston, Mass.
29	Steel	Coe Brass Manufacturing Co	Ansonia, Conn.
Sept. 2	Concrete building blocks.	E. Schier	Buffalo, N. Y.
2	do	James M. Roache	Arlington, Mass.
2	Swivel	Weatherly Foundry & Machine Co.	Weatherly, Pa.
5	do	do	Do.
5	Breaker links	Plymouth Cordage Co	North Plymouth, Mass.
5	Manila rope	do	Do.
6	Rubber belting	Revere Rubber Co	Chelsea, Mass.
7	Concrete cubes	City civil engineer	Dayton, Ohio.
7	Columns	Louis Miller Co. (Inc.)	East Boston, Mass.
11	Concrete cubes	H. F. Tucker	Boston, Mass.
14	do	Boston Elevated R. R. Co	Do.
15	do	H. F. Tucker	Do.
18	Breaker links	Plymouth Cordage Co	North Plymouth, Mass.
18	Steel	Lenox Motor Car Co	Jamaica Plain, Mass.
18	Concrete cubes	H. F. Tucker	Boston, Mass.
20	Columns	Joseph Miller Column Co	Cambridgeport, Mass.
28	Concrete building blocks.	Smith Bros. Concrete Co	Watertown, Mass.
28	do	J. S. Bellanca	Buffalo, N. Y.
30	Concrete cubes	H. F. Tucker	Boston, Mass.
Oct. 2	Concrete building blocks.	Joseph Ryan & Sons	Buffalo, N. Y.
4	Cast iron	Richmond Iron Works	Richmond Furnace, Mass.
4	Steel wire	Stanley Motor Carriage Co	Newton, Mass.
6	Shackles and swivels	Fletcher & Crowell	Portland, Me.
9	Concrete cubes	H. F. Tucker	Boston, Mass.
13	Manila rope	Boston Elevated R. R. Co	Do.
19	Concrete cubes	do	Do.
19	Steel	Indianapolis Drop Forging Co	Indianapolis, Ind.
20	Concrete cubes	Boston Elevated R. R. Co	Boston, Mass.
20	Shackles	Fletcher & Crowell	Portland, Me.
21	Chimney brick	M. W. Kellogg Co	New York, N. Y.
21	Clay building blocks	E. B. Reed	Buffalo, N. Y.
23	Sash chain	Bridgeport Chain Co	Bridgeport, Conn.
23	Steel	The Marlin Firearms Co	New Haven, Conn.
23	do	The Pennsylvania Ry. Co	Altoona, Pa.
24	Limestone cubes	The Victoria Limestone Co	Bowling Green, Ky.
24	Bronze coupling	Coffin Valve Co	Boston, Mass.
Nov. 6	Steel	Lorraine Manufacturing Co	Pawtucket, R. I.
4	do	General Electric Co	Schenectady, N. Y.
7	Concrete cubes	H. F. Tucker	Boston, Mass.
7	Concrete building blocks.	Schultz Ice Co	Buffalo, N. Y.
7	do	Alexander M. Bellony	Do.
8	Mortar cubes	H. F. Tucker	Boston, Mass.
15	Concrete cubes	Boston Elevated R. R. Co	Do.
18	Mortar cubes	H. F. Tucker	Do.
21	Concrete cubes	do	Do.
21	do	Simpson Bros. (Corp.)	Do.
Dec. 5	Column	United States Column Co	Cambridge, Mass.
6	Concrete cubes	H. F. Tucker	Boston, Mass.
6	Cast stone column	Hoyt E. Fuller	Natick, Mass.
7	Concrete cubes	H. F. Tucker	Boston, Mass.
7	Rope	A. C. Lawrence Leather Co	Do.
8	Tiles	The Ohio Clay Co	Cleveland, Ohio.
9	Rubber belting	Revere Rubber Co	Chelsea, Mass.
9	Steel	J. W. Mitchell	Boston, Mass.
9	Concrete cubes	H. F. Tucker	Do.
12	Draft gears	Standard Coupler Co	New York, N. Y.
12	do	do	Do.
26	Swivel and shackle	Weatherly Foundry & Machine Co.	Weatherly, Pa.
29	Steel	Edward A. Tucker (Inc.)	Boston, Mass.

Private tests made during the fiscal year ended June 30, 1912—Continued.

Date.	Material.	Name.	City and State.
1912.			
Jan. 8	Steel	New York Air Brake Co	Watertown, N. Y.
8	Steel rollers	American Steel & Wire Co	Worcester, Mass.
9	Swivel	Fletcher & Crowell	Portland, Me.
12	Steel plate	Stanley Motor Carriage Co	Newton, Mass.
16	Rope	Rinek Cordage Co	Easton, Pa.
19	Steel music wire	National Piano Co	Boston, Mass.
23	Eyebars	Long Island R. R. Co	Jamaica, N. Y.
26	Steel	Lenox Motor Car Co	Boston, Mass.
30	do	do	Do.
30	Iron	Dr. Chas. F. McKenna	New York, N. Y.
Feb. 1	Eyebar	Long Island R. R. Co	Jamaica, N. Y.
2	Aluminum and bronze	Non Corrosive Metal Manufacturing Co.	Watertown, Mass.
7	Shackle	Fletcher & Crowell	Portland, Me.
14	Steel	J. W. Mitchell	Boston, Mass.
17	Concrete building blocks.	Ralph Silvestro	Medford, Mass.
21	Steel links	The Thomas Laughlin Co	Portland, Me.
21	Column	Daniel Buckley	Dorchester, Mass.
23	Canvas belt	Fire Fighters Fearnaught Belt Co.	Boston, Mass.
24	Steel	Erie Forge Co	Erie, Pa.
Mar. 6	Stone	Columbia Finance Co	Spokane, Wash.
7	Monel metal	The Bayonne Casting Co	Bayonne, N. J.
8	do	do	Do.
8	Steel	Bethlehem Steel Co	South Bethlehem, Pa.
11	Buffer springs	Standard Coupler Co	New York, N. Y.
15	Steel	Pennsylvania R. R. Co	Altoona, Pa.
16	Concrete building blocks.	Zoel A. Houle	Watertown, Mass.
20	Buoy swivel	Weatherly Foundry & Machine Co.	Weatherly, Pa.
20	Bolt	Dr. Chas. F. McKenna	New York, N. Y.
23	Riveted joints	Board of Water Supply	Do.
25	Rubber belting	Revere Rubber Co	Chelsea, Mass.
25	Conveyer belt	do	Do.
26	Shackles	Fletcher & Crowell Co	Portland, Me.
27	Stone	The Connecticut Crushed Stone Co.	Hartford, Conn.
27	Concrete cubes	H. F. Tucker	Boston, Mass.
30	do	Boston Elevated R. R. Co	Do.
Apr. 1	do	do	Do.
1	Manila rope	Plymouth Cordage Co	North Plymouth, Mass.
3	Belting	Revere Rubber Co	Chelsea, Mass.
3	Steel	Crucible Steel Co	Pittsburgh, Pa.
6	Cast iron	Davis & Farnum Manufacturing Co.	Waltham, Mass.
9	Steel balls	Metz Co	Do.
11	Conveyer belt	Revere Rubber Co	Chelsea, Mass.
12	Shackles	Fletcher & Crowell Co	Portland, Me.
16	Concrete cube	Boston Elevated R. R. Co	Boston, Mass.
20	Manila rope	Rinek Cordage Co	Easton, Pa.
23	Swivel	Weatherly Foundry & Machine Co.	Weatherly, Pa.
23	Concrete cube	Boston Elevated R. R. Co	Boston, Mass.
30	do	H. F. Tucker	Do.
May 8	Shelf supports	The Snead & Co. Iron Works	Jersey City, N. J.
10	Swivel	Treadwell Engineering Co	Easton, Pa.
16	Sash chain	The Bridgeport Chain Co	Bridgeport, Conn.
18	Swivels	Treadwell Engineering Co	Easton, Pa.
20	Brick	New England Brick Co	Boston, Mass.
23	Crucible steel casting	Connolly Steel Casting Co	Chelsea, Mass.
June 4	Track bolts	The Pennsylvania Steel Co	Boston, Mass.
10	Concrete building block.	H. S. Hemingway	Somerville, Mass.
11	Shelf supports	The Snead & Co. Iron Works	Jersey City, N. J.
12	Bricks	Bay State Brick & Stone Co	Springfield, Mass.
13	Steel	The Pennsylvania Steel Co	Steelton, Pa.
14	do	do	Do.
15	Shackles	Fletcher & Crowell	Portland, Me.
15	Steel	Titusville Forge Co	Titusville, Pa.
17	do	Builders Iron Foundry	Providence, R. I.
19	Swivel	Treadwell Engineering Co	Easton, Pa.
21	Sash chain	The Bridgeport Chain Co	Bridgeport, Conn.
26	Sand-lime bricks	Bay State Brick & Stone Co	Springfield, Mass.
26	Concrete building block.	H. S. Hemingway	Somerville, Mass.
26	do	Theo. Kaitanowski	Buffalo, N. Y.
27	Rubber belting	Revere Rubber Co	Chelsea, Mass.

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