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ENGINEERING MECHANICS

Publications by Members of the Staff of the National Bureau of Standards

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#### GENERAL INFORMATION

Some of these papers have appeared in the publications of the National Bureau of Standards, the National Advisory Committee for Aeronautics, and other scientific and technical journals. Unless specifically stated, these publications are not obtainable from the National Bureau of Standards.

Where the price is stated, the publication can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price includes delivery in the United States, its territories and possessions, and in certain foreign countries which extend the franking privilege. For all other countries, one-third the cost of the publication should be added to cover postage. Remittances should be made either by coupons (obtainable from the Superintendent of Documents in sets of 20 for \$100, good until used,) or by check or money order payable to the "Superintendent of Documents, Government Printing Office."

Publications marked "OP" are out of print, but may be consulted in technical libraries.

For papers in other scientific or technical journals, the name of the journal or of the organization publishing the article is given in abbreviated form, with the volume number (underscored), page and year of publication. The Bureau can not supply copies of these journals, nor reprints from them, and has no information on where they may be purchased. Usually they can be consulted in technical libraries.

Photostatic copies of papers may be purchased from the Engineering Societies' Library, 29 West 39th Street, New York, N. Y.

ABBREVIATIONS  
National Bureau of Standards

- T = "Technologic Paper". T1 to T370. In 1928, these papers were superseded by the "Bureau of Standards Journal of Research."
- RP = "Research Paper". These are reprints of articles in the "Bureau of Standards Journal of Research" (BS J. Research) and the Journal of Research of the National Bureau of Standards (J. Research NBS), the latter being the title of the periodical since July 1934 (volume 13, number 1). When requesting a Journal at a library the volume number should be given as a reference.
- C = "Circular".
- M = "Miscellaneous Publication".
- LC = "Letter Circular". Free on request to the National Bureau of Standards.
- BMS = "Building Materials and Structures".

National Advisory Committee for Aeronautics

- TR = "Technical Report". Those reports which are out of print will be found in the Annual Reports. These Reports are in public libraries and in the Office of Aeronautical Intelligence, National Advisory Committee for Aeronautics, Washington, D.C.
- TN = "Technical Note". Free on request to the National Advisory Committee for Aeronautics.

Circular C24 and Supplements (1901-1936) give a list of the publications of the National Bureau of Standards and is sold by the Superintendent of Documents for 55 cents. New publications are reviewed each month in the Technical News Bulletin; Subscription 50¢ per year.

APPARATUS

(See, also, Proving Rings and Strain Gages)

<u>Title</u>	<u>Series</u>	<u>Price</u>
An extensometer comparator. A. H. Stang and L. R. Sweetman. J. Research NBS <u>15</u> , 199 (1935). Mechanical World and Engineering Record (Manchester, England) <u>XCVIII</u> , 473 (1935) - - - -	RP822	5¢
A simple fixture for testing belting. American Machinist (New York, New York), <u>60</u> , 722 (1924).		
Cable reel of simple design. H. L. Whittemore. Machinery (New York, New York), <u>30</u> , 925 (1924).		

## AREA, CROSS-SECTIONAL

<u>Title</u>	<u>Series</u>	<u>Price</u>
The areas and tensile properties of deformed concrete reinforcement bars. A. H. Stang, L. R. Sweetman and C. Gough. BS J. Research <u>9</u> , 509 (1932) -----	RP486	5¢
Determination of cross-sectional areas of structural members. J. A. Miller. J. Research NBS <u>23</u> , 621 (1939) -----	RP1258	10¢

## BEAMS

Discussion of tests of I-beams in torsion. L. B. Tuckerman. Eng. News-Record <u>93</u> , 882 (1924).		
A theory of flexure for beams with nonparallel extreme fibers. W. R. Osgood. Trans. ASME <u>61</u> , A-122 (1939).		

## BEARINGS

The friction and carrying capacity of ball and roller bearings. H. L. Whittemore and S. N. Petrenko. (1921) -----	T201	10¢
Accelerated service test of pintle bearings. A. H. Stang and L. R. Sweetman. J. Research NBS <u>15</u> , 591 (1935) -----	RP854	5¢
Tests of ball bearings for rotating beam fatigue machines. L. B. Tuckerman and C. S. Aitchison. Am. Machinist (New York, New York), <u>61</u> , 369 (1924).		

## BOLTS

Note on the electrical resistance of contacts between nuts and bolts. F. Wenner, G. W. Nusbaum and B.C. Cruickshanks. BS J. Research <u>5</u> , 757 (1930) -----	RP227	10¢
The relation of torque to tension for threadlocking devices. H. L. Whittemore, G. W. Nusbaum and E.O. Seaquist. BS J. Research <u>7</u> , 945 (1931) -----	RP386	30¢
Impact and static tensile properties of bolts. H. L. Whittemore, E. O. Seaquist and G. W. Nusbaum. J. Research NBS <u>14</u> , 139 (1935) -----	RP763	10¢
Experimental use of liquid air and explosives for tightening body-bound bolts. H. L. Whittemore. Am. Machinist (New York, N.Y.) <u>56</u> , 524 (1922).		
The strength of bolt threads as affected by inaccurate machining. G.M. Deming. Mech. Engineering (New York, N.Y.), <u>45</u> , 583 (1923).		



CALIBRATION OF TESTING MACHINES  
(See, also, Proving Rings)

<u>Title</u>	<u>Series</u>	<u>Price</u>
A new dead weight testing machine of 100,000 lb capacity. L. B. Tuckerman, H. L. Whittemore and S.N. Petrenko. BS J. Research <u>4</u> , 261 (1930). Metals and Alloys (New York, N. Y.), <u>1</u> , 661 (1930) -----	RP147	5¢
Calibration of testing machines under dynamic loading. Bruce Wilson and Carl Johnson. J. Research NBS <u>19</u> , 41 (1937) -----	RP1009	OP

COLUMNS

(See, also, Plates, Stresses from  
Strain-Gage Readings, and Structures)

Tests of large bridge columns. J. H. Griffith and J.G. Bragg. (1918) -----	T101	30¢
Results of some compressive tests of structural steel angles. A.H. Stang and L.R. Strickenberg. Tech. Pap. BS <u>16</u> , 651 (1922) -----	T218	10¢
Compressive strength of column web plates and wide web columns. R.S. Johnston. Tech. Pap. BS <u>20</u> , 733 (1926) -----	T327	20¢
Tests of large columns with H-shaped sections. L. B. Tuckerman and A. H. Stang. Tech. Pap. BS <u>21</u> , 1 (1926) -----	T328	40¢
Transverse tests of H-section column splices. J. H. Edwards, H.L. Whittemore and A.H. Stang. BS J. Research <u>4</u> , 395 (1930). J. Am. Welding Soc. (New York, N.Y.), <u>2</u> , 7 (1930) -----	RP157	10¢
Column curves and stress-strain diagrams. W.R. Osgood. BS J. Research <u>9</u> , 571 (1932) -----	RP492	5¢
Contribution to the design of compression members in aircraft. W.R. Osgood. J. Research NBS <u>13</u> , 157 (1934) -----	RP698	5¢
Tests of steel tower columns for the George Washington Bridge. A.H. Stang and H.L. Whittemore. J. Re- search NBS <u>15</u> , 317 (1935) -----	RP831	10¢
Some tests of steel columns incased in concrete. A.H. Stang, H.L. Whittemore and D.E. Parsons. J. Re- search NBS <u>16</u> , 265 (1936) -----	RP873	10¢
Tests of eight large H-shaped columns fabricated from carbon manganese steel. A.H. Stang, H.L. Whitte- more and L.R. Sweetman. J. Research NBS <u>16</u> , 595 (1936) -----	RP896	5¢

## COLUMNS (Continued)

<u>Title</u>	<u>Series</u>	<u>Price</u>
Tests of steel chord members for the Bayonne Bridge. A. H. Stang, H. L. Whittemore and L.R. Sweetman. J. Research NBS <u>16</u> , 627 (1936) -----	RF897	5¢
Column strength of tubes elastically restrained against rotation at the ends. W.R. Osgood. NACA Tech. Reports <u>24</u> (1938) -----	TR615	15¢
The column strength of two extruded aluminum-alloy H- sections. William R. Osgood and Marshall Holt. NACA Tech. Reports <u>25</u> (1939) -----	TR656	10¢

## COMPRESSION

(See Columns and Stresses from Strain-  
Gage Readings and Welding, Gas)

The "pack" method for compressive tests of thin speci- mens of materials used in thin-wall structures. C.S. Aitchison and L.B. Tuckerman. NACA Tech. Reports <u>25</u> (1939) -----	TR649	10¢
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## CUTTING, GAS

Tests on structural details flame-cut from I-beams. Eng. News-Record (New York, N.Y.), <u>101</u> , 668 (1928).		
New series of tests on flame-cut wind connections. O.E. Hovey. Eng. News-Record (New York, N.Y.), <u>106</u> , 729 (1931).		

## ELEVATORS

Load distribution and strength of elevator cable equal- izers. A.H. Stang and L.R. Sweetman. J. Research NBS <u>17</u> , 291 (1936) -----	RP912	5¢
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## FATIGUE OF METALS

Design of specimens for short-time fatigue tests. L.B. Tuckerman and C.S. Aitchison. Tech. Pap. BS <u>19</u> , 47 (1924) -----	T275	5¢
Fatigue testing of wing beams by the resonance method. W.M. Bleakney. NACA Tech. Note 660 (1938) -----	TN660	
Discussion of fatigue or progressive failure of metals under repeated stress. L.B. Tuckerman. Proc. Am. Soc. Testing Materials (Philadelphia, Pa.) <u>22</u> , Part II, 266 (1922).		
Tests of ball bearings for rotating beam fatigue machines. L. B. Tuckerman and C. S. Aitchison. Am. Machinist (New York, N.Y.), <u>61</u> , 369 (1924).		

FLOORS, STEEL  
(See Structures and Stresses from  
Strain-Gage Readings)

HARDNESS  
(See, also, Proving Rings)

<u>Title</u>	<u>Series</u>	<u>Price</u>
Comparison of five methods used to measure hardness. R. P. Devries. (1912) -----	T11	OP
Relationships between Rockwell and Brinell numbers. S. N. Petrenko. BS J. Research <u>5</u> , 19 (1930). This number of the Journal is available, price 40¢.-----	RP185	OP
Determination of the Brinell number of metals. S.N. Petrenko, W. Ramberg and B. Wilson. J. Research NBS <u>17</u> , 59 (1936) -----	RP903	5¢
Table of Brinell hardness numbers. Misc. Pub. BS, M62 (1924) -----	M62	5¢
The hardness testing of metals. Report of Committee of Eng. Div. of Nat. Research Council. Mech. Engineering (New York, N. Y.) <u>43</u> , 445 (1921).		
Mechanical meaning of hardness numbers. S. N. Petrenko. Mech. Engineering (New York, N. Y.), <u>46</u> , 926 (1924).		
Hardness and hardness testing. L. B. Tuckerman. Mech. Engineering (New York, N. Y.), <u>47</u> , 53 (1925).		
The need for cheaper hardness tests. H. L. Whittemore. Mech. Engineering (New York, N. Y.) <u>47</u> , 223 (1925).		
Discussion of standardizing the Brinell test. H. L. Whittemore, L. B. Tuckerman and S. N. Petrenko. Trans. Am. Soc. Steel Treating (Cleveland, Ohio), <u>XI</u> , 67 (1927).		

HOOKS, GIRDER  
(See Stresses from Strain-Gage  
Readings)

IMPACT  
(See also Bolts)

Comparative slow bend and impact notched bar tests of some metals. S. N. Petrenko. Tech. Pap. BS <u>19</u> , 315 (1925) -----	T289	20¢
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## LABORATORIES, METALS TESTING

<u>Title</u>	<u>Series</u>	<u>Price</u>
Directory of commercial testing and college research laboratories. Misc. Pub. NBS, M125 (1936) -----	M125	15¢
Testing laboratories equipped for mechanical tests of metals and other engineering materials (1929) ----	LC191	free direct from NBS
LIMIT, PROPORTIONAL		
Discussion of the determination and significance of the proportional limit in testing metals. L.B. Tuckerman. Proc. Am. Soc. Testing Materials. (Philadelphia, Pa.) <u>29</u> , Part II, 538 (1929).		

## MACHINES, TESTING

(See, also, Calibration of testing machines)

Testing machines for determining the strength and other properties of engineering materials in the laboratories of the National Bureau of Standards (1934)--	LC405	free direct from NBS
Testing full-sized members to destruction - massive testing machine. The Engineer (London, England) <u>CXLII</u> , 331 (1926): Iron Age (New York, N. Y.) <u>118</u> , 1347 (1926).		
Speed control for screw-power testing machines driven by direct-current motors. A. H. Stang and L. R. Sweetman. Am. Soc. Testing Materials. (Philadelphia, Pa.) Bul. No. 87, August, 1937.		

## MATERIALS

(See, also, Impact and Proving Rings)

Physical properties of materials (1924). (Circular 101 and Supplement, 40¢). (Supplement only, 5¢)-----	C101	40¢
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## PIPE

(See, also, Tubing)

Comparative tests of six-inch cast iron pipe of American and French manufacture. S. N. Petrenko. Tech. Pap. BS <u>21</u> , 231 (1927) -----	T336	15¢
Tests of rotary drill pipes. A. H. Stang. Iron Age (New York, N.Y.), <u>108</u> , 804 (1921) and <u>109</u> , 359 (1922).		
A welded steam pipe. H. L. Whittemore. Industry and Welding (Cleveland, Ohio) <u>2</u> , 2 (1931).		
A welded dredge pipe. H. L. Whittemore. Industry and Welding (Cleveland, Ohio) <u>2</u> , 12 (1931).		



## PLATES

<u>Title</u>	<u>Series Price</u>
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Strength of rectangular flat plates under edge compression. L. Schuman and G. Back. NACA Tech. Reports <u>16</u> (1930)-TR356	15¢
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PROPELLERS, AIRCRAFT  
(See Vibration)

PROVING RINGS  
(See, also, Calibration of Testing  
Machines)

Specification for proving rings for calibrating testing machines (1939) -----	free LC548 direct from NBS
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Elastic ring for verification of Brinell hardness testing machines.  
S. N. Petrenko. Trans. Am. Soc. Steel Treating (Cleveland,  
Ohio) IX, 420 (1926).

Rings for checking accuracy of testing machines. W. S. Morehouse.  
Iron Age (New York, N. Y.), 123, 945 (1929).

Discussion of thermal effects in elastic and plastic deformation.  
L. B. Tuckerman. Proc. Am. Soc. Testing Materials. (Philadelphia,  
Pa.) 32, Part II, 594 (1932).

Weighing bridge reactions with proving rings. C. M. Spofford and  
C. H. Gibbons, Eng. News-Record (New York, N. Y.), 114, 446  
(1935).

## RAILS

Final report committee on welded rail joints. Am. Bureau Welding  
(New York, N. Y.) (1932).

## RESEARCH

Research the best way to reduce costs. H. L. Whittemore. Am.  
Petroleum Inst. Bul. (New York, N. Y.), VIII, 107 (1927).

RIVETING  
(See, also, Vessels, Pressure)

Mechanical properties of aluminum alloy rivets. William  
C. Brueggeman. NACA Tech. Note 585 (1936) -----TN585

Bibliography on riveted joints. Am. Soc. Mech. Engineers (New York,  
New York) (1924).

Investigation of the behavior and of the ultimate strength of riveted  
joints under load. E. L. Gayhart, Commander U.S.N. Trans. Soc.  
Naval Architects and Marine Engineers (New York, N.Y.), 34, 55  
(1926).

## ROOFING, COPPER

<u>Title</u>	<u>Series</u>	<u>Price</u>
Seams for copper roofing. K. H. Beij, BS J. Research 5, 585 (1930) -----	RP216	15¢

ROPE, WIRE  
(See, also, Elevators)

Strength and other properties of wire rope. J.H. Griffith and J. G. Bragg. (1919) -----	T121	OP
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Inspection and tensile tests of some worn wire ropes. W.H. Fulweiler, A.H. Stang, and L.R. Sweetman. J. Research NBS <u>17</u> , 401 (1936) -----	RP920	OP
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Some tests of steel wire rope on sheaves. E. Skillman. Tech. Pap. BS <u>17</u> , 227 (1923) -----	T229	10¢
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Discussion of report on guard fence research. H. L. Whittemore. Proc. Eighth Annual Meeting Highway Research Board (National Research Council, Washington, D. C.) 281 (1928).		
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SEAMS, SOLDERED  
(See Roofing, Copper)

## STRAIN GAGES

New electrical telemeter. B. McCollum and O.S. Peters. Tech. Pap. BS <u>17</u> , 737 (1924) -----	T247	15¢
--	------	-----

Compensation of strain gages for vibration and impact. William Bleakney. J. Research NBS <u>18</u> , 723 (1937)---	RP1005	5¢
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Optical strain gages and extensometers. L. B. Tuckerman. Proc. Am. Soc. Testing Materials (Philadelphia, Pa.), <u>23</u> , Part II, 602 (1923).		
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New developments in electrical telemeters. O. S. Peters and R. S. Johnston. Proc. Am. Soc. Testing Materials (Philadelphia, Pa.), <u>23</u> , Part II, 592 (1923).		
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Whittemore strain gage. H. L. Whittemore. Instruments (Pittsburgh, Pa.) <u>I</u> , 299 (1928).		
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## STRAIN LINES IN STEEL

Strain lines, structural members. Delaware Bridge. Misc. Pub. BS M72 (1926) -----	M72	5¢
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Strain detection in mild steel by wash coating. R. S. Johnston. British Iron and Steel Inst. (London, England) <u>CXII</u> , 342 (1925).		
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## STRESSES FROM STRAIN-GAGE READINGS

<u>Title</u>	<u>Series</u>	<u>Price</u>
Physical tests of motor truck wheels. C.P. Hoffman. (1920) -----	T150	OP
Load strain-gage test of 150-ton floating crane for the Bureau of Yards and Docks, U. S. Navy Department. L. J. Larson and R. L. Templin. (1920) -----	T151	10¢
Tests of some girder hooks. H.L. Whittemore and A.H. Stang. Tech. Pap. BS <u>18</u> , 305 (1924) -----	T260	10¢
Compressive tests of bases for subway columns. J. H. Edwards, H. L. Whittemore and A. H. Stang. BS. J. Research <u>5</u> , 619 (1930). J. Am. Welding Soc. (New York, N. Y.) <u>10</u> , 20, (1931) -----	RP218	10¢
Stress distribution in welded steel pedestals. J. H. Edwards, H. L. Whittemore and A. H. Stang. BS J. Research <u>5</u> , 803 (1930). J. Am. Welding Soc. (New York, N. Y.) <u>10</u> , 46, (1931) -----	RP232	10¢
Strain measurement in the reinforcement for the dome of the Natural History Building. W. C. Lyons, H. L. Whittemore, A. H. Stang, and L. R. Sweetman. BS J. Research <u>6</u> , 183 (1931) -----	RP268	15¢
Compressive tests of jointed H-section steel columns. J. H. Edwards, H. L. Whittemore and A. H. Stang. BS J. Research <u>6</u> , 305 (1931) -----	RP277	15¢
Tests of cellular sheet steel flooring. H.L. Whittemore and J. M. Frankland. BS J. Research <u>9</u> , 131 (1932). J. Am. Welding Soc. <u>12</u> , 4 (1933) -----	RP463	10¢
Determination of stresses from strains on three inter- secting gage lines and its application to actual tests. W.R. Osgood and R.G. Sturm. BS J. Research <u>10</u> , 685 (1933) -----	RP559	5¢
Test of a flat steel plate floor under load. L. B. Tuckerman, A. H. Stang and W. R. Osgood. BS J. Research <u>12</u> , 362 (1934) -----	RP662	OP
Determination of principal stresses from strains on four intersecting gage lines 45° apart. W. R. Osgood. J. Research NBS <u>15</u> , 579 (1935) -----	RP851	5¢
Tests of eight large H-shaped columns fabricated from carbon-manganese steel. A. H. Stang, H. L. Whittemore and L. R. Sweetman. J. Research NBS <u>16</u> , 595 (1936) -----	RP896	5¢

## STRESSES FROM STRAIN-GAGE READINGS (Continued)

<u>Title</u>	<u>Series</u>	<u>Price</u>
Graphical computations of stresses from strain data. Ambrose H. Stang and Martin Greenspan. J. Research NBS <u>19</u> , 437 (1937) -----	RP1034	10¢
Strength of a riveted steel rigid frame having straight flanges. Ambrose H. Stang, Martin Greenspan and William R. Osgood. J. Research NBS <u>21</u> , 269 (1938)-	RP1130	15¢
Strength of a riveted steel rigid frame having a curved inner flange. Ambrose H. Stang, Martin Greenspan and William R. Osgood. J. Research NBS <u>21</u> , 853 (1938) -----	RP1161	10¢
Heterostatic loading and critical astatic loads. L. B. Tuckerman. J. Research NBS <u>22</u> , 1 (1939) -----	RP1163	10¢
Strength of a welded steel rigid frame. Ambrose H. Stang and Martin Greenspan. J. Research NBS <u>23</u> , 145 (1939) -----	RP1224	5¢
Approximation to a function of one variable from a set of its mean values. Martin Greenspan. J. Re- search NBS <u>23</u> , 309 (1939) -----	RP1235	5¢
Experimental study of deformation and effective width in axially loaded sheet-stringer panels. Walter Ramberg, Albert E. McPherson and Sam Levy. NACA Tech. Note 684 (1939) -----	TN684	
Compressive test of a monocoque box. Walter Ramberg, Albert E. McPherson and Sam Levy. NACA Tech. Note 721 (1939) -----	TN721	
Laboratory strength tests of motor truck wheels. T. W. Greene. J. Soc. Automotive Engineers (New York, N. Y.), <u>XV</u> , 150 (1924).		

## STRUCTURES

(See, also, Stresses from strain-gage readings, Strain lines in steel, and Welding, electric, gas, and general)

Research on building materials and structures for use in low-cost housing. Hugh L. Dryden -----	BMS1	10¢
Methods of determining the structural properties of low- cost house constructions. Herbert L. Whittemore and Ambrose H. Stang -----	BMS2	10¢

The BMS reports on the structural properties of house constructions are listed in LC552. This letter circular can be obtained free on request from the National Bureau of Standards.



## STRUCTURES (Continued)

<u>Title</u>	<u>Series</u>	<u>Price</u>
Test of arc-welded plate girder by American Bridge Company and the U. S. Bureau of Standards. H. L. Whittemore. J. Am. Welding Soc. (New York, N. Y.), <u>6</u> , 42 (1927).		
Spot-welded girders and columns tested for strength. L. B. Tuckerman. Eng. News-Record (New York, N.Y.), <u>92</u> , 982 (1924).		
Discussion of wind bracing connection efficiency. W. R. Osgood. Proc. Am. Soc. Civil Engineers (New York, N.Y.), <u>58</u> , 675 (1932).		
Discussion of stresses in space structures. W. R. Osgood. Proc. Am. Soc. Civil Engineers (New York, N.Y.), <u>60</u> , 1085 (1934).		
Tests of Mesnager hinges. D. E. Parsons and A. H. Stang. J. Am. Concrete Inst. (Detroit, Mich.), <u>6</u> , 304 (1935). Proc. <u>31</u> .		

## STRUTS

(See Columns)

## TANKS

(See Vessels, Pressure)

## TESTING, GENERAL

The significance of tests. Warren E. Emley and L. B. Tuckerman. Am. Soc. Testing Materials (Philadelphia, Pa.) Bul No. 99, August 1939.

## THREADS, SCREW

(See Bolts)

## TORSION

(See Beams, Tubing)

## TUBING

(See, also, Columns, Pipe)

Physical properties of electrically welded steel tubing. H. L. Whittemore, J. S. Adelson, and E. O. Seaquist. BS J. Research <u>4</u> , 475 (1930). J. Am. Welding Soc. (New York, N.Y.), <u>9</u> , 17 (1930)	-----RP161	OP
Torsion tests of tubes. Ambrose H. Stang, Walter Ramberg and Goldie Back. NACA Tech. Reports <u>23</u> , (1937)	-----TR601	10¢
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<u>Title</u>	<u>Series</u>	<u>Price</u>
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Efficiency of machinists' vises. H. L. Whittemore and L. R. Sweetman. BS J. Research <u>3</u> , 191 (1929) -----	RF91	10¢
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WELDING, ELECTRIC  
(See Pipe and Structures)

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WELDING, GENERAL (See, also, <u>Pipe</u> , <u>Rails</u> , <u>Stresses from Strain-gage Readings</u> , and <u>Vessels, Pressure</u> )		
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## WHEELS, TRUCK

(See Stresses from Strain-Gage Readings)

