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A Bibliography of Screw Thread Measurement

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A BIBLIOGRAPHY ON SCREW THREAD MEASUREMENT

by

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This bibliography on screw thread measurements was compiled as background material for an evaluation of the current the state of the art. The bibliography covers screw thread measurement methods (lead, pitch diameter, etc.), tables for ball and wire methods, discussions of instruments for thread measurements, and papers on the basic geometry of thread forms. When possible the entire abstract is presented. The papers are presented in chronological order starting from 1890 to 1991.

Following the abstracts there are two indexes, one by author and the second by keyword. The reference code is made up of the year of publication and the beginning letters of the first author's last name.

1890

anon., **Systems of Screw Threads,** Mechanics, Sept. - Oct. 1890.
Chapter IV. of "The Constructor". Formulas and tables.

1893

anon., **Proposed Uniform System for France,** Amer. Eng. & Ry. Jour., Dec. 1893, p.584.

Formula and the table giving the pitch, length of screw and diameter for the screw of different trade numbers.

1898

Marre, M., **Insturments for Gauging Screw Trheads** (Sur les Instruments Verificateurs des Filletages), 6000 W. Bull de la Societe d'Encour Jan. 1898.
Describing a system of gauges intended for use on the metric screw thread system known as the "System Francais" (S.F.) with table for the system.

1901

anon., **Insturment for Measuring Screw Threads,** H.J.C., Standards Dep., Board of Trade, Westminster Oct. 01, 1901.
A design of a measuring instrument, the Viscometer, for measuring the angle and pitch of a screw thread.

1903

Cantelo, Walter, **Measuring External Screw Thread Diameters,** 1200 W. Am Mach June 25, 1903.
Gives sketches, formulas and tables, worked out by the writer, so that by using ordinary micrometer calipers and wire of the diameter called for in the table, the standard threads can be compared with the figures given.

NPL, **Screw Measuring Machine** (at National Physical Laboratory), 1200 W. Engng Nov. 13, 1903.
Illustrates and describes a machine art the British National Laboratory for Micrometrically testing the accuracy of commercially-produced screw threads and taps.

1904

anon., **A Microscope for Measuring Screw Threads,** Am Mach v27 pt1 n3 Jan. 21, 1904, p.78.
Illustrations show the microscope, the arrangement of the cross wires, and various adjustments. Instrument made by the Cambridge Scientific Inst. Co. for the small screw Gage Committee of the British Association, by whom it was placed in the custody of the National Physical Laboratory.

Bruce, R.A., **Determining the Errors in Screws,** Am Mach v27 Apr. 07, 1904, p.454-5.
Microscope and scale arrangement for determining lead errors of lead screws, with a micrometer for measuring the magnitudes of the errors, a contact point being inserted in the thread space, and a cross hair of the microscope being set on the scale divisions.

Colburn, George L., **A Screw Thread Angle Table,** 500 W. Am Mach June 09, 1904.
A table giving the angle of helixes of various pitches and diameters with respect to a line perpendicular to the axis, with explanatory notes.

Stabel, J.M., **Measuring External Thread Diameters,** Am Machy (N.Y. Eng Ed) v2 n5 Jan. 1904, p.248-50.
Describes method of thread measurement by means of wires and micrometers.

1906

NPL, **Measuring the Pitch of Nuts,** GB NPL Rep. 1906, P.43.
A carriage actuated by an accurate guide screw can slide along a bed A, and on the carriage is a second slide B making an angle 62.5 deg. with the slide A. On slide B is a pivoted lever arrangement. The nut is set up with its axis parallel to slide A, and the arrangement is such that when the lever point on slide B is brought into contact with the slide of the thread any movement of the point in the direction of the slide B causes no displacement of the lever, the angle being 55 deg. This acts as an indicator of contact between the point and the side of the thread, and by means of the guide screw the pitch may be measured.

Storey, J.E., **Methods of Correcting Inaccuracies of Screw Threads,** 700 W. Mech. Engr. Apr. 14, 1906, No. 76196 A.
Illustrates and describes a method applicable to measuring apparatus, dividing machines, and other instruments of precision recently patented.

1907

anon., **Measuring External Screw Thread Diameters,** Am Machy v30 March. 07, 1907, p.356-7.

The application of micrometers and wires in the measurement of USS, V, and Whitworth threads.

Cantelo, W., **Measuring Screw Thread Diameters,** Machy (N.Y.) v14 Sept. 1907, P.33-4.

Gives formulas for the limiting sizes of wires for 60, 55 and 29 deg. threads.

Jeffcott, H.H., **Notes on Screw Threads,** Proc. Inst. Mech. Engrs. Dec. 1907, p.1067-1108. Collected Researchers NPL v5 1909, p.215-50.

Contain an account of some theoretical aspects of screw threads, partly from the stand-point of accuracy in the interpretation of results of measurement. Equations of the surface of the screw thread were obtained in two different ways: One by a consideration of the method of generation and the other by the use of Fourier series. Approximate formulas for the measurement of effective diameter of a screw are derived on the basis that measurements are taken over cylinders, which being free, set themselves nearly along the rake of the thread. A similar case in which the cylinders are fixed perpendicular to the axial plane of measurement of the screw is also considered. The effect of small errors in the various elements of a screw on the interpretation of the results of a measurement of effective diameter is exhibited as a formula. Compiler's Comment: **Jeffcott's** (approximate) Three Wire Method has been internationally used for almost 60 years in the measurement of standard screw threads, particularly for single-start screws.

1908

Conners, E.R., **Testing the Lead Screw of a Lathe,** Am Mach v31 Nov. 19, 1908, p.751.

Uses micrometer to measure motion of carriage.

Oberg, E., **Testing the Lead of Taps and Screws,** Machy (N.Y.) v14 Jan. 1908, p317-8.

Describes testing the lead by gages and comparators for the lead of taps and screws.

1909

Anderson, M.E., **A Device for Measuring Screw Threads,** Am Mach v32 n41 Oct. 14, 1909, p.665-8, No. 8802.

Illustrates and describes roller calipers which can be conveniently adjusted to suit any angle of helix and to measure accurately threads of any lead. System evolved to meet the needs of the S.S. White Dental Mfg. Co. 12 or 15 years ago.

Springer, J.F., **A Method of Finding Sizes of Roller Thread Screw Blanks,** 1200 W. Wm Mach v33 n21 1909, No. 14389.

An approximate diameter formula is derived.

1910

anon., **Measuring Metric Screw Threads,** Am Mach v33 pt2 Dec. 01, 1910, p.1028.

Includes tables of constants for measuring the pitch diameter of metric threads by the three-wire system.

1911

Longworth, G.H., **Dividing the Pitch of Double and Multiple Threaded Screw,** 1800 W. Mech Wld March. 31, 1911, No. 22496 A.

Describes the various methods employed. Ills.

Whitemore, H.L., **Testing Pitch of Micrometer Screws,** Am Mach v34 March. 09, 1911, p.437-8.

Optical lever device for testing uniformly pitch and diameter.

1912

Stewart, J.J., **Wires for Measuring Threads,** Am Mach v36 May 23, 1912, p.842.

Illustrated discussion of use of wires.

1913

anon., **Measuring Screw Threads by Means of Micrometers,** Machy (N.Y.) v19 n5 Jan. 1913, p.384.

Includes a table of sizes of two types of micrometer ball points applicable to various threads per inch.

De La Guerre, S.I., **Insturction a L'Usage des Etablissements Constructeurs pour la Reception des Vis et Ecrous au Filetage** (Instruction on the Usage of the Establishments Constructeurs for the Receipt of Threaded Screws and Nuts), Artillerie Dec. 23, 1913.

Includes a description of a comparator for checking pitch diameter of screw threads, which embodies V-shaped anvils for contact with thread. Also includes description of a lead tester.

1914

anon., **New Measuring Insturments,** Horseless Age Aug. 12, 1914.
New measuring instruments and measuring methods in Automobile Manufacture and deals with the measurement of screws and gears.

Banwell, I., **One Wire System for Measuring Screw Threads,** Machy (N.Y.) v19 July 1914, p.978.
Gives a formula for measuring pitch diameter with one wire.

1916

Fennell, K., **Measuring B and S or ACME 29 deg. Threads,** Am Mach v45 Nov. 16, 1916, p.846.
Gives formulas for any size of wire that will touch the sides and project above the top of the thread, not taking the lead angle into account.

NPL, **Notes on Screw Gages,** NPL (Teddington) Feb. 1916, p.28.
Includes discussion of measurements of effective diameter and angle by cylinders of other than best diameters. Use of a reference groove and cylinder for effective and core diameter measurements.

NPL, **Errors of Screws** (70473 a), 1500 W. Mch W May 05, 1916.
Reprinted from Nat. Phys. Lab. pamphlet. Ills.

1917

anon., **Measuring Screw Threads by the Three-wire System,** Machy (London) v11 Nov. 15, 1917, p.181.
Formulas proving that the effect of lead angle readings is negligible with standard threads.

Billings, J.H., **Errors in Measuring Thread Pitch Diameters with Wire,** Am Mach v47 n25 Dec. 20, 1917, p.1007-8; Mech Wld v63 May 03, 1918, p.207.
Discusses discrepancy in measurements of pitch diameter obtained by means of wires and by thread micrometers.

Bingham-Powell, H.J., **The Inspection of Screw Gages for Munitions of War,** Am Mach v47 n25 Dec. 20, 1917, p.1065-73.
The measurement of the pitch. Devices for measuring pitch. Pitch from thread to thread.-Levelling operations. Ring screw gages. Plug screw gages. The thread-micrometer principle. One wire better. Tolerance allowed. Illustrations etc.,

Brooker, A., **Screw Thread Measurement,** Eng v103 n2666 Feb. 02, 1917, p.113-6; n2667 Feb. 09, 1917 p.139-41; n2668 Feb. 16, 1917, p.165-6.

This paper deals with the methods of measurement and with the whitworth standard system. See also Cambridge Scientific Instrument Co., title no. 79. First installment. Gives Engineering Standards Committee definitions of configuration of screw and threads (effective diameter and core diameter etc.,).

Brooker, Arthur, **Screw Thread Measurement,** 4000 W. Mech. Engr. May 04, 1917.

Serial, 1st part. History of the standardization of screw threads; methods of measurement, etc., Ills.

Hamilton, D.T., **Gaging and Inspecting Screw Threads,** Machy v23 n6 Feb. 1917, p.477-86 tables ni-ix; the same, ii. Machy v23 n7 Mar. 1917, p.481-6.

Consists of British and American Standards on tolerance limits on various parameters, included angle etc., and also consists of a general survey of devices for testing lead of taps and screws.

Ile, W.T., **Master Whitworth Thread Gauges,** Machy (N.Y.) v24 Sept. 1917, p.51-2.

Formulas for measuring the pitch diameter and checking the flank angle by means of two wires.

Lee, A.J. and H.B. Steel, **Calibration of New Screw Measuring Machine,** Astron J v30 May 05, 1917, p.128-9.

Description of tests of a new measuring machine designed by F.Schlesinger and made by Gaertner of Chicago. The screw is 18 mm. in diameter and has 249 threads of 1 mm. pitch. The periodic error was found to have a max. value of 0.00013 mm., which is negligible in all work with stellar images. The progressive errors were determined for every cm. of the screw, with a temperature range, during the measurement, of 1.3 deg. C. They are small and negligible for the work in view.

Williams, F.R., **The Microscope for Inspecting Screws,** Am Mach v46 n17 Apr. 26, 1917, p.736.

The microscope and the fixtures used in adapting it for testing threads. Author treats on accurate checking of hobs, taps, thread chasers, forming cutters and a number of other tools with cutting edges. He also refers to the chapter on "The use of the compound microscope in the toolroom" in the work under the title: Accurate tool work, by Goodrich and Stanley.

anon., **Precision Screw Measuring Machine,** Machy v24 Feb. 1918, p.494-5.
Describes precision screw measuring machine made by the Cambridge Scientific Inst. Co. Ltd. for the small Screw-Gage Committee of the British Association. For measuring major diameter, pitch diameter, lead and angle of commercially produced screw threads and taps.

anon., **Simple Method of Measuring Pitch Diameter of Screw Threads, Machy (London) v12 May 02, 1918, p.128.**
Sketch and formulas are given, using three wires and measuring from crest of thread to over wires.

anon., **Sheffield Thread-Lead Testing Machine for Screw Gages,** Am Mach v49 n4 July 25, 1918, p.180.
Description of a testing machine for the lead of screw thread gages. The machine has been placed on the market by the Sheffield Machine and Tool Co., Springfield, O.

anon., **Coats Lead Testing Machine,** Machy (N.Y.) v24 Aug. 1918, p.1150.
A lead measuring machine in which a fluid gage is used as indicator and measurements of lead are made by means of precision gage blocks.

anon., **Fortney Measuring Wires,** Machy (N.Y.) v25 Nov. 1918, p.269.
Four styles of wires are shown designed for use with special machines for measuring pitch diameter.

Funnell, H.M., **Thread Measuring Formulas,** Am Mach v49 n19 Nov. 07, 1918, p.839.
States that when using the three-wire system of measuring threads the usual formulas given in various popular handbooks are correct only when the thread is standard. Gives formula based on "angle root diameter" for threads which depart from standard form.

Jones, Franklin D. **Projection Method of Testing Screw Threads,** 2800 W. Machy Apr. 1918, (85351 A).
Projection apparatus as applied to inspection of thread gages for munitions manufacture. Ills.

Richards, W., **The Measurement of Internal Threads,** Machy (London) v12 July 18, 1918, p.425-7.
Internal ball point micrometer, with calculations for its use, and table of diameters for ball points.

Rowell, W.S., **Measurement of Internal Threads,** Machy v24 n5 Jan. 1918, p.429 (83421 A).
Recommends the use of an inside micrometer with ball points to assist in making and gaging internal threads.

Van Keuren, H.L., **The Measurement of Thread Gages,** ASME J v40 n11 Nov. 1918, p.913-8. Trans ASME v40 1918, p.827-49.
(Chief of Gage Section, NBS). Measurement of plug thread gages, pitch form and angle of thread, core diameter, full diameter, effective diameter. Choice of wires, Standardization of wires, computation of effective diameter, precautions in making three-wire measurements. Test of ring thread gages: Measurement of pitch or lead, angle, thread farm, full diameter, core diameter and effective diameter.

Van Keuren, H.L., **Use of Measuring Wires,** Automotive Industries v39 Dec. 19, 1918, p.1056.
Choice and standardization of wires, Computations.

West and Dodge Co., **Screw Thread-Lead-Testing Machine,** Am Mach v48 May 30, 1918, p.931-2. Machy (N.Y.) June 1918, p.949-50.
To test the lead of threads the contact point is placed in position in one of the threads and the micrometer spindle adjusted so that the dial indicator points to zero. The point is then moved along a number of threads and micrometer readings taken. Drunken threads are detected by turning the gage partway around and again measuring. The dial indicator is not to show the correct amount of pressure to apply on the micrometer spindle. The large graduated wheel gives readings to 0.0001 in. if desired and a solid plug can be used in place of the indicator spindle and Johansson blocks used between contact points on the base.

Wright, H.H., **Error in wire Method of Measuring Worm Threads,** Machy (N.Y.) v24 n5 Jan. 1918, p.439-40.
Points out the necessity of taking the lead angle into account.

1919

anon., **The Precision Measurement of Thread Gages,** Machy v21 Jan. 30, 1919, p.113-5. Automotive Indus. v39, p.1008-10.
Commercial equipment manufactured by Arthur Knapp Eng Corp after models developed by Bur. of Standards. Can

anon., **Determining Error in Thread Angle by Three Wire Method,** Machy (N.Y.) v25 Feb. 1919, p.552.

anon., **Pitch and Angle Errors,** British Eng. Standards Assn., n95 Dec. 1919, p.59.
Compensation of British Standard Tables, for use in Engineering Workshops giving

corrections to Effective Diameter Required to Compensate Pitch and Angle Errors in Screw Threads of Whitworth Form.

Arrow Tool Co., **Thread-Lead Testing Device,** Am Mach v50 March. 13, 1919, p.517-8.

To use the device the gage to be tested is placed on the centers and tightened. One of the gaging points is then brought into contact with the gage, observation being made against a piece of white paper or other reflecting material laid on the base. After this adjustment is made the slide is clamped and the measuring spindle of the micrometer head, which has been brought to some predetermined reading is brought into contact with the raised hub, and slide is then clamped. The micrometer spindle is then turned back, the first gaging point is withdrawn and the second one advanced to contact with the thread. The gage under test must not be allowed to rotate on the centers. If any error exists it must be met moving the slide along the slideway until the second gaging point is in contact. When this is done the variation from true lead is measured directly plus or minus with the micrometer.

Hartness, James, **Optical Projection for Screw Thread,** Mech. Eng., v41 n2 Feb. 1919, p.127-35.

Analysis of screw thread elements essential to strength and dependability; description of method for their accurate inspection.

Hartness, James, **A Practical Comparator for Screw Threads,** Am Mach v51 n23 Dec. 18, 1919, p. 1057-59.

Projection type of apparatus which shows resultant effect of errors in lead, form of thread, smoothness of surface and diameter, and includes tolerance measurement, that insures interchangeability and prevents acceptance of undersized and undependable screws.

Shaw, P.E., **A Machine for Measuring Screws,** Engineering vol. 107, no.2769, Jan. 24, 1919, p.104-8.

Methods described depend upon a simple point contact in all cases. The machine used deals with the diameters and the pitch and is of a simple type, easy to use.

Miller, H.W., **Measuring ACME Threads Without Special Wires,** Am Mach v50 May 15, 1919, p.932.

Gives formulas for wires or balls.

Reindl, J., **Gewindemessen mit Drahten** (Screw Thread Measurements with Wires), Betrieb v1 n14 Aug. 1919, p.361-5.

Discusses manufacture of wires, use for pitch diameter and thread angle measurements, and gives tables for Whitworth, International, and Lowenherz threads for pitch diameter and angle measurements with wires.

anon., **Measuring Templets and Screw Threads with Microscopic Measuring Machine,** Am Mach v53 July 22, 1920, p.187; Eng. Prod. v2 Jan. 13, 1921, p.40-4; Machy (N.Y.) v24 May 1918, p.791-3.

Construction and adjustment of Alfred Herbert design of measuring machine and application for testing accuracy of templates or contour gages and screw threads.

anon., **Screw Thread Measurement,** Eng. Prod. v1, n12, Nov. 1920, p.440-4.

Determination of effective diameters by three wire system.

Boyer, Jacques, **Inspection of Screw Threads** (Methode de comparaison des filets de vis), Nature (Paris), n2346, Dec. 11, 1920, p.369-72.

Hartness comparator for screw threads.

Gopel, F., **Zwei Apparate zur Messung Von Gewinden and Lehren** (The Apparatus for the Measurement of Threads and Gages), Werkstattstechnik v14 Nov. 01, 1920, p.559-63.

Description of a measuring machine thread; and an anglemeter for chasing tools based on principle of goniometer.

Meyer, F., **Messen und Prufen Von Gweinded** (Measuring and Verifying of Screw Threads), Betrieb v2 Feb. 1920, p.136-9.

Discusses measurement of pitch diameter, lead and thread angle by means of a screw thread measuring microscope in which knife edges to contact the thread surfaces are used.

NPL, **Screw Thread Measuring Insturments,** Eng. Prod. v1 June 1920, p.221-5.

Machines designed by Metrology Department of NPL, England.

Pearson, H.A., **Gaging Acme Threads Without Special Wires,** Am Mach v51 Nov. 06, 1919, p.830; Mech. Wld v68 July 23, 1920, p.60.

Equations are given which, it is said, can be applied to any wire which may be available.

Pearson, H.A., **Three Wire System for Measuring Standard Work Threads,** Machy (N.Y.) v27 Nov. 1920, p.238; Machy (N.Y.) v26 Aug. 1920, p.1131.

Gives formulas and tabular data, when using wires of any suitable diameter. Discussion by T.A. Reilly,

1921

anon., **The Bath Internal Thread Micrometer,** Am Mach v54 n25 June 23, 1921, p.11002; Machy (N.Y.) v27 July 1921, p.1070.

An internal thread micrometer having sliding-wedge-operated threaded measuring jaws available with any number of threads per inch in sizes from 1 to 5 inches in diameter.

Ayre, V.E., **Measuring Screw Threads by Three Wire Method,** Machy (N.Y.) v27 Nov. 1921, p.281.

Gives formulas.

Berndt, G., **Die Messung des Flankendurchmessers** (The Measurement of the Pitch Diameter), Betrieb v4 n3 Nov. 12, 1921, p.70-81; n10 Feb.18, 1922, p.333-8.

Critical considerations regarding errors occurring in the measurement of flank diameter by different methods (thread micrometer, special micrometers) wire methods and optical measurement. Application of the results to the allowable error in the measurement of pitch. Feb. 18: in the comparison of thread gages with standard gages by means of thread micrometers, in measurement with a micrometer having ball contacts. Error of an inaccurate adjustment or positioning of the thread axis in the vertical plane in the measurement of flank diameter or pitch. It is absolutely necessary to measure on 2 oppositely leaning flanks and to take the mean.

1922

anon., **Sine Bar Fixture for Accurate Checking of Thread Angles,** Machy (N.Y.) v28 May 1922, p.722.

A sine bar fixture attachment for a bench lathe comprising a pivoted plate carrying at one end a contact point accurately ground to the basic thread angle and at the other end a plug or button, which, with the plate pivot, comprises the sine bar, screws for adjusting the angular position of the plate, and a fixed block opposite the plug on the plate which serves as a reference point for taking micrometer measurements over the block and button. The fixture is first set to a master groove cut on a cylinder by aligning the contact point with the conical sides of the groove, and a micrometer reading over the block and button is taken. The master is then replaced by the work to be checked, and from differences between measurements taken when the sides of the contact point are aligned, first with one side of the thread and then with the other, the error in the thread angle is determined.

anon., **Van Keuren Thread-Measruing Wires,** Am Mach v56 June 01, 1922, p.833.

Machine lapped wires, accurate as to roundness, uniformity and size furnished packed in glass bottles to protect against rust, loss or breakage.

anon., **Checking the Accuracy of Lead Screws,** Machy (N.Y.) v28 July 22, 1922, p.903-4.
Lead screws are checked by determining the distance that the nut moves for a given rotation of the screw. Measurements are made by means of a micrometer and end standards, using P.&W. measuring machine.

anon., **Work at National Physical Laboratory,** Machy, (Lond.), v20 n514 Aug. 03, 1922, p.558-561.
Internal effective diameter measurement of screw threads.

Buttner, C., **Screw Thread Measuring Comparators** (Gewinde-messkomparator), Betrieb, v4 n9 Feb. 11, 1922, p.289-292.
Describes construction and function of a new optical screw thread measuring machine for maximum accuracy with which all dimensions can be determined in coefficients of measure.

Eppenstein, O., **Die Optische Messung des Flankendurchmessers Von Gewinden** (Optical Measurement of Flank Diameter of Threads), Prazision n22 1922, p.4.
Describes measurement of pitch diameter using a projector and contacting the thread by means of knife edges.

Fisher, A., **Measurement of Worm Threads,** Machy (London) v20 Aug. 10, 1922, p.591-2.
Discussion by E.A. Limming, Machy (London) v22 Sept. 20, 1923, p.794-5. as to the different chords involved.Reply to an inquiry as to formulas for measuring the addendum and thickness of multiple-threaded worms with gear tooth calipers.

Fisher, A., **The Normal Chordal Thickness of a Worm Thread,** Machy (London) v21 Oct. 26, 1922, p.118-9.
A further discussion of preceding articles by Limming and Fisher in which it is concluded that very accurate measurements with gear tooth calipers are obtained with difficulty. The dimension usually taken is the minimum thickness obtained when the calipers are allowed to choose their own angle.

Flanders, Ralph E., **Speeding Up Screw Thread Measurement by Optical Projection, Flanders.** Paper presented before Am. Gear Mfrs. Assn. Automotive Industries, v46 n21 May 25, 1922, p.116-9.
Speed and accuracy attained by Hartness screw thread comparator. Method applied to test cutters and to locate imperfect edges of gear teeth by tracing outline of median tooth section.

Fredericks, P.A., **Notes on Worm Thread Formulas,** Mach v55 Dec. 1922, p.1043.
Discusses three-wire measurements. Am

Henry, J.M., **Measuring Thread Plug Gages,** Machy (N.Y.) v28 March. 1922, p.545-6.
Shows various set-ups in the Pratt and Whitney measuring machine.

Limming, E.A., **The Normal Thickness of a Worm Thread,** Machy (London) v20 Sept. 07, 1922, p.707-8.

Develops a more nearly correct mathematical formula for the normal thickness of a worm thread at a particular radius R, defined as the thickness in the plane normal to the lead helix of that particular radius.

Merritt, H.E., **The Exact Calculation of Worm-Thread Dimensions,** Machy (London) v21 Dec. 14, 1922, p.330-1.

Discusses preceding articles by Fisher and Limming. Proposes an exact calculation of worm-thread dimensions.

1923

anon., **Measurement of Pitch Diameter of Screw Thread Gages,** NBS Letter Cir n23 July 14, 1923, p.60.

Discusses measurement of pitch diameter of straight and taper threads by means of wires, measurement of thread angle by wires, and gives derivations of various wire formulas in the appendix.

anon., **New Projector Measures Wide Range of Precision Parts,** Automotive Industries, v49 n8 Aug. 23, 1923, p.364-7.

Describes contour measuring projector, an instrument developed by Bausch & Lomb Optical Co., for visual inspection of screw threads, forms of gear and cutter teeth, and other parts; accuracy of 0.0001 in. can be attained; separate attachments make photographs.

anon., **Vertical Projection Machine,** Machy (London), v21 n544 March. 01, 1923, p.692-3.
Machine for inspecting screw threads and gear teeth, also tools used for producing these etc.,

anon., **Inspection of Taper Thread Gages,** NBS Letter Cir n13 Oct. 20, 1923, p.27.
Describes methods of measuring taper screw thread gages, with seven tables of wire sizes, constants and other data.

Burns, Charles L., **Modern Methods of Thread Measurements,** Am. Mach., v59 n6 Aug. 09, 1923, p.217-219.

Comparison of ring gages; three wire and projection methods; defects of former and economy of latter.

Hanson, B.M.W., **Thread Measuring Devices,** Machy (N.Y.) v29 n12 Aug. 1923, p.946-8.
Describes different devices with special reference to lead measuring machine.

Limming, E.A., **Normal Thickness of a Worm Thread,** Machy (N.Y.) v21 Dec. 21, 1992, p.360-2. Machy (London) v22 Apr. 1923, p.114-5.

Derives equation for the calipered chord of a screw thread which is identical with the contact chord of the best-size ball of its contact nut. (They are identical with Vogel's corresponding equations for the best-size ball measurement of internal threads.) Discussion by A. Fisher, Machy (London) v21 March. 15, 1923, p.759.

Merritt, H.E., **The Gauging of Involute Threads,** Machy (London) Apr. 05, 19 July 26, Aug. 02, 1923, p.11,13,79,80,81.

Deals with: gaging straight-spur teeth by tooth caliper, rack-generated gears corrected for undercut, gaging straight-spur teeth by the plug or wire method, applications of the plug method, zone and line contact between spiral gear and rack, application of the plug method to spiral gears, helical gears. Discussion: E.A. Limming Apr. 26, May 10, p.114,191; C. Pettit May 17, p.210; H.E. Merritt May 24,31, p.251,275; E.A. Limming June 07, p.307; E.A. Limming July 12, p.475; H.E. Merritt July 26, Aug. 02, p.525,569.

Wright, H.T., **The Mechanical Measurement of Pitch,** Machy (London) v23 n582 Nov. 22, 1923, p.236-9.

Method of recording and analysis of test results; describes pitch-measuring machines.

1924

anon., **Measuring Threads Accurately with Micrometers,** Can. Machy., v31 n18 May 01, 1924, p.31-32 and 51.

Hints on accurate use of micrometers.

anon., **John-Sons Screw Thread Lead Tester and Ccomparator,** Am Mach v61 July 10, 1924, p.79.

The cradle of the screw is composed of annular gaging elements which are free to rotate on their holding stud and, with the exception on one fixed roll, can also move laterally to adapt themselves to the lead variations of the screws to be measured. A wedge-shaped plunger which runs in a groove in the "indicator roll" is elevated against the spindle of the indicator, when the screw is placed in the cradle, and provides the means by which the lead errors are recorded on the indicator. The indicator is set to zero by masters. Made in two sizes, No. 0 to 1/2" and 1/4" to 7/4".

Eppenstein, O., **Uber Fortschritte in der Optischen Gewindemessung** (Regarding Progress in the Optical Measurements of Screw Threads), Zeit Feinmechanik v32 June 05, 1924, p.115-7.

Communicated from Zeissworks in Jena. Discusses measurement of pitch diameter, using knife edges.

Lemming, E.A., **Cylinders and Spheres for Gauging Worm and Screw Threads,** Machy (London) v23 Jan. 03, 1924, p.466-7.

Derives formula for angle between axis of wire and axis of screw. Also diameter of wire which will touch at a given radius of thread.

Merritt, H.E., **The Gauging of Finish-Ground Worms by Cylinders,** Engr. v138 Aug. 08, 1924, p.162-3.

Shows that from certain fundamental worm dimensions size and position of a cylinder to gage any point on thread contour may be calculated, and in spite of apparent difficulty of problem, solution is very simple and easy of application.

1925

anon., **Zeiss Thread Measuring Instruments,** Am. Mach., v62 n22 May 28, 1925, p.861-2.

Describes several thread-measuring devices, including screw-thread micrometer caliper, thread-profile gage, optical thread caliper and toolmaker's microscope.

anon., **New Thread Measuring Tools,** Automobile Engr., v15 n204 July 1925, p.232-3.

Notes on modern methods in screw thread gaging.

Kreis, E., **Herstellung der Gewindelehren** (Manufacture of Screw Thread Gages), Technik und Betrieb v2 n8 Aug. 1925, p.253-62.

Describes measuring methods. For highest accuracy of measurement of thread elements of thread gages, author advocates use of optical means such as the Zeiss universal measuring microscope with contacting knife edges. Discusses inadequacies of wire measurements.

Sabine, M.H., **Efficiency of Screws,** Machy (London) v25 n641 Jan. 08, 1925, p.465-7.

To save time in calculating the efficiencies of various screws, writer has worked out values for square and Acme threads, these being most commonly used screws for transmission of motion and power in machine tools.

Schuchardt, E., **Testing Screw Threads** (Prufung Von Gewinden), Maschinenbau, v4 n14 July 16, 1925, p.676-680.

Discusses a thread gage which may be used even by unskilled hands in quantity production and quantity application of thread parts.

1926

Bentley, H., **Screw Thread Micrometer Calipers,** Indus. Mgmt. (London), v13 n6 June 1926, p.261-2.

Application of micrometer calipers to measuring V-type screw threads.

Smith, C.F., **A Screw Projector,** Machy (London) v29 n733 Oct. 28, 1926, p.103.
Instrument designed by writer to deal with screws of diameters varying from 2 to 10 inches of lengths between centers up to 16.5 inches of parallel or taper form; illuminating system is arranged so that light may be directed along helix and lamp-house is pivoted about center approximately coincident with second nodal point of lens.

Steinle, A., **Universal Measuring Microscope** (Ein Universalmessmikroskop), Maschinenbau v5 n10 May 20, 1926, p.445-9.
Discusses optical measurement of thread and progress attained in increased precision with projection method.

Tomlinson, G.A., **Correction for Elastic Compression in the Measurement of Screws with Small Cylinders,** Machy (London) v28 Aug. 26, 1926, p.616-8.
Points out that in accurate measurements of small screw, correction should be applied on account of compression that ordinarily occurs; nomogram for computing compression correction in effective diameter measurement. See also "Notes on Screw Threads". The National Physical Laboratory, 1930 Proc Inst Engrs n4 p.1031-6.

Wilde, H., **Steigungsprufer fur Leitspindeln** (Pitch Testers for Lead Screws), Zeit fuer feinmech und prazision Dec. 15, 1926, p.265-8.
Describes Zeiss optical instrument and gives examples of measurements.

1927

anon., **Thread Gauges,** Indus. Mgmt. (London)v14 n3 March. 1927, p.107-8.
Practical notes on gages used for checking up screw threads.

anon., **The Measurement of Screw Thread Gages,** Mech. Wld., v81, n2093, 2096, 2099, 2105 and 2112 Feb. 11, March. 04, 25, May 06 and June 24, 1927, p.103-4,159,211,320-1 and 446-7.
Coarser and finer test; causes of inaccuracy; temperature changes. Mar. 4: Origination of screws; evolution of thread sections. Mar. 25: Pitch errors; effective diameter. May 6: Adjustment of external gages; snap type of thread gage; snap limit gage. June 24: Microscopic methods of determining errors in screw threads.

anon., **Screw Thread Pitch Measuring Machine,** Machy (N.Y.) v33 n9 May 1927, p.710-1 and Am Mach., v66 n18 May 05, 1927, p.752-3.
Apparatus brought out by societe Genevoise d'Instruments de Physique, Geneva, Switzerland embodying a micrometer having a range of 4 in. and a knife-edge multiplying lever system sensitive to 0.00001 in. as the indicator. Machine is adapted to the measurement of both internal and external threads. It will hold plug gages up to 6 in. diameter and 8 in. in length, and has a travel of its micrometer screw of 4 in.

Bochmann, H., **Die Adplattung Von Stahlkugen Und Zylindern Durch Den Messdruck** (The Oblateness of Steel Balls and Cylinders Due to Measuring Force), Zeit fur Feinmechanik and Prazision v35 Apr. 1927, p.95.

Contents: The Hertz theory; review of literature; experimental arrangements; experiments on steel balls between planes; experiments on gages between planes; general evaluation of the several cylinder tests; experiments on crossed cylinders; groove tests on steel wires; summary.

Tomlinson, G.A., **Correction for Rake in Screw-Thread Measurement,** Inst Mech Engrs Proc n4 1927, p.1031-6.

Simple method of computing necessary rake correction based on exact geometrical considerations and equations, which is now being used at National Physical Laboratory for threaded work of large lead angle, measured by means of wires.

Valentine, A.L., **Devices for Thread Measurements,** Machy (N.Y.) v34 n34 and n3 Nov. 1927, p.179-183.

Methods and equipment for accurately gaging tap threads.

1928

anon., **Rational Measurement of Elements of a Screw Thread with Wires** (Determination rationelle des elements d'un filetage a l'aide de "piges"), Genie Civil v93 n10 Sept. 08, 1928, p.238-240.

Principles of thread pitch and diameter measurements of screw threads by means of wires and micrometers and formulas used are described.

Baty, J.E., **The Measurement of Taper Screw Thread Gauges,** Machy (London) v32 Aug. 16, 1928, p.617-21.

Methods for inspecting outside, effective and core diameters of taper screw plug gages, which are applicable to British Standard pipe, Briggs, American Petroleum Institute or any other standard thread and taper; measuring fixture described and formulas for each computation given.

Candee, A.H., **Measurement of Thickness of Involute Gear Teeth,** Am Mach v68 n9, 11 and 14 March 01, 15 and Apr. 05, 1928, p.365-8, 463-7 and 573-6.

Mar. 01: Formulas for pin measurement developed; measuring distance across round pins or plugs placed between teeth on opposite sides of gear to determine tooth thickness; tables from which dimension across pins for standard involute spur gears can be obtained very easily; direct methods of calculation given for special cases of spur gears and for helical gears. Mar. 15: Calculations for pin measurement with standard pin sizes; simplification of calculations by means of standard tables for both external and internal gears; center of pin generally will not come on pitch circle; for given pitch and number of teeth dimensions between centers of diametrically

opposite pins will vary with tooth thickness and pressure angle. Apr. 05: Development of formulas for measuring thickness of helical gear teeth by standard pin method and their application to typical case; in case of odd number of teeth certain advantage is lost because two pins cannot be placed symmetrically opposite each other; importance of correct tooth form.

Fraichet, L., **Use of Wires for Proper Determination of the Elements of a Screw Thread** (L'emploi des "piges" pour la determination rationelle de elements d'un filetage), Genie Civil. v92 n6 Feb. 11, 1928, p.138-140.

Use of wires for measuring pitch is described; errors of measurement; measuring thread angle.

Limming, E.A., **Measuring Worm Threads by Means of Cylinders,** Machy (London) v33 n846 Dec. 27, 1928, p.405-10.

Discussion of formulas developed by W. Richards; method said to be theoretically incorrect because geometrical principles underlying conditions of contact between sides of threads and cylinders have not been completely taken into account; other formulas are developed.

Richards, W., **Measuring Acme Screw and Worm Threads by Means of Wires or Cylinders,** Machy(London) v32 n831 Sept. 13, 1928, p.787-790 and (discussion) v33 n843 Dec. 06, 1928, p.302-304.

Fundamental factors involved in measurement of acme and worm threads by means of wires or cylinders are given with formulas which take into account variation due to inclination of thread with axis of screw or helix angle.

Valentine, A.L., **Devices for Thread Measurements,** Machy (London) v31 Dec. 29, 1927, and Jan 14, 1928, p.417-21 and 476-8.

Methods and equipment for accurately gauging tap threads. Dec. 29: Accurate measuring devices suitable in quantity production plant; Hanson devices measures to 0.000025 in.; Wickman machine measures all dimensions of tap and other external and internal dimensions on plain, threaded and tapered work; measuring pitch diameters with wires and micrometers; measuring root diameters with micrometers; Jan. 14: Four gages for resharpened taps; Wickman go and not-go gages; device for measuring odd-fluted tools in process of manufacture; standard micrometer head, specially designed anvils and wires used; formulas for taps with five flutes and whitworth form of thread; and international forms of threads; formulas for three-fluted taps; errors in measuring pitch diameter with wires; device for measuring outside and pitch diameters of taper taps.

anon., **New Screw Thread Gage,** Iron Age, v123 n5 Jan. 31, 1929, p.351, and also Machy (N.Y.) v35 n6 Feb. 1929, p.461-2 and Machy (London) v34 n861 Apr. 11, 1929, p.48-9.

Details of Hartometer screw thread gage invented by James Hartness, president of Jones & Lamson Machine Co., Springfield, Vt.; it shows at once errors of lead and diameter, and is made regularly in sizes of from 3/8 and 3/4 in. National Commission Standard fine and coarse series; it consists of two ring nuts threaded to receive screws to be gaged.

anon., **Machine for Measuring Up To One Hundred Thousandths of an Inch,** West Mach Wld v20 n9 Sept. 1929, p.329-30.

Description of Zeiss universal optical measuring machine for measuring dimensions of screw thread, including correct pitch diameter, and for checking, laying out, or spotting of all kinds of jigs, templets, and forming tools, measurements being made up to 0.00001 in.; comparison made with mechanical methods of measuring pitch diameter.

anon., **The Measurement of Screw Elements,** Machy (London) v34 n884 Sept. 19, 1929, p.789-93.

Description of methods employed in measuring pitch diameter of screw threads with wires and verifying thread angle by two different diameter wires; charts are given for use in checking thread angle of U.S. Standard, Whitworth, S.I., and British Association threads by using set (of three) of each of two different diameter wires.

anon., **Methods for Measuring Odd-Fluted Taps,** Am Mach v71 n23 Dec. 05, 1929, Supp. No. 17 p.945.

Five methods of measuring type taps are described. Condensed from Nat. Screw Thread Commission Bulletin No. 143 Oct. 22, 1929;

Berndt, G., **The Measurement of Internal Threads by Means of Casts,** Mech Wld v86 n2234 Oct. 25, 1929, p.395.

Method devised for measuring internal threads by means of casting; some form of material used by which diameter, pitch and angle of thread can be measured and tools for making correspondingly correct external threads can be designed. From Werkzeug, p.157-63.

Bochmann, H., **Mebfehler Durch Abplattung Beim Gewindemessen** (Errors Through Flattening in Measuring Screw Threads), Zeit InstrumKde v49 n4 Apr. 1929, p.188-203.

Errors in measuring screw threads by ball or wire method due to flattening of measuring wires or balls. English translation available.

Gopel, F., **Die Prufung Konischer Normalgewinde** (Testing of Conical Standard Threads), Werkstattstechnik v23 Oct. 15, 1929, p.586-90.

Communication from German Governmental phys Inst; new equipment for measuring conical pipe-threading gages and results obtained with this; testing of threads was carried out on basis of pipe specifications of American Petroleum Institute and directions of U.S. Bureau of Standards.

Hartel, A., **Eln Neues Verfahren Zum Messen Von Innengewinden** (New Method for Measuring Internal Threads), Zeit InstrumKde v49 n6 June 1929, p.301-4.

Principles of F.D. Jones, Machy v24 1918, p. 35, have been improved by equipment described, which allows positive casting of small inside threading to be taken out undistorted in the parts.

Laurent, P.A., **La Mesure des Filetages des Vis a Filet Triangulaire** (Measuring Triangular Screw Threads) Genie Civ v94 n14 Apr. 06, 1929, p.333-6.

Precision method of French Navy described; it is combination of wire measurements of angles, diameters and pitch and mathematical derivations therefrom; precautions to be taken and errors resulting (+ or - micron).

Pampel, H. and A. Sommer, **Gewinde-Prufmethoden** (Screw Thread Testing Methods), Automobiltechnische Zeit v32 n30 Oct. 31, 1929, p.689-93.

In connection with recently conducted investigations of thread tolerances, authors present detailed description of measuring and testing methods and equipment.

Richards, W. and E.A. Limming, **Measuring Acme Screw and Worm Threads by Means of Wires or Cylinders,** Machy (London) v33 n853 Feb. 14, 1929, p.637-40. and discussion v34 n862 Apr. 18, 1929, p.82-5.

Answer to comments made by E.A. Limming appearing in Dec. 27 issue of magazine upon author's articles which were published in Dec. 06 and Sept. 13 issues; criticism of data for design of worm tools and production of worm thread refuted.

1930

Berndt, G. and E. Bock, **New Method for Measuring Internal Thread** (Ein neues verfahren zur messung von innengewinden), Zeit. fuer Instrumentenkunde v50 n6 and 7 June 1930, p.375-84 and July, p.407-16.

Principles of measuring methods based on use of balls and prisms and universal measuring microscope, developed by University of Dresden and Zeiss Co.; mathematical analysis of accuracy and errors; tables give instrument correction for Whitworth and metric thread.

Fraichet, L., **Screw Thread Gages** (Les ealibres verificateurs des filetages), Technique Moderne v22 n20 Oct. 15, 1930, p.689-91.

Author is of opinion that methods used in the measurement of screw threads at present in France do not give sufficient security; more desirable method and equipment for measurement is given to replace older system in use.

Gage Testing Staff of Metrology Department of NPL, **Notes on Screw Gauges,** Eng. Soc. Lib., N.Y., 3rd edition. Lond., His Majesty's Stationery Office, 1930, p.88.

Purpose of these notes is to assist firms that are unfamiliar with accuracy required in manufacture and testing of screws; pamphlet describes principles underlying practice of limit gaging as applied to parallel screw threads, types of error met within screw gages, and modern methods of testing these gages; data required for making tests are included.

Gopel, F., **Improved Screw Thread Measuring Equipment** (Verbessertes Gewindemessgeraet), Zeit fuer Instrumentenkunde v50 n1 Jan. 1930, p.33-42.

Measuring equipment described in zeitschrift fuer Feinmechanik und Praezision, 1924, has been improved; equipment and its applications are described.

Johnson, C.V., **Application of Roll Type Thread Gages,** Machy (N.Y.) v37 n4 Dec. 1930, p.253-4.

Advantages of roll type go and not-go thread gages manufactured by Pratt and Whitney Co., requirements insuring interchangeability and dependability.

1931

anon., **Measuring Cycle Engineer's Institute Standard Screw Thread by the Three-Wire Method,** Machy (London) v38 May 14, 1931, p.212-3.

Derivation of formulas for measurement over wires and the best size of wire. Table of wire sizes.

anon., **Michigan Spiral Gear Lead Checking Fixture,** Am Mach v75 Sept. 03, 1931, p.395.

This spiral-lead checking fixture will handle spiral gears up to 16 in. in diameter and with any lead of 10 in. or over, either right or left-hand. The gear is mounted on a stub arbor or between centers up to 12 in. in length. The fixture is of the sine bar type. Mounted on top and towards the sides of the gear carriage are two lapped surfaces which drive the work spindle by contacting two friction rolls. These rolls cause the spindle to rotate in timed relation with the movement of the carriage on which the indicator is mounted.

anon., **National Cleveland Helical-Gear Checking Device,** Am Mach v75 Nov. 26, 1931, p.830.

This device is shown attached to the model "B" gear checking machine, and may also

be attached to model "C" machine. In addition it is furnished as a bench type, or mounted upon a pedestal stand. The helical gear is mounted upon a stub shaft carried by a slide, which is moved so that the teeth of the gear engage the teeth of the rack. the reading of the angle thus established is taken direct from the large drum. The device will check right or left hand helical gears. When mounted on a pedestal the device may be placed in the production line to permit 100 per cent inspection.

anon, **"Detroit" Lead Testing Instrument,** Am Mach v75 Dec. 17, 1931, p.939-40.

Measurement is made by means of a spiral micrometer and microscope supported on a carriage and focussed on an optical scale. The carriage is fitted with a spring-loaded plunger, carrying at its extremity a removable ball point, which engages two adjacent threads of the piece. This plunger mechanically locates the carriage. Maximum error does not exceed a total of 0.00018 in. for the 8-in. length.

Berndt, G., **Determination of Thread Diameters by the 3-Wire Method,** Zeit InstrumKde Nov. 1931, p.560-74.

Describes method, derives equations for pitch diameter. Corrections are also obtained for the flattening of the wires and for the case of oblique threads, and tabulated.

Kugler, C., **Measuring Pitch Diameters for Taper Threads,** Am Mach v74 May 07, 1931, p.730.

Gives a practical procedure for measuring pitch diameter at a definite point with three-wire system. Includes formulas.

Rickenmann, A., **Flankenmessurgen An Schnecken Und Trapezegewinden** (Measurement of Pitch Diameter of Worms and trapezoidal Threads), Maschinenbau/ Betrieb v10 Oct. 01, 1931, p.619-20.

A cone and vee micrometer is used. Discusses corrections to measurements and gives curve for lead angle corrections.

Rolt, F.H., **Caliper Screw Thread Gages,** Machy (London) v37 n954 Jan. 22, 1931, P.543.

Method of adapting caliper gage with annular rollers satisfactory as "go" screw gage by making profiles of grooves of rollers depart from Whitworth form by small but appropriate amounts.

Wende, F., **Neues Ueber Gewindemessugen** (New Aspects of Thread Measurement), Werkstattstechnik v25 n12 June 15, 1931, p.297-300. See also translation in Machy (London) v38 n989 Sept. 24, 1931, p.821-823.

Recent development in caliper-type gages; examples of faulty threads; snap-thread gage with measuring edges at front faces of anvils, and with fixed measuring rolls new type of gage developed by precision tool divisions of F. Werner, A.G., Berlin, has flat anvils with parallel measuring surfaces, screw threads, as measured in direction of

screw axis, having correct angle of thread and being cut in exact direction of average pitch angle.

1932

Berndt, G., **Gewinde-Messungen,** Archiv fuer Technisches Messen v1 n10 Apr. 1932, p.T52 (4p).

Fundamentals of measuring cylindrical thread with data on tolerances; comparison of accuracy and stability of various gages.

Berndt, G., **Bestimm Des Flankendurchmessers Von Gewinden,** Maschinenbau v11 n7 Apr. 07, 1932, p.133-8.

Results of investigation of accuracy of different mechanical methods for measuring pitch diameter of thread on bolts.

Berndt, G., **Die Messung Des Flankendurchmessers Dreinutiger Gewindebohrer** (The Measurement of Pitch Diameter of Three-Fluted Taps), Zeit InstrumKde v52 July 1932, p.307-19, and Aug., p.353-64; Sept., p.408-16.

Mathematical analysis of accuracy of methods of measuring diameter of taps with three flutes, including use of wires, cones, cylinders, prisms etc., experimental verification.

Berndt, G., **Die Bestimmung Des Flankendurchmessers Nach Der Driedrahtmethode** (The Determination of Pitch Diameter by the Three-Wire Method), Zeit InstrumKde v51 Nov. 1932, p.560-74; Maschinenbau/ Betrieb v11 Apr. 1932, p.133.

Advantages, methods of making measurement, calculations, and discussion of errors.

Cornelius, J.R., **Three Wire Measurement of Screw Threads,** Am Mach v74 May 21, 1932, p.805.

Discussion by W.S. Rowell v75 Sept. 10, 1932, p.416. Gives tables.

Trimbath, S., **Helical Gear Tooth Measurement,** Am Mach v76 Aug. 31, 1932, p.966-7.

Advantages of sizing helical gear teeth by measuring across pins; standard form.

Werner, A., G. Bockmann, and R. Lehmann, **Die Pruefung Konischer Innengewinde** (The Testing of Internal Taper Threads), Zeit InstrumKde v1 Jan. 1932, p.14-9.

Methods and equipment for measuring internal dimensions of ring gages for taper threads developed by Physikalische-Technische Reichsansatalt, according to specifications of American Petroleum Institute.

1933

Bearce, H.W., **Common Defects in Screw Threads,** Am Mach v77 n5 March. 01, 1933, p.148.
Examples of results of excessive thread depth; National Screw Thread Commission recommends that minor diameter of "go" ring gage be same as minimum minor diameter of nut, tolerance on minor diameter of gage being minus.

Berndt, G., **Fortschrotts Und Forschungen Auf Dem Gebiete Des Technischen Messwesens** (Progress and Research in Field of Technical Measuring Methods), Maschinenbau v12 n5 March. 02, 1933, p.118-21.
With particular regard to equipment for measuring screw threads and gears. Bibliography.

Sasaki, S., **Einige Aufgabe Ueber Die Messunges Des Geswinde -Flankendurchmessers,** Soc. Mech. Engrs, Japan-J v36 n197 Sept. 1933, p.612-7.
Measurement of screw thread pitch diameter; tests show that, strictly speaking, ordinary pitch micrometer is not suitable for pitch-diameter measurement of bolts with mean tolerances; micrometer with reduced measuring surface or with three measuring wires is much more accurate. (In Japanese).

Wilhelm, J., **Korrektionen Deider Messung Von Innengewinden** (Corrections for the Measurement of Internal Threads), Feinmechanik und prazesion v41 Oct. 1933, p.147-52.
Derivation of factors for correcting the measurement of internal threads by means of balls, V-blocks and size blocks taking into consideration the deformation of the balls and the errors relating the helix.

1934

anon., **Develops Machine for Testing Lead and Helical Gears,** Iron Age v133 n13 March. 29, 1934, p.35; Machy (N.Y.) v41 n3 Nov. 1934, p.150-1; Automobile Engr. v24 n319 May 1934, p.187.
Details of machine introduced by Lees-Brander Co., Cleveland, Ohio, which accurately measures helix angles or lead of helical gears, and also calibrates machine settings.

anon., **New Helical Lead Checking Machine,** Machy (N.Y.) v41 Nov. 1934, p.150.
Machine marketed by Illinois Tool Works, Chicago, Illinois, for determining accuracy of helices.

Guenther, N., **Analytisches Verfahren Zur Ermittlung Der Gunstigsten Messdrahte Fur Die Sogenannte "Dreidrahtmethode"** (Analytical Method for Determining the Most Suitable Measuring Wires for the so-called "Three-Wire Method"), Zeit Instrumkde v53 Sept. 1934, p.373.

anon., **Vickers Contour-Projection Apparatus,** Engineering v139 n3609 March 15, 1935, p.280-1.

Apparatus made by Cooke, Troughton and Simms intended for accurate gaging of screw threads, irregular templets and parts, cams etc., and consists of optical system which projects magnified image of part to be gaged on to horizontal translucent screen, on which measurements can be made by scale or in other ways.

anon., **New Helical Lead Checking Machine,** Machy (London) v46 n1195 Sept. 05, 1935, p.690-1.

Machine, marketed by Illinois Tool Works, Chicago, for determining accuracy of helixes, has capacity for gears up to 12 in. in diameter and will take work up to 15 in. between centers; checks helix angles from o to 90 deg.

Berndt, G., **Bestimmung Des Flankendurchmessers Von Gewinden Nach Der Dreidrahtmethode Bei Unsymmetrischem Profil** (Determination of Pitch Diameter of Screw Threads of Unsymmetrical Profiles by the Three-Wire Method), Werkstattstechnik v29 June 1935, p.237-9.

Knedel, W., **Das Messen Von Saegegewinden** (The Measurement of Buttress Threads), Werkstattstechnik v29 Feb. 1935, p.50-2.

The method of measuring Buttress threads by the three-wire method. Explanation of calculations involved.

Rideout, T.R., **Worm Thread Measurement,** Am Mach v79 n24 Nov. 20, 1935, p.861.

Reference book sheet data giving formulas for obtaining caliper settings for measuring threads; these have been checked several times for extreme cases by accurate laboratory measurements and have been found to be exact.

Schorsch, H., **Untersuchungen Von Gewinde-Rachenlehren** (Study of Screw Thread Micrometer Calipers), Wertstattstechnik und Werksleiter v29 n21 Nov. 01, 1935, p.419-21.

New method recommended for adjustment of calipers in which natural weight is changed by additional weight. Also published separately as a book.

Smith, C.F., **Optical Inspection of Screw and Worm Profiles,** Machy (London) v46 n1179 May 16, 1935, p.185-9.

Limitations of optical thread inspection; method of determining whether interference is present; optical system providing compensation for varying helix angle; Matrix projector.

1936

Berndt, G., **Gewindemessungen** (Screw Thread Measurements), VDI Zeit v80 n48 Nov. 28, 1936, p.1455-60.

Outline of various methods and equipment at present available for measurement of screw threads. Bibliography.

Diettrich, G., **Die Messtechnik U Ihre Aufgaben In Der Werkstatt,** Maschinenbau v15 n 19/20 Oct. 1936, p.553-6.

Measuring technique and its application to workshops; report before plant engineering session in Erfurt discussing measurements on screw threads by physical and optical methods; and measurements of gears, of surface quality, etc.,

1937

Berndt, G., **Die Messung Konischer Gewinde** (The Measurement of Taper Threads), Bauer and schaurte Neuss 1937, 81p.

Various calculations.

Chesley, W.L., **Size Measurement of Gears,** Tool Engr v5 n9 Jan. 1937, p.14-5.

Easily understood method presented of calculating sizes over pins or balls for spur or helical gears.

Erickson, E.C., **Measuring Plating on Screw Threads,** Bell Lab Rec v15 n6 Feb. 1937, p.187-9; Wire & Wire Prod. v12 n3 March. 1937, p.144-5.

In absence of any standard gaging apparatus which could be used to make determinations accurate for ascertaining thickness of coatings on finished screw threads, optical contour projector was devised to determine such measurement; apparatus and methods used, with special reference to screws used in telephone apparatus.

Kress, K., **Messen Und Pruefen Von Gewinde,** Werkstatt u betrieb v70 n13/14 and 15/16 July 1937, p.193 and Aug., p.221-2.

Practical hints on measurement and testing of screw threads.

Vogel, W.F., **Neuartige Konfkreisfreie Zahndicken-Messungen Fur Schragzahnarader Und Evolventen-Schnecken** (Novel Method of Measuring Tooth Thickness for Involute Helical Gears and Involute Worms without use of Addendum Circle), Werkzeugmaschine v41 n11 June 15, 1937, p.253-61.

Mathematical analysis of span measurements and its application to both spur- and helical involute shaped tooth forms. A section "Tauchkorper Messungen" (Dive-Body Measurements) deals first with pin and ball measurements of involute spur teeth.

Extension of the analysis to the ball-measurements of helical involute gears and involute worms leads to the introduction of the author's "Substitute- (thin) Disk Method", which reduces the measurement simply to that of involute spur gears. The same simplified method and equations have later been applied to pin-measurements of all involute screws. (Vogel 1945 see subsections 10.1.2 and 10.1.3 and Zahorski in Van Keuren Handbook 33 1945). Bibliography.

Wescott, B.B., **The Measurement of Pipe Threads,** Am. Petroleum Inst. June 03, 1937.
A critical discussion of the various instruments available for the purpose and suggestions regarding a proposed standard measuring practice.

1938

anon., **Gauging Screw Thread by Wire Method,** Machy (London) v53 n1359 and 1360 Oct. 20, 1938, p.71-4 and Nov. 03, p.133-8.
Screw threads can be measured with precision by making use of calibrated wires; direct reading charts and tables prepared by Societe Genevoise d'Instruments de Physique, Geneva, for use in conjunction with standard calibrated wires and measuring instruments, are given. Includes formula for computing values, correction factor for obliquity, method of computing best diameter, corrections for elastic deformation of wires.

anon., **Gaging Multi-Start Threads by the Wire Method,** Machy (London) v53 Nov. 17, 1938, p.200.
Formulas for determination of best wire diameter in measuring multi-start threads and threads with very large lead angles.

Bauerle, K.E., **Checking Gear Size by Measurement Over Pins,** Machy (N.Y.) v44 n6 Feb. 1938, p.353-7.
Tables simplifying application of this precise and generally available method to external and internal spur and helical gears.

Buckingham, E., **Pin Method of Measuring Worms and Helical Gears,** Machy (N.Y.) v45 n1 Sept. 1938, p.1-7.
Gives general formulas for pin diameter and measurement over pins; general formulas for screw threads and helical gears; application to screw threads and to a helical gear; compensation for possible deflection of pins or wires; errors in tooth thickness resulting from pin deflection; relation between a formula for screw threads and the simplified general formula. Compiler's comment: Formulas take lead angle into account but are not exact, as stated. They are approximations similar to those of Jeffcott. NBS formula (10) quoted on p.5 is likewise not exact as here stated. In the original B523 reference it was stated to be a close approximation for screw threads.

Buckingham, E., **Checking Screw Threads and Helical Gears by Measurement Over Pins,** Machy (N. Y.) v45 n4 Dec. 1938, p.273.

Compiler's comment: This article was obviously in answer to reader objections to the author's preceding September article. Particularly, the author's allegedly exact theory was incompatible with the exact contact conditions of pins and balls used in the measurement of involute screws, as analyzed and published by A.H. Candee 1928. In this article the author tries to explain these contradictions by his obviously honest belief and statement that the behavior and contact geometry of a pin in the thread groove of an involute screw are basically different from those in other types of screws. More recent developments disprove this concept as well as the author's theory of bending deformations of the pins and their needed compensations. See Tomlinson 1927. Vogel 1947, and Marriner and Wood 1958.

Koehler, O.E., **Errors in Wire Measurement,** Am Mach v82 n9 May 1938, p.367.

When lead is great, as with Acme or multiple V threads, consideration of lead angle should be included when measuring by wire method.

Rolt, F.H, and A. Turner, **Measurement of Drunkenness of Screw Threads,** Machy (London) v52 n1345 July 21, 1938, p.489-91.

Method devised by authors, which can be applied to testing of machine tool; based on fact that if screw has true helix, then threads or grooves on one side of it are always exactly midway between those on opposite side in same axial plane; machine for testing screw threads for drunkenness illustrated and described.

Rolt, F.H. and A. Turner, **Machine for Measuring Plug Screw Gauges in Quantities,** Machy (London) v52 n1352 Sept. 08, 1938, p.701-2.

Illustrated description of machine for measuring diameters of batches of gages of same nominal size; machine closely resembles floating micrometer type of screw measuring machine; only difference is in fittings of upper measuring carriage; in present machine these units are replaced by adjustable anvil and measuring indicator.

1939

Berndt, G., **Die Bestimmung Des Flankendurchmessers Von Gewinden Mit Symmetrischem Profil Nach Der Dreidrahtmethode** (The Determination of Flank Diameter of Threads with Symmetrical Profile by the Three-Wire Method), Zeit InstrumKde v59 n11 Nov. 1939, p. 439-48.

Determination of flank diameter of screw threads with symmetrical profile according to three-wire method; mathematical and geometrical considerations and applications. The algebraic and geometrical considerations of the method and the influence of various sources of error are considered.

Bianco, E., **Misurazione Degle Elementi Fondamentali Delle Filettature, Col Metodo Dei Rulli Calibrati,** Industria Meccanica v21 n8 Aug. 1939, p.599-607.

Outline of method of measuring principal elements of screw threads by means of calibrated rollers; alignment charts; numerical examples.

Diettrich, G., **Begriffsbestimmungen In Der Gewindemesskunde** (Definitions in the Science of Thread Measurement), Maschinenbau v18 n11/12 June 1939, p.289-93.

Measurement of screw threads; geometric relations explained and universal rules generally applicable in measuring practice given.

Gunther, Von N. and H. Zollner, **Die Messung Der Flankendurchmesser Mehrgangiger Gewinde Mit Drei Drahten** (Measurement of Flank Diameter of Multiple Threads with Three-Wires), Feinmechanik und Prazision v47 n9 1939, p.129-31.

Contents: The three-wire method; the theory of screw surfaces; contact conditions with derivation of exact trancedental equation; the approximation process; summary and buttress threads.

Hahn and Otto, **Gewinde Und Gewindemessung Im Kraftfahrzeug- Und Flugzeugbau,** Automobiltechnische Zeit v45 n5 March 05, 1939, p.151-3.

Screw threads and screw thread measurements in automobile and aircraft manufacture; kinds of thread and definitions, tolerances, gages, Acme threads, helix angles, strength of threads etc.,

Laessker, F., **Messen Des Zahnschraegewinkels An Stirnraedern Mit Schraegverzahung** (Measurement of Helix Angle and Pitch of Teeth on Helical Gears), VDI Zeit v83 n5 Feb. 04, 1939, p.133-5.

Outline of measuring method and detailed description of testing equipment and its operation, characteristics, and results attainable.

Tschirf, L., **Genaue Innengewindemessung Durch Ausschraubbare Gewindeabguesse,** Werkstattstechnik und werksleiter v33 n19 Oct. 01, 1939, p.467-9; Pratique des industries Mechaniques v23 n4 Jan. 1941, p.89-91.

Accurate measurement of internal threads by molds which can be unscrewed; descriptions and principles of system.

Zahorski, A., **Ball Measurement of Helical Gears,** Am Mach v83 n14 July 12, 1939, p.520-2.

Method developed consisting of substituting real ball by imaginary roll, which will permit carrying out computation of measurement of tooth thickness of helical gears in same manner as done for spur gears; formulas and examples illustrated and described. Same as the Vogel "substitute disk method" 1937.

1940

Berndt, G., **Die Bestimmung Bes Flankendurchmessers Von Gewinden Mit Unsymmetrischem Profil Nach Der Dreidrahtmethode,** Zeit fuer Instrumentenkunde v60 n1 Jan. 1940, p.14-22.

Determination of flank diameter of screw threads of asymmetric profile by aid of 3-wire method; theoretical principles and application of method.

Berndt, G., **Die Anlagekorrekturen Beider Bestimmung Des Flankendurchmessers Von Symmetrischen Und Unsymmetrischen Aussen Und Innengewinden** (Corrections of Position in Determination of Flank Diameter of Symmetric and Asymmetric External and Internal Threads According to Three-Wire Method or by Means of Two Spheres), Zeit InstrumKde v60 n5, 6, 7, 8 and 9 May 1940, p.141-54; June, p.177-86; July, p.209-20; Aug. p.237-48 and Sept., p.272-8; Werkstattstechnik und Werksleiter v34 n17 Sept. 01, 1940, p.277-82.

Detail theoretical mathematical study; approximate formulas for corrections of position presented. Bibliography.

Berndt, G., **Paarungs- Und Ist Durchmesser Bei Gewinden,** Werkstattstechnik u Werksleiter v34 n11 June 01, 1940, p.180-7.

Pairing and actual diameter of screw threads; contribution to problem of thread tolerances with asymmetric profile.

Diettrich, G., **Gewindemessen Im Betrieb,** Maschinenbau v19 n1 Jan. 1940, p.15-9.

Screw thread measurement in plant operation; author discusses available measuring methods with regard to their suitability to standardized procedure in industry.

Kordt, W., **Wirtschaftliche Gewindepruefung In Der Mengenfertigung,** Werkstattstechnik u Werksleiter v34 n15 Aug. 01, 1940, p.245-8.

Economic testing of screw threads in mass production; illustrated description of special types of limit gages employed for this purpose.

1941

Drinkwater, J.W., **Unusual Screw Thread Measurement,** Machy (London) v59 n1517 Nov. 06, 1941, p.149-50.

Mathematical analysis.

Hight, E.K., **X-ray Measurement of Internal Screw Threads,** Aero Digest v38 n5 May 1941, p.199-200.

Methods used at Bell Aircraft Laboratories for measurement of internal screw threads; radiographic procedure as routinely applied is illustrated.

Tschirf, L., **Mensuration des Taraudages par des Moulages Devissables,** Pratique des Industries Mecaniques v23 n4 Jan. 1941, p.89-91.

Measurement of internal screw threads by adjustable molds. Indexed in engineering index 1939, p.1051, from Werkstattstechnik u Weksleiter Oct. 1939.

1942

anon., **"Sine Line" Machine for Checking Spiral-Gear Leads,** Machy (N.Y.) v48 March 1942, p.162.

Machine of the adjustable sine bar type, is designed to check right and left-hand spiral gear leads with angles from 0 to 90 deg.

anon., **Vollautomatisch Arbeitende Pruefvorrichtung,** Aluminium v24 n12 Dec. 1942, p.410-1.

Fully automatic screw thread testing apparatus; illustrated description of device for checking diameter of cylindrical workpieces, such as ship propellers, claimed to be simple and reliable.

Berndt, G., **Durchmesser Der Draehte Fuer Das Dreidrahtverfahren** (Diameter of Wires for the Three-Wire Method), Werstattstechnik und Werksleiter v36 n23, 24 Dec. 1942, p.507-19.

Diameter of wires for three-wire method of determination of flank diameter of single threads with symmetrical profile; determination of flank diameter without regard to non-perpendicular position of wires to thread axis; influence of position of measuring wires inclined toward thread axis.

Drinkwater, J.W., **Method of Screw Pitch Measurement,** Machy (London) v60 n1541, 1542 Apr. 23, 1942, p.341-5 and Apr. 30, p.372-3.

Outline of necessary measurements to be checked in screw threads if accuracy is desired; description of screw pitching machine; details of how machine can be used to determine certain defects in screw threads and machine tools.

1943

Chiverton, H.A., **Should Whitworth Thread be Modified!,** Machy (London) v63 n1616 Sept. 30, 1943, p.373.

Suggested modified form of Whitworth standard thread (55 deg.) having radiused roof and flat crest for general work.

Drinkwater, J.W., **Optical Projector for Measuring Tapered and Square Threaded Screws,** Machy (London) v62 n1590 Apr. 01, 1943, p.353-4.

When measuring effective diameter of tapered screw plug gage, it is essential to alter measurements to position of thread along taper; optical projector described is used in conjunction with thread form layout, to find start of thread on tapered screws.

Taylor, W.T., **Calculating Screw Thread P.D.,** Tool Engr. v12 n8, 9 Aug. 1943, p.87-9; Oct. p.99, 101, 103 and 105.

Purpose is to simplify general formulas for overwire (3-wire) dimension, to present formulas in terms of basic pitch diameter and basic major diameter, to show best wire sizes which amy be used for any particular number of threads per inch and to show permissible plus-minus limits on wire diameter for Whitworth 55 deg. thread so that American wire sizes can be used to practical advantage; method of calculating and measuring even and odd fluted taps.

1944

anon., **Measurement of Screw Thread Gages,** Ordnance Inspection Handb on Gages, ORD-M608-5-Sec 800 Sept. 1944, p.110-11.

Inspection gage Sub-Office, Office of Chief of Ordnance, U.S. Army. Describes measurement of thread plug, ring and snap gages.

Adkins, H.F., **Should Pitch of Taper be Longer than that of Screw!,** Machy (London) v64 n1645 Apr. 20, 1944, p.429.

Author elobrates on his statement in previous article that pitch of tap should be longer than that of screw; and points out that screw and nut should be of same pitch when under stress, not when free; that is pitches when free should not be equal.

Consler, R.J., **Gauging of Taper Pipe Threads,** Aero Digest v46 n3 Aug. 01, 1944, p.112, 114, 122.

Tremendous proportion of parts, previously rejected, can be salvaged by proper application of inspection gages; resume of gaging procedure for tapered aircraft pipe threads is exposition of Army-Navy-Aeronautical specifications, together with interpretation of AN-GGG-P363 Amendment 1.

Drinkwater, J.W., **Measurement of Large Ring Screw Gauges,** Machy (London) v64 n1638, 1647 March 02, 1944, p.238-40 and (discussion) May 04, P.49-56.

Illustrated description of omtimeter (E.H. Jones, Ltd.,) which is optical comparator arranged for measurement in horizontal plane; principle of measurement is to compare ring under examination with assembly of Matrix slip gages and pair of adapters arranged to simulate perfect ring gage.

Reimschissel, C.A., **Helix Angles of Single Acme Threads,** Am Mach v88 n23 Nov. 09, 1944, p.121, 123.

Tables show helix angles used for wetting grinding wheels, milling cutters and lathe threading tools when cutting single and double acme threads.

Rights, H.T., **New Electromagnetic Method of Measuring Screw Thread Leads to Few Millionths of Inch,** Instruments v17 n3 March. 1944, p.134-5.

Method has been embodied in instrument of comparator type, which can be read directly to within 0.00001 in. and readings can be estimated to within 0.000001 in.; method being electrical rather than mechanical, gaging point functions with pressure of only three ounces; it has no time lag and is rapid in operation; anyone experienced in checking thread lead can set up instrument quickly and operate it successfully.

Taggart, C.C., **Cast Iron Thread Gages,** Metals & Alloys v20 n6 Dec. 1944, p.1607-10.

One of war production bottlenecks has been supply of steel gages for dimensional inspection; problem solved by using specially processed high strength cast iron for thread gages, with notable savings in production time, operating costs, labor and critical material; description of use of performance of cast iron gages and some of machining, heat treating and other manufacturing operations.

1945

anon., **Larmar Three-Wire Measuring Instrument for Screw Threads,** Machy (London) v66 n1684 Jan. 18, 1945, p.75-6.

Illustrated description of apparatus manufactured by Larmar Eng. Co.; to obviate difficulty in positioning three wires prior to measuring over them with micrometer, wires are held to micrometer anvil and spindle faces by clamps.

anon., **Thread Measuring Gauge,** Engineer v180 n4685 Oct. 26, 1945, p.332-3.

Illustrated description of device made by J.E. Baty & Co. for rapidly and accurately checking effective diameter of screw threads; known as "O-Vee" gage, it is based on 3-wire method of thread measurement and is intended for use in conjunction with hand micrometer.

Atkins, H.F., **Thread Angle of Bolts and Nuts,** Machy (London) v66 n1700 May 10, 1945, p.516.

Author presents his reasons which provide conclusive argument that angle of 53 deg. and 8 mt's. is correct angle for screw thread where nut is one screw diameter long.

Boeckel, F.W., **Simplified Inspection of Thread Gages,** Tool Engr. v14 n11 June 1945, p.29.

Illustrated description of simple fixture, in combination with three-wire method, which provides easy checking of pitch diameters of pipe thread gages; method provides accurate means of analyzing many perplexing problems associated with pipe thread inspection.

Buckingham, E., **Checking Pitch Diameters of Precision Screw Threads,** Machy (N.Y.) v52 n1 Sept. 1945, p.162-4.

Consideration of three classes of screw thread profiles effecting measurement in checking pitch diameter of screw thread by measuring over pins or wires; involute-helical gear formula provides theoretically correct results when applied to screw thread of involute helicoidal form and very close approximations for threads having intermediate profiles; applicable formulas given.

Lebourhis, C., **Butees D'Etalonnage pour la Mesure sur Flancs des Filetages a L'Aide D'Un Comparator D'Atelier,** Technique des Industries Mecaniques 1945, p.82-4.

Measurement of blank diameter of threads by means of shop comparator; illustrated description of apparatus and method employed.

Miller, D.R., **Measurement of Thread Gages Using Wires,** National Bureau of Standards. Sept. 18, 1945.

To avoid complicated formulas, the author deals with symmetrical threads only, that is, threads on which the angle of the leading and following flanks are nominally the same. Unsymmetrical threads (Buttress) should be treated as a special case.

Schuyler, M., **Simple Diagrams Solve Problem of Thread Gage Instruction,** Am Mach v89 n10 May 10, 1945, p.103.

Diagrams solve problem of thread gage instruction more efficient and cognizable than inspection training.

Vogel, W.F., **Involutometry and Trigonometry,** Michigan Tool Co., Detroit 1945, p.325.

Contains simple exact equations, with derivations, for pin and ball measurements of involute-shaped spur gears and splines, also of involute screws (e.g. helical gears, helical involute splines and involute worms). Forms with step by step calculations are provided for various purpose measurements of spur toothed products. All measurements are explained as applications of a complete geometrical system of involutometry and are tailored to be used with the large Main Table and a great variety of other numerical tables.

1946

anon., **Two Screw Thread Measuring Devices,** Eng. v181 n4703 March 01, 1946, p.208.

Brief illustrated description of simple means of measuring effective diameter of screw thread, introduced by Thos. firth and John Brown; first is by means of ascertaining points on flanks of thread vee where width is half of pitch; second effective diameter measuring instrument is comparator arranged for use by setting with standard thread. See also Machy (London) v68 n1757 June 13, 1946, p.756-7;

anon., **Thread-Measuring Parallels,** Engineering v161 n4185 March. 29, 1946, p.297.
Illustrated description of device known as "Marlco" thread measuring parallels, patented by W.H. Marley & Co. for measuring accurately and rapidly effective diameter of thread work. ; See also Engineering v181 n4700 Feb. 08, 1946, p.139.

anon., **Internal-Thread Comparator,** Eng. v162 n4201 July 19, 1946, p.55.
Illustrated description of instrument developed by Machine Shop Equipment, Ltd., for rapid and precise measurement of effective diameter of internal screw threads; it consists of beam, on which slide pair of heads carrying brackets furnished with projecting ball tips, and dial indicator.

Drinkwater, J.W., **Measurement of Straight-Flanked Helicoids,** Machy (London) v69 n1762, 1764, 1767 July 18, 1946, p.77-82; Aug. 01, p.139-43; Aug. 22, p.235-40.
Methods of mathematical treatment for determining relations existing between radius and rake measuring cylinder, thread form, effective diameter and helix angle; effect of helix angle from zero to 90 deg., including straight splines; thread angle in axial, normal and transverse sections considered for screw threads, taps, hobs, spiral broaches and gears.

Jansson, A., **Fellows Introduces New Lead Measuring Instrument,** Tool Engr. v17 n3 Oct. 1946, p.53.
Features and operation of new instrument developed by Fellows Gear Shaper Co., instrument incorporates arrangement whereby lead of helix is checked by continuous motion of measuring pointer in conjunction with desired rotation of work; principle embodies two tangent bars and pins, both of which operate slides, one effecting traverse movement of member carrying measuring pointer and other, rotation of work.

Meadows, J.J., **Three-Wire Thread Gaging Simplified,** Iron Age v157 n16 Apr. 18, 1946, p.51-7.
Formula for checking thread size using three-wire method, based on major thread diameter; charts and tables commonly involved and cover National Fine and National Coarse series, Whitworth standard, British Assn., British Standard Fine, and French standard thread forms.

Williamson, D.E., **Effect of Elastic Modulus on Measurement of Thread Wires,** Prod. Eng. & Mgmt. v18 n2 Aug. 1946, 4p.
Analyses the various factors relating to the use of carboloy wires.

1947

anon., **Adjustable Plug Gauge,** Engineer v183 n4769 June 20, 1947, p.547-8.
Gage developed by Manvers Adjustable Gages Ltd., consists essential of hollow

tapered body, in lower part of which are four slots cut at 90 deg. to each other.

anon., **New Plug Gage Simplifies Gaging Operation,** Machine & Tool Blue Book v43 n7 July 1947, p.174-6.

Features DuBo plug gage; belonging to fixed limit classifications of internal gages, it is based on principle of using spherically shaped gaging surfaces, and of bringing these surfaces into contact with bore walls; gages use separate "Go" and "No-Go" members for checking minimum and maximum allowable limits of hole.

Lee, J.W., **Wire Dimensions for Screw Threads,** Tool Engr. v18 n1 Feb. 1947, p.36-8.

Develops formulas for calculating wire measurements of pitch diameter, taking the lead angle into account. These are based on the assumption that the contact points of the wire with the thread are located on the normal to the central pitch helix of the thread (which assumption gives more accurate results than assuming contact in an axial plane but still is not exactly true). Presents relations between screw dimensions and measurement data.

Vogel, W.F., **The Best Wire for Over Wire Measurement of General Screws**, Monograph copies deposited at Library of Congress, National Bureau of Standards, Detroit Public Library, and Wayne State University. The Van Keuren Co. Watertown, Mass. Sept. 09, 1947, 56p.

Develops universal theory of screw measurements over pins, including prerequisites for a general screw measurement, significance of the involute screw, the exact equations for general screw measurement (i.e., for cylindrical screws of any symmetrical thread profile), number of pins and balls to be used, and formulas for routine calculations.

1948

anon., **Screw Gauging,** Aircraft Production v10 n116 June 1948, p.207.

Details of triple purpose combination gage for external threads.

Clark, K.A., **Comparator-Chart Inspection of Tapered Pipe-Thread Gages,** Machy (N.Y.) v54 n12 Aug. 1948, p.165-7.

Inspection practice at Lockheed Aircraft Corp., in use of comparator charts to check pitch diameter, gaging notch diameter, taper angles, and forms of pipe thread production gages; charts are designed to provide all contours and check points necessary for inspection of each of National pipe thread standard pitches, as outlined in Army-Navy Specification An-GGG-P-363.

Laetzig, W., **Gewindepruefen Und Gewindelehren,** Werkstatt u Betrieb v81 n4 Apr. 1948, p.85-8.

Screw thread testing and gages; pointers for choice of most suitable gages; photographs, sectional drawings.

Pruliere, A.C., **Gauging of Precision Screw Threads,** Microtecnic v2 n2, 3, 5, 6 Apr. 1948, p.71-8; June, p.115-22; Oct., 222-8; Dec., p.234-40.

Description of different methods such as Zeiss measuring prism method, optical-mechanical and mechanical method; illustrated description of measuring apparatus.

Von Keussler, V., **On The Influence of Periodic Screw-Error on the Density Distribution in Spectroheliograms,** Zeit Astrophysik v24 n3-4 1948, p.233-9.

Even small periodic errors of the order of 0.002 mm prove very disturbing. A new device for testing measuring-spindles is described.

1949

anon., **Pitch-Checking Instrument and Micrometer Slip Gauges,** Engineering v168 n4367 Oct. 07, 1949, p.380.

Matrix screw thread pitch checking instrument and set of slip gages for checking micrometers, known as "Matrix Mikechex" introduced by Conventry Gauge & Tool Co.

Budnick, A., **Ein Stufenloses Schaltgertriebe Hoher Genauigkeit** (A Stepless Switchgear of High Accuracy), Werkstattstechnik und Maschinenbau v39 n2 1949, p.45-8.

High precision apparatus with stepless switchgear for measuring cylindrical milling cutters and spiral shaped objects; indicator motion in measuring slide by precision spindle screw and frictional transmission; indicator is set up at angle by set of permanent and varying gears with holes on rim; measurement and varying gears with holes on rim; measurement errors do not exceed 0.00004 in.; photographs, table.

Burndrett, W.E., **Why Taper Threads Don't Fit,** Am Mach v93 n1 Jan. 13, 1949, p.95-9.

Interchangeability discussed in processing rotary tool joint connections and other taper threaded products for all oil industry; possible errors outlined and conditions for maximum interference mentioned; examination of discrepancies in working gages; diagrams, tables.

Mackiewicz, S., **Pomiar Gwintow Metoda Drucikowa,** Mechanik v22 n1-2 Jan. - Feb. 1949, p.67-9.

Screw thread measurement by the three-wire method; diagrams, tables.

Parkinson, A.C., and W.H. Dawney, **Thread Grinding and Measurement,** Eng. Soc. Lib. N.Y. Sir Isaac Pitman & Sons, London, and Pitman Publ. Corp., New York, 1949, 227p.

Thread terms and definitions are classified and explained; limit systems and their special applications to screw threads, worms and hobs; in regard to the thread measurement, considerable amount of space devoted to wire methods.

1950

Litvin, F.L., **Determination of the Thickness of the Teeth of Worms and Spiral-Toothed Wheels With the Help of Rollers and Balls,** Acad Sci (Russia) v10 n39 July 06, 1950, p.22-7.

English translation is available at NBS and Van Keuren Co., A distinction is made between convoluted, Archimedean and evoluted helical surfaces. Develops exact relationship between position of the roll in the thread space of the worm, the lateral surfaces of the teeth, and the thickness of the teeth. Develops relationships connecting variation in the position of the roll and variation in thickness of teeth.

Peres, N.J.C., **Position of Contacting Sphere Between Teeth of Helical Gear,** Machy (London) v77 n1977 Sept. 21, 1950, p.324.

Derives equation for angle between center of pin and point of contact of pin and tooth. (Obviously the author was unaware of the existence of much simpler exact equations offered in the "Substitute Disk Method", see Vogel 1937 and 1945).

1951

anon., **Gauging and Measuring Screw Threads,** Nat. Phys. Laboratory- Notes on Applied Science n1 1951, 109p. 7 supp. plates.

General definitions and symbols; gaging of parallel screw threads; errors of screw threads; control of accuracy of pitch; hardness of screw gages; measurements of parallel screw plug and ring gages; inspection of parallel ring gages with check plugs; testing of screw caliper gages; optical projection apparatus; gaging of taper screw threads; measurement of taper screw plug and ring gages.

Butrick, Jr., F.M., **Measuring Gear Components,** Tool Engr. v26 n2 Feb. 1951, p.44-5.

Lengthy but simple method for measuring helix angle of helical, herringbone or screw gear when regular gear checking machine is not available; equipment required and steps to follow; inaccuracies are small; illustrations.

Harrison, G.R., and J.E. Archer, **Interferometric Calibration of Precision Screws and Control of Ruling Engines,** J. Opt. Soc. Am v41 Aug. 1951, p.495-503.

A new device is described with which screws of any length can be calibrated rapidly for both periodic and cumulative errors in terms of interference fringes. It can also be used to plot correction cams to remove fixed errors of translation or rotation, and

to monitor the operation of an engine while ruling diffraction grafting or scales, correcting by automatic feedback differences between the actual carriage position and its proper position as shown by an optical interference field. The "commensurator" (i.e., for over-coming the incommensurability of the wavelength of the light used for calibration and the lead of a screw) consists principally of a screw driven system, eight-figure dials, and a generator, geared together in ratios that can be controlled to one part in 10 power 8 . Fringes produced by a Michelson interferometer are changed photoelectrically to a wave train that measures translation to within 0.1 micro in. A Second wave train almost identical average frequency is produced by the commensurator generator to measure screw rotation, and the two trains are continuously compared by means of a phase sensitive amplifier and motor to within 1/100 cycle or fringe. Corrections for changes in barometric pressure or in temperature can be introduced during operation. Transient as well as fixed errors of run and period can be automatically compensated for. If the fringe system is lost, it can be re-established from the commensurator record, so that controlled ruling of gratings wider than any available coherent fringe-field appears possible.

Ogawa, M., **On Precision Screw Threads,** Rep. Inst. Indus. Sci. Univ. of Tokyo v2 n1 ser 10 Apr. 1951.

Translation of chapter 1 on Theory on the Three-Wire Method is available from Eng. Metrology Section, NBS. Contents of chapter: General theory; states of contact between measuring wires and a helicoidal surface; conditions for the stable contact; general solutions; the most accurate ordinary solution; the best wires; errors in the three wire method.

Rolt, F.H., **Autographic Method of Checking Accuracy of Micrometer Screws,** Machy (London) v78 n1993 Jan. 25, 1951, p.165-7; Engr. v191 n4957 Jan. 26, 1951, p.117-9.

Conventional method necessitates recording of numerous readings; new method of obtaining autographic records compares travel of micrometer spindle continuously with that of master screw, differences being recorded as trace on moving strip of paper; design and general arrangement of micrometer head testing apparatus; illustrations.

Stocker, W.M., Jr., **How to Inspect Screw Thread Elements,** Am Mach v95 n21 Oct. 15, 1951, p.137-52.

Two inspection methods- analytical vs. functional described; fundamentals of gaging screw threads; control of screw thread accuracy; analytical inspection, with specified methods for each element; how to save inspection time; common inspection errors pointed out; salvage techniques outlined; illustrations.

1952

Berndt, G., and K.H. Kuebler, **Die Optische Messung Von Aussengewinden** (Optical Measurement of External Threads), Dresden. Tech. Hochschule Wiss Zeit v2 n2 1952-53, p.199-213; n3, p.467-78; n6, p.989-1000.

Part-1: Measurements of threads with symmetrical profile. Part-2: Threads with asymmetrical profile. Part-3; Measurement of identical threads.

Harrison, W.H., **Analysis of Screw Thread Measurement,** Mach v96 Apr. 02, 1952, p.602-4.

Gives analysis intended to make clear the exact conditions of contact of measuring cylinders to thread flanks, without taking account of deformation of work or measuring cylinders. Solve example by iteration.

Wolf, F., **Prufen Und Messen Von Gewinden** (Testing and Measurement of Screw Threads), Munich 1952.

1953

Burger, K., and M. Gary, **Methods and Equipment of the Physikalisch-Technische Bundesanstalt for the Inspection of (A.P.I) Taper Thread Gauges,** Proc. of Symposium of Eng. Dimensional Metrology, H.M. Stationery Office, v1 paper 6 Oct. 21-24, 1953, p.97.

Discusses measurement of pitch cone diameter, lead, taper of ring gages and thread angle, 14 refs.

Butrick, F.M. Jr., **Homemade Checker Bridges Gap,** Steel v133 n26 Dec. 28, 1953, p.91.

Lead comparator for helical gears fabricated in tool room is designed to serve until commercially made comparator arrives; drawing shows how this simple device compares gear with master.

Harrison, P.W., and I.G. Wood, **Continuous Recording of Effective Diameters of Screw Gauges,** Communication from NPL. Machy (London) v82 n2099 Feb. 06, 1953, p.266-8; see also Engineer v195 n5063 Feb. 06, 1953, p.205-6; Engineering v175 n4545 March. 06, 1953, p.318-9.

Measuring machine described produces continuous record of simple effective diameter over full length of helix of screw plug gage under test; design details given and basic movements shown in diagram; machine also designed for rapid comparative measurements; effects of eccentric rotation; modification of machine for measurement of ring gages.

Harrison, P.W. and Mrs. J.G. Wood, **Screw Gauge Measurement Gives Continuous Record,** Mach Feb. 14, 1953, p.250.

An electric measuring head replaces the indicator of the floating micrometer-diameter measuring machine designed by the NPL. It thus shows variations in

effective diameter to be continuously recorded.

Le Bourhis, C.A., **Methods and Insturments for Thread Gauge Inspection,** (Laboratoire Central de l'Armement, France), Proc. of Symposium on Eng. Dimensional Metrology, H.M. Stationery Office, v1 Paper 5 Oct. 21-24, 1953, p.81.

Describes some methods and instruments which have proved efficient in daily practice.

1955

Gary, M., **Die Berechnung Der Gewinde-Anlagekorrekturen,** Forschung auf dem Gebiete des Ingenieurwesens v21 n4 1955, p.107-17.

Calculation of rake corrections in screw thread measurements; conditions governing contact of spheres and cylinders in helical grooves of thread; resulting transcendental equations solved by iteration for all threads with straight flanks in axial sections; formula established for best pilot wire diameter for asymmetrical thread profiles.

Simonet, J., **Etude Critique D'un Appareil Mesureur De Pas,** Revue Universelle des Mines de la Metallurgie des Travaux Publics v11 n8 Aug. 1955, p.381-99.

Critical study of screw thread gage equipped with two feelers, displacement of which is measured by two comparators, pitch being obtained by difference between comparator readings.

Vogel, W.F., **New Thread Measuring Formulas,** Catalog and Handb n36 Appendix D The Van Keuren Co., 1955.

Exact equations of the trignometric solution of the Best-Pin method are provided with numerical tables (by the Van Keuren Co.) based on it.

Waltermire, W.G., **Gaging Confusall,** Fasteners v10 n3 1955, p.11-5.

External thread used as example to illustrate various points concerning inspection by GO and NOT-GO gages; effective size, envelope tolerances and P.D. tolerances discussed; details of recent standard revisions concerning acceptability of threads.

1956

Gabbey, E.G., **Updating Accuracy in Measurement of Screw Threads,** Tooling & Production v22 n6 Sept. 1956, p.91-6.

Essential gage requirements; 60 gages for checking several elements of screw threads and NO GO gage for inspecting pitch diameter only; single element visual aid diagrams; results of form error on tolerance; terminology of new standard H.28 1950 Supplement; O-Vee gages; wire method observation.

Gabby, E.G., **How Screw Thread Errors Can Change Effective Pitch Diameter,** Can Machy v67 n11 Nov. 1956, p.136-9,162.

Difficulties in gaging of screw threads; seven varying elements of screw thread which can effect interchangeability; checking with "go" and "no-go" gage'; visual aid diagrams; results of form errors; determining pitch diameter; effects of form error; conflicting views on screw gage.

Gary, M., **Geometrische Probleme Bei Der Vermessung Von Zylindrischen Evolventen-Schnecken Und Evolventen-Schragstirnradern** (Geometric Problems in the Measurement of Cylindrical Involute Worms and Involute Helical Gears), Konstruktion v8 n10 1956, p.412-8.

Methods are outlined for measurements of the standard gage with balls or measuring wires of cylindrical involute worms and involute helical gears. For symmetrical involute worms a method is given for determination of the base cylinder radius and the tooth thickness. Contents: Equations for the position of a cylinder in an involute worm 1) cylinder with predetermined inclination to the worm axis; 2) cylinder at minimum distance from the worm axis. Equations for the position of a ball in an involute worm. Computation of the base cylinder radius and tooth thickness from the results of two diameter determinations over cylinders or balls. Three numerical examples.

Stewart, W.C., **SCREW THREAD LIMITS,** Fasteners v11 n3 1956, p.12-4.

Standard pitch diameter limits for various classes of screw threads; problem of interpretation of pitch diameter limits and acceptable method of gaging; recommendations by American Standards Association.

1957

anon., **Are You Gaging Your Screw Threads Accurately?,** Iron Age v170 n1 July 04, 1957, p.82-4.

Two different and distinct types of gages for measuring screw pitch diameter (PD) used by Standard Pressed Steel Co., Jenkintown, Pa; "functional" Pd gage checks screws against high limit of tolerance, while "pure" PD gage is employed to check against low tolerance limit; most commonly used PD gages engage two or even three screw threads; system for setting and checking gages.

anon., **Screw Thread Standards for Federal Services,** NBS Handb H28 (1957) Parts I and III and 1963 supplement. Supt. of Docs. Government Printing Office, Washington, D.C.

Appendixes 4 and 13 contain tables for wire measurements for 60, 29 deg. and Buttress threads.

Johnson, S.G., **The Effectiveness of Various Contacting Elements Used for Gaging and Measuring Pitch Diameter,** Johnson Gage Co., Bul n400 May 15, 1957.

Contrasts cone and vee method against three-wire method of measuring pitch diameter.

Nickols, L.W., **Effect of Differences Between U.S. and British Practices in Measuring Screw Gages for Unified Threads,** Machy (London) v90 n2315 Mar. 29, 1957, p.723-5; Metalworking Prod. Mar. 29, 1957, p.539-41.

American and British method of measuring effective diameters of screw plug gages and setting plugs; effective diameter measurements made at single specified position on each of five screw plug gages having Unified threads in order to determine experimentally effect of differences between two methods.

Varnum, E.C., and S.J. Johnson, **Precise Formulas for Over-Pin Measurements of Helical Forms,** Tool Engr. v38 n6 June 1957, p.116-20; Also Letter to the Editor of the Tool Engr. v39 n2 Aug. 1957, p.183 by W.F. Vogel; also AGMA paper 239.03 June 1957.

Gives a desk calculator routine for computing over pin measurements by iteration. (The print is an authorized AGMA paper only if it carries a sticker giving credit to preceding exact solutions by W.F. Vogel in Van Keuren publications).

1958

Brierley, P.R., **Small Screws, Their Standardization, Production and Measurement,** Fasteners v13 n2 Summer 1958, p.3-6; See also Tooling & Production v24 n6 Sept. 1958, p.160-2.

National and international systems of small screw threads; comparison of these systems as regards diameter and pitch; conventional methods of production and inspection used for sizes down to about 1.5 mm diameter; no tolerances for screw threads below 1.5 mm have been formulated to date.

Closson, H.T., W.E. Danielson and R.J. Nielsen, **Automatic Measurement of Small Deviations in Periodic Structures,** Rev. Sci. Instrum. v29 n10 Oct. 1958, p.855-9.

Description of accurate microdeviometer, originally developed for measurement and recording of pitch uniformity of helices in traveling wave tubes; instrument combines optical, mechanical and electronic techniques; electronic circuitry automatically stores and processes position information and feeds processed information, in form of deviations from corresponding ideal structure, to pen recorder.

Marriner, R.S., and Mrs. J.G. Wood, **Rake Correction in the Measurement of Parallel External and Internal Screw Threads,** Inst. Mech. Engrs. (London) July 1958, 9p.

Formulas are derived for calculating the rake correction for a ball seated in the helical groove of an internal screw thread and a ball or cylinder in an external thread. the equivalence of a ball and cylinder in an external thread is discussed. A

simple approximation formula, and an exact equation are derived for determining occurrence of double contact between the cylinder and thread flank.

Martin, L.D., **Over-Pin Measurements of Worms,** Tool Engr. v41 n1 July 1958, p.50-4.
Simple approximate formula for over-pin measurement of worms presented which yields results within practical limits affected by workpiece elasticity, measuring pressure, profile deviations and observational error. Criticism by J. Silvagi. Nov. 1958, p.195-6.

Petersen, C., **Accurate Thread Gaging Streamlines Quality Control, Eliminates Misfits Before Reaching Assembly Lines,** Western Metalworking v16 n2 Feb. 1958, p.50-2.
Gages employed for rigid inspection of threaded fasteners and SPS Unbrako socket head cap screws used in assemblies for McCulloch chain saws and Scott Atwater outboard engines; pitch diameter check; Pratt & Whitney dial indicating tri-roll gage for checking high limit tolerance, and pure Pd gage for low limit PD tolerance; sampling; maintaining gage accuracy.

Sievritts, A., **Das ISO-Gewindeprofil,** Werkstattstechnik u Maschinenbau v48 n4 May 1958, p.281-4.
ISO screw thread profile; characteristics of different profiles including Whitworth, metric, UST (Unified screw thread), and DIN; proposed ISO profile; meaning of changeover from present metric to new international screw thread.

Simonet, J., **Discussion des Methodes de Mesure du Diametre Sur Flanes des Filetages Coniques Males** (Discussion of Methods of Measuring Diameter of Conical Screw Threads on their Flanks), Revue Universelle des Mines v14 n3 March. 1958, p.73-9.
Five methods of measurement are examined; in each case three is serious difficulty in calibration of measuring instrument; advantages and disadvantages of each method and domains of their application.

Stimson, G.H., **Thread Gage Measurement,** Automatic Machining March. 1958, p.31.
Points out some of the conditions which contribute to inaccurate results, and the measures which must be taken to avoid them.

Stocker, W.M. Jr., **At Last a "Drunkometer" for Threads,** Am Mach v102 n26 Dec. 15, 1958, p.87-9.
"Drunken helix" being deviation of helix from theoretical or true helical path can now be measured by new electronic thread comparator developed by Greenfield Tap and Die Division; new instrument compares two points, separated by predetermined angle such as 90 or 180 deg., on single thread and measures deviation from true helix; typical recorded patterns showing rejected, acceptable and master thread for 8-32 thread plug gages are presented.

1959

Giesler, H., **Neues Vereinfachets Messverfahren Fuer Die Bestimmung Des Steigungsfehlers Innerhalb Eines Oder Mehrerer Gewindegaenge** (New Simplified Measuring Method for Determination of Errors in Pitch within One or Several Screw Threads), Werkstattstechnik v49 n4 Apr. 1959, p.192-5.

Review of existing methods; new method described is more accurate, permits simpler handling and saves time.

Haake, H., **Zur Geometric Der Gewindeflanken,** Werkstattstechnik v49 n7 July 1959, p.376-85.

Geometry of flanks of threads; numerical examples presented for calculation of external internal threads with symmetrical profile.

Simonet, J., **Contribution to Testing of Precision Lead Screws,** Microtecnic v13 n1 Feb. 1959, p.15-11; Inspection Engr. v23 n6 Nov.- Dec. 1959, p.134-9.

Details of design, construction and operation of special precision measuring instrument developed at Metrological Laboratory, University of Liege for checking pitch of lead screws. Presents a critical study of a new lead measuring instrument and a statistical examination of results of measurements.

Werber, H., **Verfahrensbedingte Profilfeher Von Gewinden Mit Im Axialschnitt Geraden Flanken,** Magdeburg. Hochschule fuer Schwermaschinenbau- Wissenschaftliche Zeit v3 n2-3 1959, p.225-32.

Profile errors of threads with straight flanks in axial cut as result of manufacturing method; various thread cutting methods were studied theoretically in order to assess their attainable accuracy and facilitate selection of proper method.

1960

Edensor, K., **Note on Measurement of Rake Angle and Relief Angle of Taps and Dies,** Machy (London) v97 n2507 Nov. 30, 1960, p.1237-9.

Measurements require setting of graticule cross line so that it is tangential to circle, method described provides means for positive location of tangent.

Endo, O., N. Hoshina, Y. Yokoyama, M. Sawabe, and S. Sukigara, **Screw Thread Flank Tester,** Rept. Central Inspection Inst. of Weights and Measures, Japan v9 n4 rept. 24 1960, v10 n3 rept. 27 1961.

A new screw thread flank tester is developed in order to determine the flank profile and the half-angle of the thread. The tester consists of bed, sine table, column, carriage, electronic micrometer and pen-recorder. Some illustrations on several flank profiles which are recorded by the tester of some screw thread gauges are given. In Japanese.

Nickols, L.W., **New Method of Measuring Pitch Errors of Screws to Very High Accuracy,** Machy (London) v96 n2480 May 25, 1960, p.1171-6.

Method developed at NPL employs autocollimator technique to compare pitch of screw with end-standards of length; apparatus was designed to measure pitch errors of V-threaded precision lead-screws, within certain limitations of size, and is also suitable for measuring pitch errors of reference screw plug standards used to calibrate pitch measuring machines; apparatus and measuring procedure described; effect of errors on accuracy of pitch measurement.

Nickols, L.W., **New Method of Measuring Pitch Errors of Screws to Very High Accuracy,** Quality Engr. v24 n4 July - Aug. 1960, p.107-11.

Method developed at National Physical Laboratory measuring pitch errors of screws having vee thread form to considerably higher accuracy than formerly; method employs autocollimator technique to compare pitch of screw with end standards of length; results indicate that, provided no temperature variations occur, pitch may be measured in terms of measured sizes of end standards to accuracy better than plus or minus 5 micro in.

Omel'chenko, A.I., **Microscope for Measuring Internal Threads,** Meas Techn. 1959 n8 July 1960, p.584-6. Translated from Izmer Tekh n8 Aug. 1959, p.7.

The described microscope for measuring internal threads provides better measurements than other methods of the three basic internal thread elements with a nominal diameter of 18 mm. and over. The instrument is based on the double microscope of Academician V.P. Linnik.

Zhuravlev, N.M., **Controlling the Curvature of Thread Gages,** Meas Techns 1959 n12 Sept. 1960, p.940-3; Translated from Izmer Tekh n12 Dec. 1959, p.14.

Proposes a new instrument combining high productivity with great precision for measuring helix variation of screw thread gages. Checking of gages showed that such variations sometimes exceeded the pitch tolerance. Can be used for automatic thread testing in conjunction with electric induction or pneumatic recorders.

1961

Bennett, J.M., **Method of Determining Comparator Screw Errors With Precision,** J Opt. Soc. Am v51 n10 Oct. 1961, p.1133-8.

Precise determination of relative cumulative error and periodic error of comparator screw; measured curves for Mann comparator and Gaertner comparator; method gives relative lengths of intervals on scales used.

Glover, J.H., **New Equations Simplify Pin Measurement of Gears,** Prod. Eng. v32 n11 Mar. 13, 1961, p.80-1.

Gives equations for calculating over-pin and between-pin measurements of ideal involute tooth forms of external and internal spur gears. The equations also establish

measurements for desired variations in tooth thickness and pin size. This will be very valuable if the calculations are made with assistance of numerical tables giving over- or between-dimensions only for a specified thickness (usually:standard thickness) and for a specified theoretical value of the pin size, which may not be available at the needed accuracy. The same equations can be used for external helical gears only if they have an even number of teeth. Internal helical teeth cannot be measured by pins. If balls are used for their measurement then the mentioned equations can be applied to both odd and even numbered internal helical gears. (The exact equation simplify the measurement, but the simple basic geometry of the measurement can no more be recognized in this presentation).

Harrison, P.W., **Further Report on the Effect of Differences Between U.S. and British Practice in the Measurement of Screw Gages for the Unified Threads,** Machine Shop Mag. v22 n4 Apr. 1961, p.207-9.

The application of rake correction to measurements made by American methods improves their agreement with the British values in seven out of eight cases and reduces the mean difference to one quarter of its previous value.

Khairov, A.A., **Measuring the Profile Angle of Internal Conical Threads,** Meas Techns 1961 n7 Dec. 1961, P.521-4. Translated from Izmer Tekh n7 July 1961, p.6-7.

Describes an electrical contact instrument for measuring half the profile angle of internal threads with a pitch of 6 and 6.35 mm. With an appropriate change in the dimension of the electrical contact head it is possible to measure profiles of threads with a pitch of 5 mm.

Nezhurin, I.P., **Determination of Helical Gear Sizes by the Two-Roller Method,** Russian Eng. J v39 n8 1961, p.11-3. English translation by Pera.

Describes a method of calculation of the size over rolls which ensures an easy criterion of their displacement in the tooth groove of helical gears with an odd number of teeth. Demonstrates the existence of the "oddness effect", that is: In contrast to even-numbered helical gears, the axis of the micrometer when measuring over two rolls is askew to the axis of the odd-numbered helical gear; it neither intersects the axis nor is its location in a plane of rotation of the gear. The correctly recognized geometry of the problem was evaluated in exact equations for the measurement. For one of them an approximate simplification is offered. (Unfortunately, one of the exact equations was found to be erroneous. See correction by Khalebskii, 1963 and acknowledgment by Nezhurin, 1963).

Nickols, L.W., **Effective Diameter of Parallel Screw Thread,** Production Engr. v40 n5 May 1961, p.344-51.

Differences between 2 different interpretations of the effective screw diameter in use in various countries; importance of pitch errors in relation to effect on fit of mating threads; calculation of virtual effective diameter and its relation to different interpretations of effective diameter.

Parsons, R.T., **Getting Bugs Out of Three-Wire Measurement,** Am Mach/ Metalworking Mfg. v105 n14 July 10, 1961, p.86-8.

Three sources of error in 3-wire method of measuring thread gages and threaded parts are discussed including lead angle effect, calibration and accuracy of measuring wires and computation of correct constants, and measuring instruments and pressures; 60 deg. single start threads with lead angles of less than 5 deg. are only considered.

1962

Beam, A.S., and C.E. Hall, **Measurements of Helical Gears with Pins or Balls, Analysis of Pitfalls and Their Elimination,** AGMA 129.15 June 1962.

Clarification of the geometry of measurements from center of gear over one pin. Useful mathematical formulations are presented as a new tool in the art of gear inspection. It is shown that when pins are used on helical gears with even number of teeth, the prevalent belief that the distance between the axes of the two pins assumes an extreme value which can be found as a low or high point of the measurement is an oversimplification. The discussion cover: 1) Measurement over one pin or ball when; a) measurement from the center over one pin and b) measurement from the outside surface over a pin or ball places in an opposite tooth space. 2) Measurement over two pins or balls when a) gears have even numbers of teeth and b) gears have odd numbers of teeth. 3) Measurement over three pins of spur and helical gears.

Green, R.E., **Mitsui Leadscrew Measuring Machine with Automatic Recording Equipment,** Machy (London) v100 n2564 Jan. 03, 1962, p.37-41.

Machine built by Japanese company will detect inaccuracies as small as plus or minus (2 plus or minus 3L/100)micron, where L is length to be measured in millimeters; for such measurements, temperature difference between workpiece and master leadscrew built into machine, must be less than 0.05°C; new measuring principle employed is based on use of 2 electrical measuring contacts, average of 2 readings being provided electronically; errors due to distortion or eccentricity of screw are automatically canceled out.

Haake, H., **Sonderfragen Zur Geometrie Der Gewindeflanken,** Werkstattstechnik v52 n4, 7 Apr. 1962, p.180-6; July, p.339-43.

Special problems concerning geometry of flanks of threads; it is shown how diagrams can be drawn which make possible general view of entire thread series and facilitate calculation in measuring flank diameter with 3-wire. Apr. Thread with unsymmetrical profile considered. July. Taper threads discussed.

Kirillova, T.S., and E.A. Shilova, **The Error in Measuring Periodic Faults in Guide Screw Pitches,** Meas. Techns. 1962 n7 Feb. 1963, p.543-4. Translated from Izmer Tekh n7 July 1962, p.8-10.

Compares accuracy of measurements obtained by the use of recorders with those obtained with universal microscopes.

Koop, H.A., **Teilungsmessungen An Verzahnungen In Der Praxis** (Pitch Measurements on Gear Teeth in Practice), Werkstattstechnik v52 n12 Dec. 1962, p.646-52.

Installations and devices employed are described; interpretation of measuring results with regard to various types of errors is explained.

Murase, Z., **Study on a Ball Screw (Part 3),** J Japan Soc. Prec. Eng. v28 n6 1962.

There are many reports on the measuring method about the triangular helicoidal surface, but rather few about generalized helicoidal surface. In the part 3, the mechanical measuring method of the radius from the screw axis to any point on the race-way surface (generalized helicoidal surface) of the nut or the threaded shaft of the ball screw, using the balls or the cylinders as the measuring feelers, is studied. And the exact equations, by which the correction value of the measuring results will be calculated, are deduced. These corrections are necessary, because the elastic deformation at the contact point of the race-way with the measuring feelers and the diametral error of the feelers are always existent more or less. New mathematical method of determining the race-way surfaces, the exact equation of the principal direction and the principal curvature on the contact point of the ball-race with the ball, and the theoretical calculation of the elastic approach between the ball-race and the balls of the ball screw are the fundamentals of the studies on this part of this series. In Japanese.

Voeneky, G., **Neues Verfahren Zum Messen Von Engtolerierten Innengewinden,** Werkstatt u Betrieb v95 n11 Nov. 1962, p.755-8.

New method for measuring close-tolerance internal threads; explanation of 2-ball method used in measuring effective diameter of internal threads is followed by comparison with method using contact arms and with that of caliper microscope; application of internal thread measuring device in connection with shop microscope and universal comaprator is described.

1963

Kaluzka, H., **Podatnose Statyczna Ukladu "O-P-N" I Jejwykorzystanie Do Korekcji Bledow Skoku Przy Obrobce Srub Pociagowych** (Static Flexibility of Machine Tool-Workpiece-Tool System and Its Use for Pitch Error Correction in Lead Screw Machining), Prezglad Mechaniczny v22 n6 March. 25, 1963, p.163-6.

Sources of pitch errors in machining high-precision lead screws are analyzed and

error formula derived; simple method is suggested for eliminating pitch error by applying to workpiece axial force determined from expression derived and acting from back center towards chuck plate.

Katsman, F.M., and S.V. Yakonovskii, **Error in Measuring Pitch of Screw Propellers by Means of Goniometers,** Meas. Techns. 1962 n12 July 1963, p.992-5; Translated from Izmer Tekh n12 Dec. 1962, p.8-11.

Analyzes the precision with which it is possible to measure this element by means of goniometers, in view of the stringent tolerances specified in GOST (All -Union State Standard) 8054-59 for the local pitch of screw propellers which must not exceed + or - 3.5% for those of the lower grade.

Koronkevich, V.P., L. Ya. Gustyr', and A.N. Raxuvaev, **Interference Method for Measuring Thread Elements,** Meas Techns 1963 n2 Aug. 1963, p.100-7; Translated from Izmer Tekh n2 Feb. 1963, p.8-14.

If the distance between the first fringe and the edge of the shadow contour is evaluated, it becomes possible for this fringe to be used as a setting line instead of the graduation of a measuring knife-edge. The application of interference fringes for measuring the mean thread diameter and the dimensions of components which have a curvature along the optical axis is beset with certain difficulties which, in the first place, consist of the effect of microscope focusing on the distance to the first interference fringe and of the effect of the light-beam aperture on the interference pattern. This article aims at elucidating the effect of these factors.

Montilla, J., **Interferometric Device for the Calibration of the Micrometer Screw of a Microscope,** Anales de la Real Sociedad Espanole de Fisica y Quimica v59A n1-2 Jan. - Feb. 1963, p.19-20.

The device is based on the relation between the displacement of the interference fringes of Fizeau type and the displacement of the microscope tube. An accuracy of lambda by 200 or better is obtained. In Spanish.

Nexhurin, I.P., **Measuring Helical Gears with an Odd Number of Teeth by Rollers,** Russian Eng. J v42 n10 1963, p.11-3.

Calculations as given in previous articles have been simplified by means of a nomogram which yields highly accurate values fully consistent with those derived by Khalebskii.

Sergeev, N.V., **Measurement of Large-Size Internal Buttress Thread Mean Diameter,** Meas Techns 1963 n2 Aug. 1963, p.100.

Describes a micrometer hole gage for measuring a buttress thread 600 mm. in diameter.

Stead, C., **Measure to Millionths-in Sceonds,** Am Mach/Metalworking Mfg. v107 n19 Sept. 16, 1963, p.109-11.

Carl Zeiss Universal Measuring Microscope employed by Taft-Peirce Manufacturing Co., Woonsocket, RI measures all kinds of contour gages, threads of any shape, cutting tools, templets, chasing tools and similar parts; with attachment it can measure eccentricity and helix angle on threads, worms, gear shaper cutters and gear and thread hobs; direct readings can be made to 50 millionths of in. and 1 min. of arc; measuring time cut 85%.

Yamamoto, A., S. Yamato, S. Isa, C. Kawamura and I. Kumagai, **Investigation and Trial Manufacture of Leadscrew Measuring Machine with Automatic Recording Equipment,** Bul Japan Soc. Prec. Eng. v1 n1 Oct. 1963, p.13-6.

Contents: Machine construction; measuring principles; specification; examples; examples of lead measurement; conclusion.

1964

anon., **Specification for Screw Thread Measuring Cylinders,** Brit. Standards Instn-Brit. Standard 3777 1964, 17p.

Standard relates to two grades of screw thread measuring cylinders intended for use in checking external screw threads by means of pitch diameter measuring machines; first part gives bases for diametral tolerances of Grade A and Grade B screw thread measuring cylinders and relative merits of these grades; second part gives complete specification for both grades of cylinders suitable for forms and pitches of screw threads shown.

anon., **Machinery's handbook,** 17th ed. 1964, 2104p. The Industrial Press, N.Y.

A section on measuring screw threads p.1208-25, contains tables of wire sizes and constants for wire measurements of Unified, Whitworth and Acme screw threads.

Atkins, W.F., **Combined Micrometer and Sensitive Indicator Unit,** Quality Engr. v28 n4 July - Aug. 1964, p.118-9.

Combined micrometer and fiducial indicator when measuring to accuracy of about 0.25 micro m. is described; unit is intended for incorporation in measuring machine of type used to measure screw plug gages of sizes above, about 12 in. diameter; it enables operator to watch movement of indicator pointer and micrometer simultaneously; unit described is equally suitable for measuring diameter of sizes down to about 4 in.

Atkins, W.F., **Combined Micrometer and Sensitive Indicator Unit,** Machy (London) v105 n2697 July 22, 1964, p.271-2.

To overcome difficulty when measuring work pieces of large diameter, design was produced at NPL in which micrometer and fiducial indicator are combined in single unit that can be mounted on machine; external and sectional views of unit are described; unit was fitted to diameter measuring machine used at NPL for checking API screw plug gages.

Brousseau, H.E., **Techinque for Calibration of Large Thread Gages,** ASTME Tech Paper 590 1964, 14p.

Annular shaped thread gages remain mounted on the arbor as processed in manufacture. The arbor center holes locate the axis of the gage, permitting measurement of lead and helical variation. Gages over 8 in. in diameter are inspected on a modified optical comparator. Special holding fixtures and undesired projection are used.

Gabbey, E.G., **Screw Thread Inspection,** Tooling & Production v30 n1 Aor. 1964, p.63-7.

Examination of reasons for conflicting views concerning control of a accuracy of threaded fasteners; basic thread problems such as lead error, angle error, helical deviation and out-of-roundness are considered; essential gaging requirements; comments on gaging methods; plating of screw threads; simplified 3-wire systems for rapidly checking pitch of screw threads to comply with latest specifications.

Morcos, W.A., **Study of Effective Diameter Equivalent of Flank Angle Errors in Fillited Triangular Screw Threads,** Int. Production Research v3 n2 1964, p.153-66.

Formulas derived are based on general case, simplified for computation purposes; sign of individual flank angle errors has been taken into consideration, which leads to four possible cases of mating for each threaded element; comparison with other formulas in current use showed small divergences in case of Whitworth threads but bigger divergences are expected in case of threads with steeper flanks.

Morcos, W.A., **Study of Effective Diameter Equivalent of Flank Angle Errors in Triangular Screw Threads,** Microtecnic v18 n1 Feb. 1964, p.9-18.

Exact formulas for computing simple effective diameter equivalent of flank angle error have been established which are valid for hypothetical parallel thread of unsymmetrical triangular form having flat roots and crests, and unequal heights above and below pitch line; formulas are applicable to threads of any number of starts.

Vanpee, M., **Normalisation-L'Introduction du Filetage Metrique ISO dans les Pays Europeens,** Rev M v10 n2 1964, p.46-50.

Standardization-introduction of ISO metric screw thread in European countries; history of ISA and ISO activities with respect to standards in this field; work of European Committee for Coordination of Standards and screw thread standards adopted in various European countries are outlined; proposals concerning small diameter screw threads.

Yamamoto, A., and M. Ichikawa, **On a Screw Thread Lead Measuring Machine With Automatic Recording Equipment,** Bul of the Tokyo Inst. Technol n58 1964, p.37-47.

A SIP model 4 type screw thread cutting lathe which had been used in a machine shop for many years, was repaired and adapted to serve as a screw thread lead measuring machine with automatic recording equipment. From this investigation the following results were obtained. 1) An electric micro-comparator with automatic

recording equipment was made by utilizing wire strain gauges, and it was ascertained that it has the satisfactory accuracy and linearity for the lead measuring machine. 2) Periodic error of measurement which was caused by the eccentric rotation of the lead screw was fully eliminated by using suspension type lead nut instead of the original one. 3) The screw thread lead measuring machine could measure to an accuracy of + or - 1 micron within the measuring range of 100 mm., by giving a correction curve to the plate cam and repairing several parts of the machine. 4) Lead error of an internal thread could be measured without taking into account the influence of eccentric chucking.

1965

anon., **Nomenclature, Definitions and Letter Symbols for Screw Threads,** ASA - Am Standard B1.7 Published by ASME 1965, 26p.

Standard establishes uniform practices for use on drawings, in tables of dimensions and for expressing mathematical relationships; contains glossary of terms, tables of dimensional symbols, illustrations and appendixes.

anon. **Specification for ISO Metric Screw Threads-2,** Brit. Standards Instn-Brit. Standard 3643 pt. 2 1965, 14p.

Limits and tolerances for commercial bolt, nut and machine screw threads; standard gives basic dimensions, allowances, tolerances and limits of size of ISO metric screw threads for commercial nuts, bolts and machine screws within range 1.6 to 39 mm diam. for coarse pitches and 8 to 24 mm diam. for fine pitches.

Mueller, P., **Differential-Messverfahren Zur Wirtschaftlicheren Gewindeherstellung,** Werkstattstechnik v55 n5 May 1965, p.240-3.

Differential measuring method for economic production of screw threads; devices are described which enable measurement of difference between mating- and actual- flank diameter, thus making it possible to obtain greatest geometric accuracy.

1966

Nawata, S., and K. Takashima, **Application of Interferometry to Measurement of Pitch of Threads on Lead Screw,** Applied Optics v5 n4 Apr. 1966, p.609-13.

Rapid method, involving use of Michelson interferometer for measuring pitch of non-rotating lead screw that involves no mechanical contact with thread is described; lead screw is mounted on carriage of machine which moves it parallel to its axis; Michelson fringes are counted continuously as screw threads are moved across light beam; passage of pitch point, to punctuate fringe count, is sensed by photoelectric microscopes and associated electronic circuitry; performance of apparatus is presented.

1967

Bateman, B.B., **Screw Thread and Hexagons 1965-1966,** Production Engr. v46 n6 June 1967, p.375-84.

Investigation of screw thread problems in view of decision made by British Government in connection with adoption of metric system; number of tables presented show scale of diameter and pitches on various samples of screws and bolts, comparison of theoretical proportions for bolts, comparison of Whitworth pitches with those of metric coarse series; hexagon sizes.

Metz, A., **Gewindemessgeraete Mit Automatisierbarer Messwertausgabe,** Werkstattstechnik v57 n7 July 1967, p.305-8.

Examples of measuring devices for external and internal threads of measuring microscopes and profile projectors are described and illustrated; extent to which such devices can be automated, is indicated in German.

1968

Jain, P.L., S.N. Sinha and A.D. Nikforov, **Production Errors on Screw Threads and Their Statistical Evaluation,** Instn Engrs. (India)-J v48 n7 pt ME 4 March. 1968, p.544-9.

Attempt is made to explore various elements of screw thread causing its production inaccuracies and to show how statistical techniques can be applied as means of investigation of inaccuracy of screw threads; further, simple but effective method of diametral compensation of errors in pitch, angle of thread and effective diameter adaptable during mass production process, is indicated.

Schmidt, H., **Gages for Metric ISO Threads,** Werkstatt u Betrieb v101 n11 Nov. 1968, p.653-7.

Design and operation of gages; their testing by producer and user; dimension and tolerances discussed; effect of conversion to metric ISO threads, on standardization of thread gages and their tolerances. In German.

Twining, JB., **Specific Procedures and Methods of Checking Thread Gages,** ASTME Creative Mfg. Seminars-Screw Thread Symposium, Detroit, Mich-Tech Sept. 12-13, 1968, 4p.

Procedures for calibrating the majority of thread gages have been established and must be followed in order to meet the requirements of government, USASI and customer specifications. Tolerance limits of acceptance have been established by the industry and must be adhered to. Scheduling for recallibration is established by the individual company, frequency being determined from past history of gage usage. If historical data is not available, recommended schedules should be used. Basic procedures for calibration of thread gages are discussed.

Watson, **Basic Metrology Requirements for Gage Control and Maintenance,** ASTME Creative Mfg. Seminars-Screw Thread Symposium, Detroit, Mich-Tech Sept. 12-13, 1968, 14p.

This paper covers traceability of the inch from the National Bureau of Standards to the gage manufacturer. Metrology Laboratory environment and basic equipment required to check thread gage elements, principles of gage acceptance and surveillance, and miscellaneous uses of the Metrology Laboratory are discussed.

1969

Davidson, M., **Care and Use of Thread Gages, Their Surveillance and Control,** ASTME Creative Mfg. Seminars-Screw Thread Symposium, LA. Calif.-Tech. Paper March 11-12, 1969, 8p.

When gages are damaged through improper care or use, pressure is usually put on the gage manufacturer for immediate replacement. This will cost the product manufacturer additional money because he usually authorizes "overtime" for the sake of expedience. Not only is the gage manufacturer's normal production interrupted, which is costly, but the product manufacturer could possibly suffer immeasurable loss due to interruption of his production and/or inspection.

Hanka, W., and R. Hase, **Determination of Adjusted Values for Thread Errors by Means of Vectors,** (Ermittlung der Ausgleichswerte fuer Gewindefeheler mittels Vektoren), Werkstattstechnik v59 n1 Jan. 1969, p.23.

To determine diameters of screw thread gages, pitch errors and thread angle errors must be taken into account; simplified method is presented where vectors can be used in graphics way, in German.

Lawser, J.J., **Geometrical Analysis of Hole Sizes for Thread-Forming Screws,** SAE-Paper 690056 for meeting Jan. 13-17, 1969, 9p.

Manufacturing technology of thread-forming screw specifications to be improved by relating required performance specifications to fundamental geometric parameters; paper derives important geometrical parameters for internal threads produced by thread-forming screws; equations relate internal thread geometry to external thread form and hole size; without complete standards for thread forming screws, technique is illustrated for Type C and sharp crested nonstandard thread form; percent thread and percent column filled between threads are given by charts.

Shelby, OJ., and JE. Watson, **Procedures and Methods for Verifying Thread Gages,** ASTME Creative Mfg. Seminars-Screw Thread Symposium, LA. Calif.-Tech. Paper March. 11-12, 1969, 22p.

Initially the required accuracy of thread gages must be achieved and verified by the

gage manufacturer. In use, gage accuracy must be maintained and monitored in order to assure an effective gaging program. As product tolerances shrink and critical requirements increase in the current space age industrial complex, one must continue to refine the state of the art of thread gage measurement, utilizing traceability, proper environment, improved measuring equipment, standard procedures and skilled technicians.

1970

Kander, Z., **Setting of Screw Thread Roll Gauges WIthout Master-Thread Plugs,** Int. J Prod. Res. v8 n1 1970, p.41-50.

According to standard handbooks and inspection practice, screw thread roll gages are set by employing, special master set plugs. In the present paper, formulas are developed to enable thread wires and gage blocks to serve the same purpose. The appropriate exact formulas, as well as approximate, easily applicable ones, are derived for symmetrical triangular and trapezoidal threads and the nonsymmetric case deduced from previous results.

Mounir, M.Z., and S.E.A.E. Kandil, **Determination of the Pitch Cone Angle Errors Compensation in Taper V-Threads,** ASME 2nd Interamerican Conf. Mater Technol., Mexico City, Mexico, Aug. 24-27, 1970, pt.1, p.349-52.

The three-wire method used for measuring the thread pitch diameter of straight (parallel)thread can be applied as well to taper V-threads to determine its pitch cone angle. Therefore, the pitch diameter at any particular point and the equivalent pitch cone angle for compensation of errors in taper V-thread can be calculated.

Yanuskevich, E.P., and E.G. Shevchenko, **Correction for Angle of Helix Pitch In Measurements of Pitch Diameter of an Asymmetric Thread,** Izmeritelnaya Tekhnika n12 Nov. 13, 1970. Translated on Dec. 1971, p.31-34.

In this article the author gives the correction for angle of helix in pitch diameter measurements for an asymmetric thread.

1971

Mustaev, R. HH., **Analysis and Development of New Instruments for Measuring External and Internal Screw Threads of Couplings with Interference Fits,** Meas. Tech. v14 n3 March 1971, p.39[illegible].

For measuring external and internal threads by the effective diameter, thread gages, indicating instruments, minimeters and micrometers with various measuring tips are used. As demonstrated by the investigations, results obtained in measuring the threads of the same component by gages and instruments with different tips are dissimilar, differing by as much as 20 to 30 microns.

1972

Jllig, W., **Probleme Der Gewindepruefung,** (Problems in Thread Inspection), Ger. TZ Prakt Metallbearb v66 n4 Apr. 1972, p.141-4.

Problems inherent in thread inspection necessary to ensure the reliability of the joint and the interchangeability of the threaded components are discussed. Both inspection with the aid of gages and with measuring instruments is considered. In particular, it is shown how more objective results can be achieved with the use of gages. In German with English abstract.

1973

anon., **Stub Acme Screw Threads,** ANSI Stand. B1.8 1973, 27p.

This standard promulgates specifications for steel Acme screw threads for use in unusual applications where a coarse-pitch thread of shallow depth is required.

anon., **Buttress Inch Screw Threads,** ANSI Stand. n B1.9 1973, 27p.

This standard relates to screw threads of buttress form and provides: a form of 7/45 deg. buttress thread with 0.6p basic height of thread engagement; a table of preferred diameter-pitch combinations; a formula for calculating pitch diameter tolerances; a system of allowances between external and internal threads; recommended methods of measuring and gaging; dimensional acceptability of buttress product.

Mintrop, H., and M. Kochsiek, **Anlagekorrektion Und Guenstigster Messkoerperdurchmesser Fuer Zylindrische Gewinde** (Rake Error Compensation and Optimum Size Cylinders and Balls for Thread Pitch Measurements), Messtechnik v81 n11 Nov. 1973, p.350-6.

Formulas for the calculation of the rake correction and a diameter of the measuring cylinder for cylindrical screw threads with rectilinear flanks are given which allow a precise calculation of these dimensions. Better accuracy of measurements is obtained, particularly of threads with larger angles of pitch (over 5 deg.). In German with English abstract.

Tanimura, Y. and J. Nara, **Pitch Measurement of Objects Having Periodic Shapes by Holographic Interference-1. On Positioning the Threaded Flanks of a Screw For Micrometer,** Bull Jap. Soc. Precis. Eng. v7 n4 Dec. 1973, p.109-114.

This paper concludes that positioning signals of the threaded flanks of a screw for micrometer can be detected by means of holographic interference. The positioning signals are used in order to measure the pitch of the screw. The conditions for applying the interference technique to positioning the flanks are to illuminate a flank to be positioned with a condensed beam of He-Ne laser at a high incident angle more than the critical angle and to utilize the regular reflected beam of the flank to be positioned as the signal beam to make a hologram. The hologram is useful as a kind of matched filter for the flank to be positioned.

1974

anon. **Gages and Gages for Unified Inch Screw Threads,** ANSI Stand nB1.2 1974, 102p.

This standard covers gaging methods for conformance of Unified Screw Threads and provides the essential specifications for applicable gages required for unified inch screw threads.

Kaifesh, C., **Revised MIL Specs Open New Era for Internal Thread Inspection,** Tool Prod v39 n10 Jan. 1974, p.49-51.

"Go" and "No Go" thread plug gages for internal threads can produce compound errors in thread angle, pitch and pitch diameter, with resulting performance problems in mated assemblies. An internal thread gage, which incorporates three floating carbide balls that simulate Best Wire methods, is described.

Kochsiek, M., **Bestimmen Der Teiflankenwinkel An Gewinden Durch Mechanisches Abtasten Der Flanken.**(Measuring of the Screw Thread Flank Angles By Gages), Phys-Tech. Bundesanst. Braunschweig, Ger, VDI Z v116 n2 Feb. 1974, p.145-50.

The methods to decrease errors in measurements of thread angles are studied. A new method with an instrument for tracing on tape is investigated. Successful results in accuracy were obtained. 9 refs. In German with English abstract.

1975

Esser, H., **Die Steigungsabweichung Dergewinde Von Kugelgewindespindeln Unter Besondered Beruecksichtigung Der Verwendung Im Werkzeugmaschinenbau** (Pitch Deviation of Ball Screw Threads, with Particular Reference to Their Application in Machine Tool Construction), TZ Prakt Merallbearb v69 n2 Feb. 1975, p.44-8.

The significance of standardization of ball screw spindles employed in machine tool construction is pointed out. Emphasis is placed on the various pitch errors which may occur in engineering practice. Some available factory standards in this field are reviewed and suggestions are given for an international standard. In German.

1976

Richard, B., **Thread Gaging with the Ball Contact Method,** SME Tech. Pap. Ser IQ at Southeast Conf. & Tool Show, Orlando, Fla. Dec. 6-8, 1976, 7p.

The principles, methods, types and designs of gages and gaging of threads have been governed by the National Bureau of Standards through their publication of H-28 Handbook: Screw Thread Standards for Federal Services. The theory of using spheres (balls) has been defined in this standard but heretofore had not been developed. The design procedure has now been introduced for measurement of the three elements of a thread (pitch diameter, lead and flank angles) using balls based upon the same principle as using wires (pins) as is now accepted for accurate measurement of external threads.

1977

anon., **Acme Screw Trheads,** ANSI Stand. ANSI B1.5 1977, 53p.
The scope of this standards includes the nomenclature of screw threads, form of threads, diameter and pitches of screws for various uses, classification of thread fits, tolerances and allowances for threaded parts and the gaging of threads. Screw threads for fire hose couplings are not included within the scope.

anon., **Stub Acme Screw Threads,** ANSI Stand. ANSI B1.8 1977, 26p.
The scope of this standard extends to nomenclature of screw threads; form of threads; diameter and pitches of screws for various uses; classification of thread fits, tolerances and allowances for threaded parts; and the gaging of threads. Screw threads for fire hose couplings are not included within the scope.

anon., **Nomenclature, Definitions, and Letter Symbols for Screw Threads and Related Features,** ANSI Stand. B1.7 1977, 26p.
The purpose of this standard is to establish uniform practices for American Standard screw threads with regard to screw-thread nomenclature, and letter symbols for designating features of screw threads for use on drawings, in tables of dimensions which set forth dimensional standards, and in other records, and for expressing mathematical relationship. The standard consists of a glossary of terms, two tables of screw thread symbols, five illustrations, four of which show the application of symbols, two tables of thread series and feature designations. Supplementary information is provided in three appendices.

1977

anon., **Metric Screw Threads- MJ Profile,** ANSI Stand n B1.21M 1978, 42p.
This standard specifies the characteristics of the MJ metric series of threads having controlled radii at the root of the external thread. This standard establishes the basic triangular profile for the MJ form thread; gives a system of designations; lists the standard series threads for aerospace screws, bolts and nuts; lists the standard series of diameter-pitch combinations for diameters from 1.6 to 200 mm; and specifies limiting dimensions and tolerances.

1978

anon., **New Angle on Thread Checking,** Mach. Prod. Eng. v132 n3404 March 29, 1978, p.34-35.
A description is given of a system devised for checking quickly and easily, the flank angles of a vee screw thread, to gauge whether the included angle lies within the permitted tolerances, and whether that angle is symmetrical about its center line. The

system described does not allow actual measurements to be taken, and is based on visual assessment against what is effectively a master gauge representing the minimum and maximum angles laid down by an appropriate standards specification. If actual measurement of error is required, then the system can be modified to provide readings either in increments of 5 mts. of angle, or even more accurately by means of a sine bar.

Yoshimoto, I., K. Maruyama, K. Hongo, and T. Sasaki, **Investigation on the Screw Threads Profile to Improve the Fatigue Strength,** Bull Res. Lab Precis. Mach. Electron Tokyo Inst. Technol. n42, Sept. 1978, p.7-15.

This paper deals with the theoretical and experimental analyses on the screw threads profile to improve the fatigue strength, taking account of the ISO proposal. The profiles of ISO general purpose threads and ISO high fatigue resistance threads are compared from the viewpoint of fatigue experiments. The separate effects of pitch modification and flank angle modification are investigated in fatigue experiments.

1979

Bitters, P.F., **Metric Screw Threads, Present Status,** SME Tech Pap. Ser. IQ n IQ79-373 1979, 10p.

The change-over to metric screw threads is developing in line with adoption of the metric system in the U.S. Certain metric thread standards have been finalized and others are being prepared. Already the picture is becoming clearer to guide American industry in the choice of diameter/pitch combinations and classes of tolerance that are or will be standard, or atleast in common usage. From the very wide and complex choice of metric sizes and tolerance classes, common sense dictates the selection of a minimum variety to suit individual product requirements.

Bytchkov, R.M., V.P. Koronkevitch, and B. Yu Chugui, **Threaded Article Parameter Measurement by Spatial Spectra Analysis,** Appl. Opt. v18 n2 Jan. 15, 1979, p.197-200.

The possibility is considered of controlling the parameters of articles of complicated shape by their spatial spectra, that is, profile angle, mean diameter and threaded article pitch.

1980

Kampa, H. and M. Schwertz, **Measurement of Internal Threads in a Multi-Coordinate Measuring Device,** Publ. for IFAC by Pergamon Press, Oxford, Engl. and New York, NY, USA. Oct. 22, 1980, p.317-24.

In the use of a computer-controlled measuring center for the quality assurance in flexible production systems, the flexibility in comparison with conventional multi-coordinate measuring devices has been increased by increasing the scope of possible measurements to an extent that largely all measurement jobs involved in prismatic

workpieces can be solved by this system. A survey revealed that there is also a need for testing internal threads; it also showed that there is a number of typical types of defects which occur very frequently in the manufacturing of internal threads, where these defects restrict the operability of the threads involved. To detect defects caused in manufacturing and to test whether the thread parameters lie within the permissible limits, a program has been prepared that permits statements as to the dimensions to be made at a justifiable amount of measurement and, thus, a correction of the errors. The development for the measuring center makes it possible to reduce the extent of material flow in the production system, since the need for additional measuring devices may be obviated.

Yoshimoto, I., K. Maruayama, K. Ohmura, **Automatic Measurement of Screw Lead By Laser Interferometer and Optical Feeler,** Bull Res. Lab Precis. Mach. Electron Tokyo Inst. Technol n46 Sept. 1980, p.11-7.

A new optical feeler which can detect the position of an object with high accuracy, is designed and manufactured by combining a tool maker's microscope and a photodiode, and it is applied to the screw lead measuring machine with laser interferometer for the automatic measurement of the cumulative pitch error and the lead error including cycle error screw.

1983

Polivka, F., **Replica Technique for the Inspection and Measurement of Small Internal Screw Threads,** Precis Eng. v5 n4 Oct. 1983, p.167-70.

The superplastic behavior of zinc-22% aluminium alloy was utilized in the production of replicas of small internal screw threads. Reproduction of size was better than with epoxy resin, molding rubber or plaster of Paris and the replica has sufficient hardness to enable a contact method of measurement to be used. The replica technique is described and examples of dimensional measurement and of the determination of surface finish parameters are presented.

1984

anon., **Gages for Metric Screw Threads for Commercial Mechanical Fasteners-Boundary Profile Defined,** ANSI Stand ANSI/ASME B1.19M- 1984, 19p.

This standard establishes the specifications, dimensions, and use of boundary profile thread gages for checking the minimum and maximum material boundaries for external and internal screw threads. Gage specifications for screw thread sizes M5 TIMES 0.8 and larger, recommended for metric commercial fasteners in ANSI B1.18M, are included.

Emanuelli, D.J., H.W. Ellison, C.E. Lynch, **Gages and Gaging for Unified Inch Screw Threads,** ANSI Stand ASME B1.2-1983 Jun. 15, 1984, 179p.

This standard provides essential specifications and dimensions for the gages used on Unified inch screw threads (UN and UNR threads form), and covers the specifications and dimensions for the thread gages and measuring equipment. Thread plug gages are controlled by direct measuring methods. Thread ring gages, thread snap limit gages and indicating thread gages are controlled by reference to the appropriate setting gages or direct measuring methods or both.

Lotze, W., and H.J. Will, **Gewindegeometrie Und Gewindemessung Aus Dreidimensionaler Sicht** (Thread Geometry and Thread Measurement from the Three-Dimensional Standpoint), Feingeraete Technik v33 n9 Sept. 1984, p.408-410.

Computer coupled coordinate measuring instruments for thread measurement allow new information about the thread geometry, the main quantities to be determined and their deviations to be obtained. Problems of thread measurement, the ideally geometrical thread in space, and coordinate measurement of the threads are dealt with. In German.

Orthwein, William C., **DESIGNING AND SELECTING SCREW THREADS USING A PERSONAL COMPUTER,** Comput. Mech. Eng. v2 n5 March 1984, p.49-52.

A microcomputer program determines the lead angle that satisfies a specified load-to-torque ratio. It then calculates the minimum engagement length necessary to prevent thread failure. As an option, the program can sketch the designed threads for different profiles.

Yanushkevich, E.P., L.G. Manyukova, D.N. Ulezko and V.F. Legeza, **Device for Measuring Average Diameter of Female Thread,** Meas Tech. v27 n12 Dec. 1984, p.1091-3.

A thread-measuring (TM) attachment was developed to the UIM-23 universal stage microscope for measuring the average diameter of a female thread in the range of 18-160 mm with pitches of 0.75-4 mm. This TM attachment to a universal stage measuring microscope can be used to certify standard threaded rings in the laboratories of the territorial organs of the stage metrological service, and also in the measuring laboratories of enterprises and organizations that make and use threaded rings.

1985

Kampa, H., J. Kring, and S. Edel, **Flexibles Rechnergesteuertes Messgeraet Zum Pruffen Von Innengewinden** (Computer-Controlled Flexible Measuring Device for Testing Internal Threads), Tech. Mess. TM v52 n12 1985, p.465-70.

The construction and functioning of a numerical controlled thread test device is described with which a functional test of internal threads can be performed during the manufacturing process. Some tests results are given. Simultaneously to the evaluation of actual torques on thread plug gages the position, the axis position and the thread depth can be determined. In German.

1986

Madgev, V.Sh., and V.A. Vorob'ev, **Element-by-Element Measurements of Outside Cylindrical Thread,** Sov. Energy Technol. n3 1986, p.67-70.

Guideline documents deal with both complex inspection (using thread gages) and element-by-element inspection of threads. While unchallenged in terms of productivity, inspection using thread gages is not always cost-effective, inasmuch as the cost of ring gages remains quite high. This tips the scale against reliance on gage-based complex inspection procedures applied to small batches of products. Large size and mass of threaded parts, such as in modern power machinery, eliminate any possibility of measuring the elements of outside male threads directly on BMI-1, UIM-23, UIM-24, and other similar general-purpose measuring microscopes. A description of a useful procedure for measuring elements of a straight male (outside cylindrical) thread, tested and approved on the production floor of PO Atommash is presented.

1986

Maruyama, Kazuo, and Kiyomi Nakano, **Automatic Measurement of Screw Pitch Error By Thermoplasitc Hologram,** Bull Jpn. Soc. Precis. Eng. v20 n2 June 1986, p.133-4.

Reference is made to a paper by other authors which reported the development of a method of automatic measurement of screw pitch error by holographic interference using a silver halide plate. Because this method required too much time to make a hologram, in this paper, a new method using thermoplastic hologram is proposed, and the possibility of this method is experimentally investigated.

1987

Maruyama, Kazuo, and Kiyomi Nakano, **Automatic Measurement of Screw Pitch Error By Thermoplastic Hologram,** Bull Res. Lab Precis. Mach. Electron Tokyo Inst. Technol. n59, March 1987, p.11-18.

A non-contact measuring method is proposed for the screw pitch error utilizing thermoplastic hologram instead of silver-halide plate hologram, and then the possibility to realize this method is experimentally investigated. The pitch signal is obtained by illuminating the hologram with both signal and reference beam, and the positional pulse is obtained through the electric circuits.

1988

Malinowski, Jan, and Wladyslaw Jakubiec, **Pomiary Srednicy Podzialowej Gwintu Walcowego Wewnwtrznego.** (Measurements of the Pitch Diameter of a Cylindrical Internal Thread), Mech. Mies. Nauk Tech. v61 n5 May 1988, p.221-226.

Formulas are presented for the pitch diameter of internal threads when measuring with the aid of ball-shaped measuring sensors. Simplified formulas for calculating the measurement inaccuracy are also presented. The significance of the measurement of thread pitch and angle and of corrections for the position of the balls in the root of the thread in the final result of pitch diameter calculations is shown. In Polish.

1989

Pfeifer, T., and M. Molitor, **Faseroptischer Sensor Zur Beruehrungslosen Innengewindemessung** (Fiber Optical Sensor for Noncontacting Measurement of Internal Threads), Feingeraete Technik v38 n1 1989, p.5-7.

In critical screw connections, such as internal threads on connecting rods, a 100 percent quality control with regard to pairing capability, load capacity or chippings is necessary instead of the usual visual testing or the sampling with hand gauges. The authors describe the fibre optical measuring principle, the design of a fiber optic sensor, the signal evaluation and the application of the sensor in the internal thread automatic measuring machines. In German.

1990

Aleksandrov, V.K., N. Yu Bienkov, Il In V N, A.L. Starkov, **Automated System for Gaging Leadscrew Pitch,** Sov. Eng. Res. v10 n5 1990, p.90-4.

Long (up to 3-6 m) leadscrews are widely used in machine tools, gaging machines, coordinate gaging devices, plotters etc., These screws must meet extremely tight accuracy requirements. For gaging long leadscrews, special gaging machines have recently come into use. The present authors analyzed the possibility of using the IZM universal gaging machine manufactured by the LOMO Combine for gaging leadscrew pitch.

Gazdag, William, **Micrometers Keep Getting Better with Time,** Quality Progress v23 n7 July 1990, p.64-5.

Micrometers are the most commonly used industrial measuring instruments throughout the world for several reasons. First, micrometers have a wide range of application. They can be used to measure outer-and inner-diameter dimensions, grooves, depths, heights, pitch diameters and hard-to-reach places. Second, they are easy to use. Today's advanced liquid crystal display (LCD) models make measurement reading easier than ever. Finally, micrometers are inexpensive compared to other types of quality control instrumentation. Micrometer types are described and their uses explained. Future developments are assessed. The following micrometer types are briefly described. Special anvil, spline-type, point, disc-type, screw thread, blade, deep-throat, indicating, bench, tube, hub, low-pressure and laser micrometers.

Gibson, C.G., and K.H. Hunt, **Geometry of Screw Systems. 1. Screws: Genesis and Geometry,** Mech. Mach Theory v25 n1 1990, p.1-10.

In this two-part paper the authors claim to present, definitively and exhaustively, all screw systems, namely all possible linear combinations of given instantaneous screws. In Kinematics, screw systems are central to multi-freedom devices, in particular those prevalent in robotics. The authors justify their work mainly because, first, there appears to be uncertainty in the minds of some as to the complements of earlier efforts to define all screw systems, and, second, our approach, via projective five-space, throws valuable light on screw theory, and so has promise of other applications. In part 1, we introduce lines and screws, and present the relevant geometry of projective five-space for their representation in it.

Gibson, C.G., and K.H. Hunt, **Geometry of Screw Systems. 2. Classification of Screw Systems,** Mech. Mach Theory v25 n1 1990, p.11-27.

Here we apply and extend the material of part 1, systematically studying all the screw systems in the screw space, corresponding to motions of one, two and three freedoms. We establish a normal form for every screw system, namely the most concise representation in terms of base screws. Since, in Part 1, the principle of reciprocity of screws is shown to correspond to a polarity in the screw space, there is no need for a detailed survey of screw systems of a higher order than three.

Vorob, Ev. V.A., and V. Sh. Magdeev, **Parameter Measurement in an Outside Cylindrical Thread Under Plant Conditions,** Measurement Techniques (English translation of Izmeritel'naya Tekhnika) v33 n5 Oct. 1990, p.452-455.

Standardization documents envisage thread checking by means of gauges and element by element, but the fastest monitoring with gauges is not always economically justified, since the costs of the gauge rings are quite high, and particularly those of the facilities for metrological service. The large dimensions and masses of threaded items in modern power machinery make it possible to measure the components of outside threads directly with universal measuring microscopes such as the BMI-1, UIM-23 and UIM-24. A method of measuring components of an outside cylindrical thread that has been tested at the Atommash Cooperative, is described.

1991

Maruyama, Mutsuo, **Estimation of the Geometry of Screw Thread by Means of the Method of Least Squares,** J Jpn. Soc. Precis. Eng. Seimitsu Kogaku Kaishi v57 n9 Sept. 1991, p.1609-14.

A method for estimating the geometrical elements of screw threads is proposed. This method is based on the method of least squares in order to obtain unknown geometrical elements, namely a position and an attitude of a screw axis, a pitch, a flank angle, a taper angle and a pitch diameter, from measured coordinates value of screw surface. A screw thread being treated to be three-dimensional, the method also

has a capability to estimate form deviations in addition to the above elements. According to experimental examinations on some thread plug gages which are performed by using a coordinate measuring machine, the method shows an expected performance, giving good results in the estimations with respect to the geometry of the specimens. In particular, the method is considered to be available for automatic inspections of screw threads by means of coordinate measuring machines. In Japanese.

Index of Names

The authors names are listed below with the year of publication of their citation given. For joint authors, all joint authors appear in parentheses and the first author, if not the indexed name, is underlined.

Keywork Index

The papers are referred to by a key made up of the year and initial letters of the first author's name. For dates after 1900 only the last two digits of the date are given. Example: the first reference "07C" refers to a paper from 1907 by the author whose last name begins with C.