Unified Screw Thread Standards

U. S. Department of Commerce
National Bureau of Standards

U. S. Department of Commerce
Charles Sawyer, *Secretary*

National Bureau of Standards
E. U. Condon, *Director*

Unified Screw Thread Standards

National Bureau of Standards Circular 479

For sale by the Superintendent of Documents, U. S. Government Printing Office,
Washington 25, D. C. Price 20 cents

Contents

Proceedings

Joint Session of the Representatives
of
Canada, United Kingdom, and United States
on the

Unification of Screw Threads

at the
National Bureau of Standards
Washington, D. C.
November, 18, 1948

Declaration of Accord

with respect to the

Unification of Screw Threads

It is hereby declared that the undersigned, representatives of their Government and Industry Bodies, charged with the development of standards for screw threads, Agree that the standards for the Unified Screw Threads given in the publications of the Committees of the British Standards Institution, Canadian Standards Association, American Standards Association and of the Interdepartmental Screw Thread Committee fulfill all of the basic requirements for general interchangeability of threaded products made in accordance with any of these standards.

The Bodies noted above will maintain continuous cooperation in the further development and extension of these standards.

Signed in Washington, D. C., this 18th day of November, 1948, at the National Bureau of Standards of the United States.

C. D. Howe	Ministry of Trade and Commerce, Dominion of Canada
J. G. Morrow	Canadian Standards Association
T. R. B. Sanders.	Ministry of Supply, United Kingdom
Percy Good	British Standards Institution
Ewart Smith	Representative of British Industry
E. U. Condon	National Bureau of Standards U. S. Department of Commerce Interdepartmental Screw Thread Committee
Fred P. Tisch	American Standards Association The American Society of Mechanical Engineers Society of Automotive Engineers
William L. Batt	Sponsors Council of United States and United Kingdom on the Unification of Screw Threads

The Joint Session

Hosts

The National Bureau of Standards, United States Department of Commerce

The Interdepartmental Screw Thread Committee of the Departments of the Army, Navy, Air Force, and Commerce

The Sponsors Council of the United States—United Kingdom on Unification of Screw Threads

The Committee on the Standardization and Unification of Screw Threads, Sectional Committee B1, organized under the procedure of the American Standards Association and sponsored by The American Society of Mechanical Engineers and the Society of Automotive Engineers

Co-Chairmen

The HONORABLE EDWARD U. CONDON, Director of the National Bureau of Standards and Chairman of the Interdepartmental Screw Thread Committee of the United States of America

MR. HOWARD COONLEY, Chairman of the Executive Committee of the American Standards Association

Official Delegations from Canada and the United Kingdom

Rt. Hon. C. D. HOWE, Minister of Trade and Commerce, Canada

MR. JAMES G. MORROW, Canadian Standards Association

MR. NEIL P. PETERSEN, Chairman, Screw Threads Standards Committee

MR. F. L. HAYDEN, representing Canadian Industry

SIR EWART SMITH, representing British Industry

MR. T. R. B. SANDERS, Ministry of Supply of Great Britain

MR. PERCY GOOD, Director, British Standards Institution

MR. H. L. GRIFFITHS, Technical Officer, British Standards Institution

Canada

His Excellency Hume Wrong, *Ambassador of Canada*

Mr. M. W. Mackenzie
Air Marshal W. A. Curtis
Commodore B. S. Godfrey
Brigadier H. E. Taber
Air Commodore R. C. Gordon
Commander E. R. Russell
Colonel L. G. Clarke
Group Captain L. J. Birchall
Captain S. S. Carroll
Captain J. P. Francis
Mr. J. R. Donald

United Kingdom

His Excellency Sir Oliver Franks, *Ambassador of Great Britain*

Mr. J. W. Taylor, *Minister of Economic and Commercial Affairs, the British Embassy*

Sir Alwyn Crow
Major General J. A. Gascoigne
Brigadier P. S. Gostling
Air Commander W. Wynter-Morgan
Commander H. White
Commander E. W. Malim
Dr. F. N. Woodward
Dr. A. MacFarlane

The Permanent Joint Board of Defense

CANADA AND THE UNITED STATES

Honorable A. G. L. McNaughton
Rear Admiral F. L. Houghton
Mr. David M. Johnson
Major General R. T. Maddocks
Major General Robert L. Walsh
Major General H. D. Graham
Air Vice Marshal C. R. Dunlap
Mr. William P. Snow
Rear Admiral R. E. Libbey

United States

Honorable James Forrestal, *Secretary of Defense*
Honorable Charles Sawyer, *Secretary of Commerce*
Honorable Ralph E. Flanders, *United States Senate*
Honorable Kenneth C. Royall, *Secretary of the Army*
Honorable John Lawrence Sullivan, *Secretary of the Navy*
Honorable W. Stuart Symington, *Secretary of the Air Force*
Honorable Gordon Gray, *Assistant Secretary of the Army*
Honorable Donald Carpenter, *Chairman, Munitions Board*
Honorable Arthur Hill, *Chairman, Security Resources Board*
Honorable Clifton E. Mack, *Director of Federal Procurement, Treasury*
Lieutenant General Henry S. Aurand, U. S A
Major General Daniel Noce, U. S. A.
Major General E. M. Powers, U. S. A. F.
Rear Admiral C. E. Braine, U. S. N.
Rear Admiral Arthur C. Miles, U. S. N.
Brigadier General John K. Christmas, U. S. A.
Brigadier General A. A. Kessler, Jr., U. S. A. F.
Captain C. R. Criddle, U. S. N.
Captain W. R. Millis, U. S. N.
Colonel Gerson K. Heiss, U. S. A.
Colonel A. Deane Gough, U. S. A.
Colonel John M. Sessums, Jr., U. S. A. F.

THE INTERDEPARTMENTAL SCREW THREAD COMMITTEE

Honorable Edward U. Condon, *Chairman*
Mr. K. D. Williams, *Vice-Chairman*
Mr. I. H. Fullmer, *Secretary*

Mr. Stanley Farrow
Mr. B. H. Slocum
Mr. A. F. Wentzel
Mr. P. M. Delzell
Mr. H. W. Robb
Mr. W. C. Stewart
Mr. Eugene von Loesch
Mr. Frank E. Richardson
Mr. D. R. Miller
Mr. H. C. Erdman
Mr. P. G. Schulz

The Sponsors Council of the United States—United Kingdom on Unification of Screw Threads

Mr. William L. Batt, *Chairman*
Mr. Ronald R. Allwork, *Secretary*

Mr. Howard Coonley
Rear Admiral Thorvald A. Solberg
Mr. George S. Case
Mr. J. M. Crawford
Mr. H. T. Woolson
Mr. Frederick R. Lack
Mr. Frederick S. Blackall, Jr.
Mr. E. M. Whiting
Mr. W. S. James

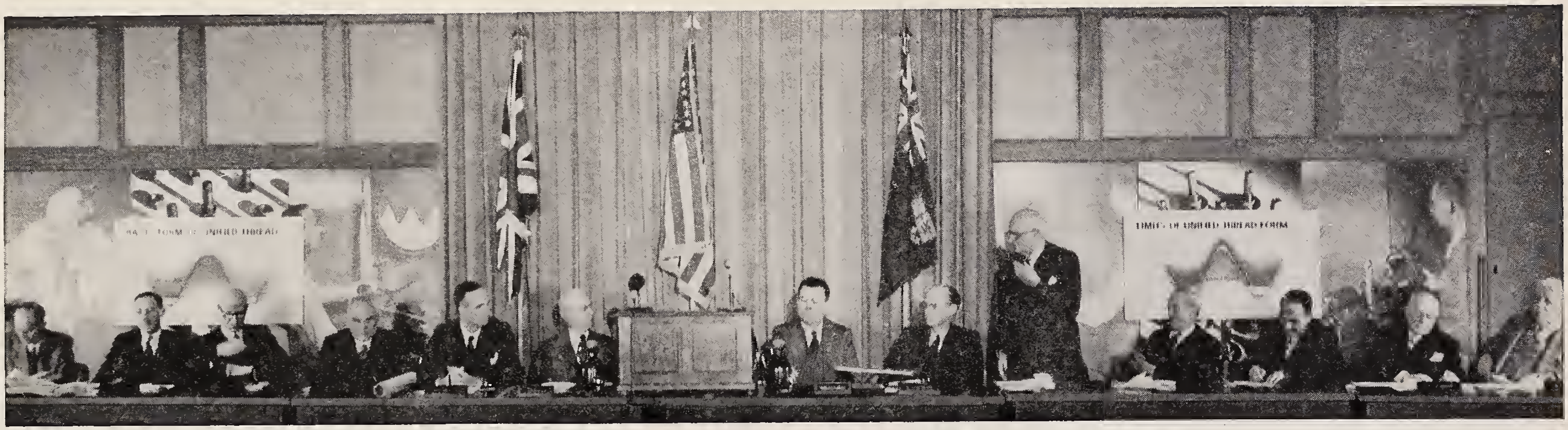
Technical Organizations

Vice Admiral George F. Hussey, *Secretary, American Standards Association*
Mr. Stanley A. Tucker, *Standards Manager, The American Society of Mechanical Engineers*
Mr. Robert S. Burnett, *Manager, Standards Department, Society of Automotive Engineers*

The Sectional Committee on the Standardization and Unification of Screw Threads

Mr. Elmer J. Bryant, *Chairman*
Mr. Frank P. Tisch, *Vice-Chairman*
Mr. Walter R. Penman, *Secretary*
Mr. R. L. Riley, *Assistant Secretary*
Mr. Paul J. DesJardins, *Chairman, Subcommittee No. 1*

Mr. W. L. Barth
Mr. Carl W. Bettcher
Mr. John S. Black
Mr. R. F. Bosron
Mr. C. B. Bronson
Mr. F. K. Brown
Mr. W. G. Brown
Mr. W. S. Brown
Mr. Earle Buckingham
Mr. G. Carvelli
Mr. George S. Case
Mr. C. G. Davey
Mr. J. S. Davey
Mr. P. M. Delzell
Mr. H. C. Erdman
Mr. Stanley Farrow
Mr. R. A. Frye
Mr. I. H. Fullmer
Mr. H. Fussner
Mr. W. H. Gourlie
Mr. Harry C. Graham
Mr. H. B. Hambleton
Mr. W. M. Hanneman
Mr. Frederick W. Helming
Mr. Russell F. Holmes
Mr. Arthur M. Houser
Mr. P. L. Houser
Mr. H. L. Keller
Mr. F. C. Leiner
Mr. Harry A. Marchant
Mr. C. F. McElwain
Mr. Henry C. E. Meyer
Mr. D. R. Miller
Mr. Paul V. Miller
Mr. H. J. Muth
Mr. L. Oest
Mr. L. F. Parlette
Mr. R. H. Perry
Mr. L. F. Polk
Mr. C. M. Pond
Mr. T. W. Ragan
Mr. F. E. Richardson
Mr. H. W. Robb
Mr. Paul G. Schulz
Mr. B. H. Slocum
Mr. W. C. Stewart
Mr. S. B. Terry
Mr. E. A. Thatcher
Mr. G. T. Trundle, Jr.
Mr. W. G. Waltermire
Mr. A. F. Wentzel
Mr. C. A. Werme
Mr. C. C. Winter
Mr. K. D. Williams



At the speakers' table, from left to right:

Mr. Percy Good, Director, British Standards Institution.

Mr. T. R. B. Sanders, Chairman, Engineering Standards Coordinating Committee, United Kingdom.

Sir Ewart Smith, on behalf of British Industry.

The Right Hon. C. D. Howe, Minister of Trade and Commerce, Canada.

His Excellency Sir Oliver Franks, Ambassador of Great Britain.

The Hon. Charles Sawyer, Secretary of Commerce.

The Hon. Edward U. Condon, Cochairman, Director of the National Bureau of Standards and Chairman of the Interdepartmental Screw Thread Committee of the United States of America.

His Excellency Hume Wrong, Ambassador of Canada.

Mr. Howard Coonley, Cochairman, Chairman of the Executive Committee, American Standards Association.

Mr. Donald Carpenter, Chairman, Munitions Board, appearing on behalf of the Hon. James Forrestal, Secretary of Defense.

Mr. William L. Batt, Chairman, the Sponsors Council of the United States-United Kingdom on Unification of Screw Threads.

Mr. James G. Morrow, Chairman, Canadian Standards Association.

Mr. David R. Miller, National Bureau of Standards and Member of the Interdepartmental Screw Thread Committee.

Mr. Frank Tisch, Vice Chairman, B1 Sectional Committee on the Standardization and Unification of Screw Threads, American Standards Association (seated to the left of Mr. Good, Mr. Tisch is not shown above).

Proceedings

[The Hon. Edward U. Condon, Director of the National Bureau of Standards and Chairman of the Interdepartmental Screw Thread Committee of the United States, greeted the delegates and guests at the rostrum and thereupon opened the joint session at the National Bureau of Standards on November 18, 1948, at 2 o'clock.]

Dr. Condon

Mr. Ambassador of the United Kingdom, delegates and Honored Guests from Great Britain; Mr. Ambassador of Canada, Delegates and Honored Guests from Canada; Hon. Charles Sawyer, Secretary of Commerce of the United States, and American Delegates and Guests:

It gives me great pleasure to welcome you here today. We are gathered to give formal recognition to the great progress made in arriving at a common understanding on unification of screw threads as used in manufactured products of the three nations represented here today.

As a result of the accord which will be signed later this afternoon, we shall enter a new era of friendly cooperation between our respective countries. More specifically, we shall have paved the way for complete interchangeability of threaded products as made and used in the three nations. This fact has great implications with regard to simplicity, convenience, and economy in the use of threaded products, involving nearly every manufactured article.

May I comment on the general character of the groups which are brought together in this meeting? This cooperative effort is, first of all, a three-way matter, involving as it does, the three cooperating nations. In each nation there are also two main groups whose interests are basic, namely the government and the industry of that nation.

For example, in the United States, the particular technical matters dealt with here today fall within the province of the Interdepartmental Screw Thread Committee, which acts for our Federal Government. For private industry, these matters are within the province of one of the major committees of the American Standards Association, under joint sponsorship of the American Society of Mechanical Engineers, and the Society of Automotive Engineers.

831563°—49—2

Similar arrangements exist in Great Britain and Canada. Governmental interest is coordinated in Great Britain, as I understand it, by the Ministry of Supply, while industry interest is handled by the British Standards Institution. Likewise in Canada: governmental interest is the concern of the Ministry of Trade and Commerce, while industry interest is developed by the Canadian Standards Association.

In this particular enterprise a great catalyzing force has been exerted by the Sponsors Council of the United States and the United Kingdom on Unification of Screw Threads, under the chairmanship of Mr. William Batt.

Again let me say how happy we in the National Bureau of Standards are to have this group of distinguished visitors with us today.

I now take great pleasure in presenting to you Mr. Howard Coonley, chairman of the executive committee of the American Standards Association, who has kindly agreed to serve with me today as co-chairman of this meeting. He will present the other speakers on the program.

Mr. Coonley

Dr. Condon, Delegates and Representatives of Canada, the United Kingdom, and the United States, and Distinguished Guests: Greetings.

As a member of the Sponsors Council, President of the International Organization for Standardization, and the chairman of the executive committee of the American Standards Association, I am particularly happy to be here today. I witnessed the initiation of this project; I am delighted to be present at its completion; and I see in the audience many who were important in the initiation of the project.

It is my pleasure to introduce to you today Mr. William L. Batt, president of the SKF Industries, former president of the American Society of Mechanical Engineers, and vice chairman of the War Production Board.

Mr. Batt

Mr. Chairman, Distinguished Representatives from abroad, and Friends at home: My remarks this afternoon will be as informal, and my approach as unprepared, as that of the Sponsors Council throughout the development of these proceedings. To all of us—in Canada, Great Britain, and the United States—who have had to do with this project over the years, this is a particularly happy, and perhaps I might even say an unexpected moment—unexpected in the sense that so many difficulties have had to be overcome through these years and yet we do have success before us today. This is a very historic occasion, an occasion however in which this comparatively technical detail, the ratification of screw thread standards, as important as that is, takes small place against the larger background of international cooperation which it so positively indicates.

Most of the people in this room understand something of the history of screw thread standards in the different countries, and therefore, it would be redundant if I, who am not an expert in that field, should talk too much about it. My first contact with the problem came in 1943 in the War Production Board when Messrs. Coonley and Allwork called to discuss the project of getting these three countries together on the standardization of screw threads. They pointed out that the problem of lack of interchangeability had been encountered in a substantial degree in World War I, and that efforts had been made for some 6 years after the ending of World War I to bring us together on a common standard, but without success. They knew, all of us who were engaged in the war effort so keenly understood—what nasty situations had repeatedly been brought about because of this lack of standardization; and the difficulties were increasing as the magnitude of our joint effort steadily increased, so they thought that it would be highly appropriate to have the great influence of the combined board directed toward this issue.

It seemed to me that we had troubles enough of our own without bothering with that one. I regretfully admit that my welcome of the suggestion that day was a very lukewarm one, to put it mildly; but, as time went on and I could see the significance of the problem, I think I became quite as enthusiastic as anyone else. And so, with the meeting in New York, at which the three countries were officially represented in 1943, the one in London in 1944, and then as the guests of our friends in Canada at Ottawa in 1945, we almost reached an agreement. If the war had not ended so quickly, I suspect we would have had one before many months had gone by; but, with the ending of hostilities, and the desire on the part of all of us to get back to peacetime work, the pressures which had led us so insistently to an agreement were lessened, and these intervening years have elapsed without accomplishment.

It would be wasting time if I were to try to give you the history of these steps that have taken place, one by one, over the intervening 3 years. I would be failing in appreciation, however, were I not to recognize in broad perspective those bodies on both sides of the water, the technical committees, and those many individuals who have each had a vital part in bringing to fruition this great objective. It is impossible to name them all one by one, as much as I should like to do so, but I think they will have in their hearts the satisfactions which come from a recognition by their fellows and by the world of a job well done.

I want to urge upon you, as important as this project is which we are now recognizing this afternoon, that there are still some further things to be done. You may think me too idealistic, but I have just the same hopes of seeing that realization as I have had of seeing this one—namely, that it shall be practicable in a reasonable time to take a British drawing and put it down tomorrow in an American shop, or vice versa, and have the goods produced. It may seem as though many hazards have to be overcome; but, given the willingness of like-minded men that is being shown here today, that objective can be reached. So I submit to you that there lies before us the opportunity to follow in the steps of this project, which we are commemorating today, by taking other steps as they may appear to us to be desirable.

In conclusion, I would like us then, in joining together for this constructive development in the field of technology, to be doing more than merely putting together some common standards. I would like us to be saying to the whole world that these three countries with so many common interests, are uniting to the maximum of their capacity to do all that they together can do; that there will be less and less separation between us on all fronts and more and more unanimity. And so, on behalf of the Sponsors Council on this side—and in that I am joined by my associates on both the British and the Canadian sides—I salute this gathering as a large piece of history which only the future will recognize in its largest sense.

Mr. Coonley

It had been our hope that we would have with us this afternoon our Secretary of Defense, the Hon. James Forrestal. Unfortunately he is not able to be here today, but we are exceedingly glad to have, as his representative, Mr. Donald Carpenter, Chairman of the Munitions Board. I am now going to ask Mr. Carpenter to speak to you.

Mr. Carpenter

Mr. Coonley, Gentlemen: I am very sorry, indeed, that Secretary Forrestal cannot be here. He asked me to express to you his regret that he could not meet with you to commemorate this occasion, which is so important not only to the country at large but specifically to the National Military Establishment. He recognizes this achievement as one of great moment in the defense of our country.

A little anecdote occurred to me, as I was listening, that seemed to symbolize the type of errors that can creep in when standards do not exist. A roommate of mine in college was studying bacteriology. He went, after graduation, to his home in South America. He was setting up a laboratory, and he wanted to get a piece of equipment which could be manufactured only in the United States. Utilizing his engineering training and education, he prepared the drawings and sent them up with the order. After about a year he got word from the neighboring port that a shipment had arrived, and he said, "Fine, send it up." The reply was: "We can't send it up that easily; you will have to come down here, take it apart, and ship it on separate cars." He said, "That is ridiculous; the thing isn't bigger than a couple of feet." They said, "Come down and look at it." He went down there, and this item that he had drawn up as a bug incubator, which he thought would be about a cubic foot, was so large that it had to be shipped in several cars. He couldn't understand it. He checked into the situation and found out that whereas in his country one mark meant an inch, in our country one mark means a foot, and the 20-inch-long microscope incubator was actually 20 feet long." I hope that is the kind of mistake we are trying to avoid in our standardization efforts.

It occurred to me also that in the progress of this work, the National Military Establishment, through its many procurement agencies, can perform a very important function by impressing upon the suppliers throughout the country the importance of this action and by using its influence as much as it can to bring about the implementation of these decisions.

I want to assure you that the National Military Establishment will carry out that obligation to its best ability. It seems to me that there is an analogy here. Two pieces of steel can be brought together to a common purpose, by common threads: perhaps several countries can be brought closer together in a common purpose by this decision.

Mr. Coonley

In all the fields of standardization, the National Bureau of Standards within the Department of Commerce has played an important part. It is particularly appropriate, therefore, that we should be meeting here today under the hospitable roof of the National Bureau of Standards. It is also fitting that we should hear a message from the Secretary of Commerce, the Hon. Charles Sawyer. I take pleasure in calling upon Mr. Sawyer.

Mr. Sawyer

Mr. Chairman, Dr. Condon, Sir Oliver, Mr. Ambassador, and Distinguished Guests: I am honored and delighted that this historic occasion can take place under the sponsorship of the National Bureau of Standards of the Department of Commerce.

Practically everything we use that is made of more than a single piece of metal is put together with nuts and bolts or other screw-threaded machine elements. Our whole modern machine age is put together with nuts and bolts. They range from the delicate parts of a fine watch to the rugged staybolts in the boilers of a great locomotive.

Considering the multiplicity of sizes, materials and special conditions of service which have to be encompassed in standards adequate for all these varied purposes, it is natural that with all the simplification that is possible there is necessarily a very large number of different styles of thread which must be made and stocked. For this reason it is particularly important that we do as much simplification and standardization of sizes as possible in these vitally important items.

Standardization results in savings in the capital investment needed in tools for making threaded products and permits reduction in inventories needed to provide repair parts and supplies. These advantages were early recognized abroad as well as in the United States. What a pity, therefore, that at that time, about a hundred years ago, we did not get started on a common and interchangeable set of standards! Most of the difficulty in bringing about a common understanding is not technical disagreement over what is desirable but the necessity for realizing that long-established practices and procedures are not easily abandoned.

Even though a large number of those assembled here today are engineers, I venture to suppose that not many realize the magnitude of the screw-thread business in modern industry. In recent years the value of products for steel fasteners alone—bolts, nuts, screws, and rivets—has been of the order of a quarter of a billion dollars annually, and approximately 1 million short tons a year of carbon and alloy steels are required for these products. During the war, production of such items for a time ran at the colossal rate of 200 million pieces a day.

Doubtless figures of corresponding impressiveness tell the story of the importance of screw-thread products in British and Canadian industry.

Efforts toward standardization and simplification in this field in the United States were given an impetus by an act of Congress passed in 1918 which established the National Screw Thread Commission under the chairmanship of the Director of the National Bureau of Standards. The Interdepartmental Screw Thread Committee, established in 1939, is the successor to the earlier Commission and develops the standard specifications for screw threads used in all things made for the Government. Closely cooperating is Committee B1 of the American Standards Association, representing the interests of private industry.

The first great realization of the importance and desirability of getting interchangeable standards for screw threads for Great Britain, Canada, and the United States dates from the war of 1914-18; but, unfortunately, it must be admitted that not much progress was made in bringing about an international agreement in spite of several working conferences on this subject held in the 1920's. Of course, the same problem rose up to plague us again during the recent war when some temporary measures to bring the three countries into line had to be adopted in a hurry.

With these lessons freshly in mind it is fortunate indeed that the technical representatives of government and industry in the three countries have worked hard to bring about a detailed mutual agreement for interchangeability, which I am sure will be of great benefit to all in stimulating international trade in the future.

I congratulate you on the progress that has been made and wish you all success as you press forward to bring about other mutual understandings concerning basic machine elements used in manufactured products in our three countries.

Mr. Coonley

I now pass to another part of our program: The reports of representatives of the cooperating government and industry committees; and I will first call upon the Rt. Hon. C. D. Howe, Minister of Trade and Commerce, of Canada.

Mr. Howe

Dr. Condon, Mr. Coonley, Distinguished Guests, and Gentlemen: We are meeting here today to confirm and celebrate an agreement on the unification of American and British standard systems of screw threads. This agreement is the outcome of a series of conferences held under the sponsorship of the combined Production and Resources Board of the war years; and, as a member of that Board, I take great satisfaction in being present on this occasion. The need for a common standard has been acknowledged for the past 30 years. Earlier attempts have been made to reach an agreement in that direction. Today's agreement is the result of a study commencing in 1943; and the fact that the outcome of that study has resulted in agreement is due, in no small measure, to the distinguished representatives of the United States, the United Kingdom, and Canada, who have shared the responsibility for the work.

Perhaps we in Canada realize the need for standardization more than any other country. We are purchasers of goods from the United Kingdom and from the United States. Our manufacturing is based in part on British designs and in part on United States designs. During the war years much of our equipment was being built to British designs, and it was necessary to redesign to United States practice to conform with our source of supply for parts. It will be a great relief to Canada when all designs call for the same standard threads and gaging practices.

Now that an accord has been reached on uniform standards, it will be the duty of all of us to see that the new standards are adopted and put into practice. I presume that our friends from the United Kingdom have the most difficult task in this regard, as theirs is the greatest departure from their present standards. For any country to fail in putting the new standards into practice will be to let down the other countries concerned.

Perhaps the first step should be to specify the new standards for all military equipment. As Minister responsible for procurement of the armed services in Canada, I hope to be in a position in due course to specify the new standards for all defense equipment. I know that I will have the support of our manufacturers in doing so, if for no other reason than that our principal manufacturers have been well represented on this committee.

I congratulate all those who have had a part in the work that has made possible the agreement that we celebrate today.

Mr. Coonley

Next I am going to call upon Mr. James G. Morrow, chairman of the Canadian Standards Association, who has participated in this development from its early stages.

Mr. Morrow

Mr. Chairman, Distinguished Guests, Gentlemen: We in Canada are particularly happy to be here on this occasion. Unification means much to us. Through two world wars Canada worked with two thread standards and two gage systems. Great Britain and the United States endeavored to reach agreement on screw-thread unification in World War I and again in 1926, but the projects were dropped.

From the Combined Production and Resources Board in 1942, came inspiration for our three countries to join in an endeavour to develop unification in screw threads. Meetings then followed in New York and London, and in Ottawa where agreements were formulated, and now, here in Washington we are happy to see the culmination of these efforts.

This work was primarily for the three services, then for industry. We gratefully acknowledge the splendid cooperation of the forces and industry throughout the whole of our work.

Further unification of engineering standards, as proposed at Ottawa, should follow.

Mr. Coonley

I am now going to ask Sir Ewart Smith, Chief Engineer of Imperial Chemical Industries and a prominent figure in British Industry, to speak to you.

Sir Ewart Smith

Mr. Chairman, Honored Guests, Gentlemen: As a representative of Great Britain, it is my profound pleasure to echo the words which you have heard from the gentlemen on my left and right today. I was particularly pleased to hear what Mr. Howe had to say; and, of course, he did mention that, in this agreement for unification of screw-threads, we in Great Britain are in fact making the major departure from previous practice. I look on this agreement as the foundation for very much wider things, very much greater building to come in the future. It is, I hope, the first milestone on the long road that we, the free nations of the world, shall tread together. I feel, however, that it would be wrong of me not to point out on this occasion that while this is a beginning—a firm beginning—it must inevitably be a considerable time before my country is able completely to change over to these new standards. That, I am sure, will be fully realized and understood by all the technical gentlemen here.

We feel that it is important, in coming to this general agreement, that we should not overlook two things. The first is that we must be sure we are talking the same language and that we have the same general principles in view. The second is that, having spoken in the same language, our written standards and records are expressed in identical terminology so that there can be no possible error at any time.

I would like to throw out the suggestion for consideration of the various sponsoring bodies that as this is, I hope, the first such international standard. it would be a logical, reasonable and sound psychological step to determine immediately in the future, before these standards are published, that we will adopt in the various countries a common form of signifying that they are international standards. I throw out the idea that all such international standards should be printed in green—green, gentlemen, for safety and progress, not red for danger. On the general principles there is, I am sure, agreement, but we must apply them to practice and we must see that they are carried out in detail.

Mr. Coonley

I am now going to call upon Mr. T. R. B. Sanders, Chairman of the Engineering Standards Coordinating Committee of the United Kingdom. Mr. Sanders.

Mr. Sanders

Mr. Chairman, Honored Guests, and Gentlemen: Two world wars have forced upon our attention the importance of developing common engineering standards between our respective countries.

I need not dwell further on this point to which reference has already been made today, and in far greater detail at the last big conference at Ottawa some years ago. In times of need, when the greatest intensity of production is called for, then is the time when the advantages of common standards are most apparent, but what is true in war is also true in peace, the only difference being that we can perhaps tread the path of progress at a rather more leisurely rate. For this reason it has been natural that the Government departments in the particular countries, and especially those which supply our armed forces, have taken the initiative in promoting these standards. But they have done it all along in the closest collaboration with their respective industrial bodies.

We assume that in the application of the standards, the same procedure will tend to be followed —in other words, that the service departments in the participating countries will commence forthwith to use the unified system insofar as is practicable on all new equipments which are designed specifically for service needs. That is the beginning from which other things will grow, and we have little doubt that gradually a wider and wider application will be found in industry.

Now in preparing a new standard for the future, on such a vital matter as screw threads, affecting as it does every branch of engineering and manufactured goods, it is inevitable that there must be some difficulty in settling final details. In fact, a standard which did not tread on somebody's toes would not be worth printing; it would be obsolescent before it appeared. It has been the duty of those who drafted these documents, and in particular the working parties who met together in the United States in July of this year, to determine the right level of compromise, to insure the maximum advantage for the future, coupled with a minimum disturbance in the present. I believe that they have done their job well, and therefore let us not worry about the last ten-thousandth of an inch which may seem important on paper but will seldom be apparent on the metal. Let us rather accept these standards as a bold and far-seeing framework within which the smaller details can be developed steadily in the light of experience and added in. We do hope to see a steady extension of the unified range. If the standards are applied in the same spirit of cooperation which prevailed in our working party discussions, then I am quite certain that that extension which we look for will be fulfilled at quite a rapid rate.

Now before I conclude, I should perhaps say a brief word about other work which we are engaged upon, items where the immediate advantages to be derived from standardization are more apparent to the defense services than to industry and where, in consequence, the stimulus is imparted to the work by the former. First in importance, perhaps, is drafting practice and its allied subjects of gaging, limits, fits, and tolerances. In this field great progress has already been made in Britain. We are nearing the final stages for a revision of some of our older established standards, and I hope that we shall get the same degree of cooperation over these that we have had with the screw threads.

In an attempt to remove one stumbling block to a common practice with the United States, the British Standards Institute has recently recognized third-angle projection, equally with first-angle, as a British standard practice for the future, specifying only that it shall be clearly shown on the drawing which method is used. In anticipation of this, many Government departments in Britain have now issued instructions making third-angle mandatory in their own drawing offices and encouraging, as far as is practicable, the use of third-angle on the contract drawings which are put out to industry. Here again progress must be fairly slow; you cannot disturb such important industries as the engineering industry all in a moment; it must be gradual, but progress is being made, and I confidently hope that within a year, or perhaps 18 months, we may be able to have another party and agree on a measure of standard practice in drafting.

There are other standards—three or four—where we are also beginning to exchange views, and we hope to see the fulfillment of a unified practice in these also in the years to come.

Mr. Coonley

And now I am going to call upon the Director of the British Standards Institution—a man who has been not only a pillar of strength to the standardization movement within his own country, but who is one of the foundation stones of the work of the

International Organization for Standardization—Mr. Percy Good, Director of the British Standards Institution.

Mr. Good

Mr. Chairman, Honored Guests, and Distinguished Americans: I feel very proud and happy to be here on this occasion. It certainly is a great occasion.

We felt that it would be very pertinent at this meeting to give some indication of the way the matter has been dealt with since the meetings held last July in this country, which achieved such good success. The British Standards Institution works in the closest cooperation with the Government, as Mr. Sanders has explained. We are represented on his committees and they are represented on ours; but we divide our work into sections, in which the engineering is perhaps the larger. In the Engineering Division we have a number of industry standards committees. Those industry standards committees are policy committees which appoint, in turn, technical committees to deal with any questions of standardization. Having got agreement to the screw thread on details, we decided to put this matter to those industry committees as a matter of policy. Now in our work we have to go forward entirely by agreement of all the parties concerned, and from July to now did not represent a long enough period to secure an effective decision of industry. On the other hand, we put this document, which we prepared after the July meetings and which represents a complete range of the unified screw threads, before each of those industry committees concerned—the mechanical engineering industry committee, the electrical engineering industry committee, the aircraft committee, the automotive industry committee, chemical engineering industry committee, petroleum equipment committee, and so on. Every engineering industry committee, which had real interest in this matter was asked to look through this document and say whether they would agree to its publication as a provisional standard for bringing into operation for a trial period of a year or 6 months, in order to enable us to find out if there were any snags in it. Normally our policy would have been to withhold it until that time had elapsed; but all those committees agreed we were justified at this stage of the work in publishing this standard as a provisional British standard immediately; and those committees having reported to the council their decisions, authority was given for its immediate publication with the hope that we might publish simultaneously with you. That authority was given subject to the two or three conditions which have already been voiced, such as common terminology, clear expression of which are unified standards, and so on, all of those conditions were policy conditions which have been conceded by your committees already.

It should be recognized, of course, that we are making a very major change, and that is why we have been to a very great deal of trouble to see that every part of our industrial life in Great Britain has been consulted. In changing over to this unified 60-degree thread form, we are taking a very serious step. We are taking it because we believe that it is the right step to take. We believe that it is the proper step to take at this stage of world affairs, and we believe that it is only the beginning to a development of unified practices among the English speaking people.

However, in accepting that, we have found at present still some difficulty with the smaller sizes. The smaller sizes below a quarter of an inch prevent a very complex problem for us. We have had in use for many years the system known as the B. A.—British Association system—and the complexity of making changes in that field are very great. However, we are actively pursuing our work in that field and are determined that at the finish there shall be a unification. Down to the ¼-inch we have authority already to publish this unified screw-thread standard; and we are very glad, indeed, to be able so to report it.

Now that is the history of our work in the United Kingdom, and we are confident, as the result of that group of meetings in which, both technical and policy people participated, that there is an intention all through to endeavor to secure the aims which we have so much at heart.

Mr. Coonley

I am now going to ask Mr. David R. Miller, a member of the Interdepartmental Screw Thread Committee and Chief of the Gage Section of the National Bureau of Standards, to speak to you.

Mr. Miller

The predecessor of the Interdepartmental Screw Thread Committee, the National Screw Thread Commission, was authorized by Act of Congress, in 1918, to develop standards for screw threads because the lack of such standards was causing numerous difficulties in the procurement of munitions in World War I. The Commission realized that the Allied procurement difficulties could best be eased by the establishment of an international standard for screw threads, and a member delegation of the Commission visited France and England in 1919. While no definite agreements could be reached, it was apparent that engineers and manufacturers of these countries were impressed with the desirability of international standardization of screw threads and were willing to cooperate.

It was apparent, however, that the first step was to crystallize screw-thread gaging practice and the unification of the screw thread standards of our own country. The Commission accordingly issued several reports to this end, the first one dated 1921, which were followed by several handbooks prepared and published by the National Bureau of Standards. One of these, Handbook H25, was used throughout Word War II. Two revisions of H25 have been issued; and these handbooks, designated H28, have had a total sale of over 100,000 copies, suggesting the importance of this publication. Handbook H25 was the bible of the military procurement agencies and the manufacturers of screw-thread products in World War II, and it supplied information with regard to our practice to our allies who manufactured some products in accordance with this handbook.

Still, no substantial progress had been made in the development of an international standard, although the National Screw Thread Commission and the Interdepartmental Screw Thread Committee, under the chairmanship of the Director of the National Bureau of Standards, had worked in this field for some 30 years. The Interdepartmental Screw Thread Committee intensified its efforts in recent years, which culminated in the preparation of a document—Unified Screw Threads as Recommended by the Interdepartmental Screw Thread Committee—which, with similar documents prepared by the British, the Canadians, and Sectional Committee B1 of the American Standards Association, form the basis of the present accord. This document is, therefore, presented with considerable gratification, as it does represent a definite step toward international standardization. This document represents the unified threads, thread series, the unified form, and a recommended gaging practice, which are essential to secure interchangeability. I would like to call your attention to the foreword, the second paragraph of which reads:

> This tentative draft presents the standards for unified screw threads in the form in which they will be submitted, for approval of the Departments, in the next revision of Handbook H28 of the National Bureau of Standards, *Screw Thread Standards for Federal Services*. In accordance with actions taken by the committee, mandatory portions of the handbook will contain those classes which meet the requirements of the departments, namely: Classes 1A and 1B step tables for allowances and tolerances; classes 2A and 2B for all standard thread series and step tables for allowances and tolerances; and the existing class 3 for all series and step table until the Unified classes 3A and 3B have had further consideration. The nonmandatory portions of the handbook will contain the following: Classes 1A and 1B coarse and fine thread series and step table for tolerances; the existing class 1 step table; and the existing class 2 for all thread series and the step table for tolerances.

While unified classes 3A and 3B are included, the existing class 3 is retained for the present because this is the standard used by the aircraft industry and unified classes 3A and 3B differ considerably for certain thread series used for aircraft threads. We must determine whether or not classes 3A and 3B are a satisfactory substitute for class 3.

831563°—49—3

The existing classes 1 and 2 step tables and class 2 for all thread series are retained because a large proportion of threaded product in use is made to these classes and the information must be available for some time. Classes 1A and 1B coarse and fine thread series, which may not be used in this country, are given because we understand that the British will use these classes for some bolts and nuts.

Mr. Coonley

Now I am going to call upon Mr. Frank Tisch, vice chairman of B1 Sectional Committee on the Standardization and Unification of Screw Threads of the American Standards Association.

Mr. Tisch

Messrs. Co-Chairmen, Distinguished Guests, and Gentlemen: I have a very fortunate position on this program—nearly last. I envy Dr. Condon his closing remarks. The Sectional Committee work has been made comparatively easy because of the wisdom and guidance of the organizations represented by the previous speakers.

Mr. Elmer Bryant, our chairman, has played a major part in the formulation of the policy of the Sectional Committee; we are deeply indebted to him for his work and sorry that he cannot be here today.

The accord that will be presented here for signatures is more than a piece of paper. It represents the expressed will and desire of people who either through the medium of divine guidance or exceptional foresight have been looking toward the future.

However gentlemen, let us not be so naive as to suppose that any program, no matter how worthwhile, can succeed without cooperation. This room is packed with people in whose hands the success of our efforts rest. Let them be aware of the responsibility they must assume and let us call upon them to use this responsibility wisely and with foresight.

It is a pleasure to have played a part in this program, and I regret that we don't have time to pay tribute to the various individuals who have made this screw thread unification project possible. I feel similiar to the poor pitcher who was on a baseball team that had eight other men who were equally skilled as hitters and fielders, and the team won all their games.

Mr. Coonley

Now we come to the all-important part of this meeting: the signing of the Declaration of Accord by representatives of the cooperating government and industry committees. As I call upon each one, I shall ask him to come to Dr. Condon's post and attach his signature.

Mr. Coonley called the names. Each affixed his signature to 11 copies of the document in the order named:

The Rt. Hon. C. D. Howe, Minister of Trade and Commerce, Canada;

Mr. J. G. Morrow, Canadian Standards Association;

Mr. T. R. B. Sanders, Ministry of Supply of the United Kingdom;

Mr. Percy Good, representing the British Standards Institution;

Sir Ewart Smith, representative of British Industry;

The Hon. Edward U. Condon, as chairman of the Interdepartmental Screw Thread Committee, Director of National Bureau of Standards of the Department of Commerce of the United States;

Mr. Frank P. Tisch, representing the American Standards Association and the sponsors of its committee, the American Society of Mechanical Engineers and the Society of Automotive Engineers; and

Mr. William L. Batt, chairman of the Sponsors Council of the United States and of the United Kingdom on the Unification of Screw Threads.

Mr. Coonley

With the completion of this final signature, I will turn the meeting back to my co-chairman, Dr. Condon.

Dr. Condon

It is appropriate at this time that I read to you the exact text of what we have committed ourselves to. This document is entitled "Declaration of Accord with Respect to the Unification of Screw Threads."

It is hereby declared that the undersigned, representatives of their government and industry bodies, charged with the development of standards for screw threads, agree that the standard for the unified screw threads given in the publications of the committees of the British Standards Institution, Canadian Standards Association, American Standards Association and of the Interdepartmental Screw

Thread Committee fulfill all of the basic requirements for general interchangeability of threaded products made in accordance with any of these standards.

The bodies noted above will maintain continuous cooperation in the further development and extension of these standards.

Signed in Washington, D. C., this 18th day of November 1948, at the National Bureau of Standards of the United States.

In one sense, this accord marks the culmination of 30 years of work by the three nations toward the establishment of unification. In another sense, the accord marks the beginning of the realization of the unification. Purchases by the three governments will be based on the new standards, but industrial use within the normal commerce of each of the nations will require a transformation of industrial practices, involving considerations of engineering, design, tooling, and production. Such a change will take time, but the transition should be completed in the next few years.

At the same time, screw-thread research is important. A screw thread is one of the more complex regular geometrical forms. There are so many variables which enter into the design of a satisfactory threaded fastener that most of the knowledge applied in such design is empirical rather than theoretical. An immediate result of the Ottawa conference in 1945 was the establishment of a program of research to be carried out by the National Bureau of Standards of the United States, the National Physical Laboratory of England, and the National Research Council of Canada.

The present accord calls for a continuance of future cooperation in the field of screw-thread standardization. Such cooperation has two aspects: first, the extension of the unification to the other English-speaking nations (all of which use the English system of measurement in manufacture) and, second, the continued development of standards. For standards are not static, and they must keep pace with improvements in materials and methods of production and inspection developed in industry. The reduction of the varieties of fasteners is one of the possibilities which further studies of standards and simplification may yield.

Moreover, the present accord pertains to the most commonly used type of screw thread. Other important types of screw threads, such as the buttress and the acme, remain to be standardized. Further, standardization of drawing-room practices within the countries and their unification among the countries are essential if there is to be a thorough understanding by each country of the production drawings of the others. In these and related fields, the three Governments, their official laboratories and committees, and the respective standardization organizations are carrying on continuing cooperative programs.

Respectfully submitted,

IRVIN H. FULLMER,

National Bureau of Standards,
Secretary, the Interdepartmental Screw Thread Committee of the United States.

The Unified Screw Thread Standards

The Unified Screw Thread Standards

The illustrations and tables of numerical data which follow present the Unified thread standards for thread form and for the Unified coarse and fine thread series. The illustrations are in the form in which they will appear in the American standard.

In addition, considerable progress has been made in the development of Unified diameter-pitch combinations and tolerances for special threads, but these are not available at the present time in their final form.

Unified Form of Thread

1. Angle of Thread. The basic angle of thread between the flanks of the thread, measured in an axial plane, is 60°. The line bisecting this 60° angle is perpendicular to the axis of the screw thread.

2. Form of Crest. The form of the crest of the external thread may be either flat or rounded. The crest of the basic thread form of the external thread shall be truncated from the sharp crest an amount equal to $\frac{1}{8} \times H$, where H is the depth of the fundamental triangle.

3. Clearance at Minor Diameter. A clearance is provided at the minor diameter of the internal thread by truncating from the sharp crest an amount equal to $\frac{1}{4} \times H$.

4. Illustration. Figure 1 shows the design forms (maximum metal condition) of the external and internal threads of the Unified form of thread.

5. Basic Thread Data. The basic thread data for all standard pitches of the Unified form of thread are given in table 1.

Thread Series

1. Coarse Thread Series. The diameter-pitch combinations and the basic dimensions of the Unified coarse thread series are given in table 2. The limits of size for the three classes of tolerances and allowances are given in tables 4 and 5. The coarse thread series is recommended for general use in engineering work, in machine construction where conditions are favorable to the use of bolts, screws, and other threaded components where quick and easy assembly of the parts is desired, and for all work where conditions do not require the use of fine-pitch threads.

2. Fine Thread Series. The diameter-pitch combinations and the basic dimensions of the Unified fine-thread series are given in table 3. The limits of size for the three classes of tolerances and allowances are given in tables 6 and 7. The fine thread series is recommended for general use in automotive and aircraft work, and where special conditions require a fine thread.

Classification and Tolerances

There are established for general use three distinct classes of screw-thread tolerances and allowances as specified in the following brief outline. These three classes, together with the accompanying specifications, are for the purpose of insuring the interchangeable manufacture of screw-thread parts. This standard includes classes 1A, 2A, and 3A, applied to external threads only, and classes 1B, 2B, and 3B applied to internal threads only. The requirements for a screw-thread fit for specific applications can be met by specifying the proper combination of classes for the components. For example, an external thread made to class 2A limits can be used with tapped holes made to classes 1B, 2B, or 3B limits for specific applications.

General

The following general specifications apply to all classes specified for applications of the Unified form of thread.

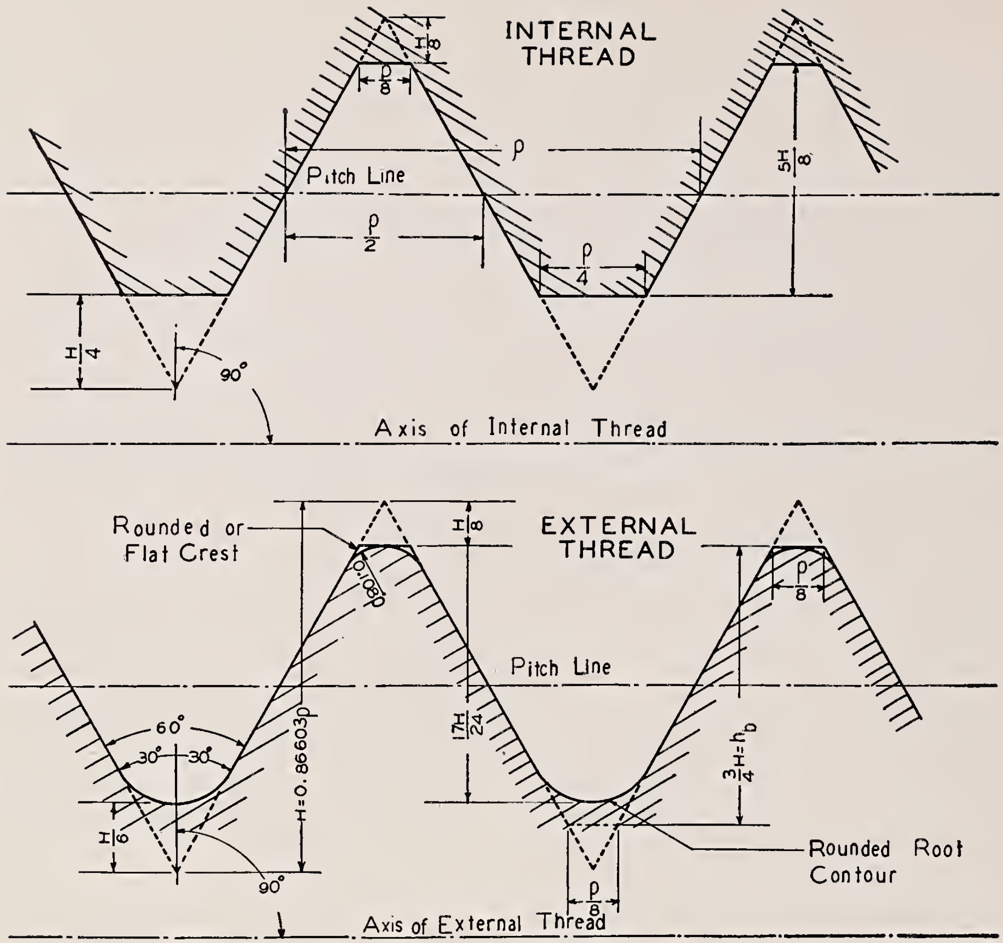


FIGURE 1. *Unified internal and external screw-thread design forms (maximum metal condition).*

1. Uniform Minimum Internal Thread. The minimum major, pitch, and minor diameters of the internal thread are respectively the same for classes 1B, 2B, and 3B.

2. Direction and Scope of Tolerances. The tolerance on the internal thread is plus, and is applied from the basic size to above basic size. The tolerance on the external thread is minus, and is applied from the maximum (or design) size to below the maximum size. The tolerances specified represent the extreme variations permitted on the product.

3. Basic Formula for Allowances and Tolerances. The basic formula, from which allowances on all diameters and tolerances on pitch diameter are derived, is:

Tolerance (or allowance) $= C\ (0.0015\sqrt[3]{D} + 0.0015\sqrt{L_e} + 0.015\sqrt[3]{p^2})$, where C is a factor which differs for each allowance or tolerance for each class, D is the basic major diameter, L_e is the length or engagement, and p is the pitch.

This formula is based on the accuracy of present day threading practice, and is applicable to all reasonable combinations of diameter, pitch, and length of engagement.

4. Allowances. Allowances are applied only to external threads. The values of the factor C (paragraph 3, above) for allowances are as follows:

Class	*Factor C*
1A	0.300
2A	0.300
3A	0.000

5. Pitch Diameter Tolerances. The values of the factor C for pitch diameter tolerances are as follows:

Class	*Factor C*
1A	1.500
1B	1.950
2A	1.000
2B	1.300
3A	0.750
3B	0.975

It will be noted that the factor C is 30 percent greater for internal than for external threads of a given class number on account of the relative difficulties of manufacture.

The tolerances on pitch diameter are cumulative, that is, they include the variations of lead and angle. Therefore, the full tolerance is not available for pitch diameter unless the lead and angle of the thread are perfect. The tolerances on pitch diameter for the coarse and fine thread series are based on a length of engagement equal to the basic major diameter.

6. Major Diameter Tolerances. The tolerances on major diameter of external threads is equal to $0.09\sqrt[3]{p^2}$ for class 1A and to $0.06\sqrt[3]{p^2}$ for classes 2A and 3A. (The American standard will provide tolerances equal to $0.09\sqrt[3]{p^2}$ for class 2A products of unfinished, hot-rolled material in the coarse thread series.)

In American practice, no tolerance is specified for internal threads, as the maximum major diameter is established by the crest of an unworn tool (see footnote 2, tables 5 and 7). In British practice, tolerances are specified.

7. Minor diameter Tolerances. In American practice, no tolerance is specified for external threads, as the minimum minor diameter is established by the crest of an unworn tool (see footnote 2, tables 4 and 6). In British practice, tolerances are specified.

The tolerance on minor diameter of internal threads for a given size and pitch of thread is the same for all classes. For all coarse and fine series threads 1 inch and larger in size, the tolerance is equal to $0.120p$. For sizes less than 1 inch in size, most tolerances are larger than $0.120p$ to minimize tapping difficulties. (Complete formulas will be available in the American Standard.)

Screw Thread Classes

1. Classes 1A and 1B. The combination of classes 1A and 1B is intended to cover the manufacture of threaded parts where quick and easy assembly is necessary, and where an allowance is required to permit ready assembly, even when the threads are slightly bruised or dirty. Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7, and their application is shown in figure 2.

2. Classes 2A and 2B. Class 2A for external threads and 2B for internal threads are suitable for a wide variety of applications where an allowance is required to permit ready assembly, but where smaller tolerances than for classes 1A and 1B are required. Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7, and their application is shown in figure 2.

3. Classes 3A and 3B. Class 3A for external threads and class 3B for internal threads have no allowance and are for applications where closeness of fit and accuracy of lead and angle of thread are important. They are obtainable consistently only by the use of high quality production equipment supported by a very efficient system of gaging and inspection. Allowances and tolerances for the respective thread series are specified in tables 4, 5, 6, and 7, and their application is shown in figure 3.

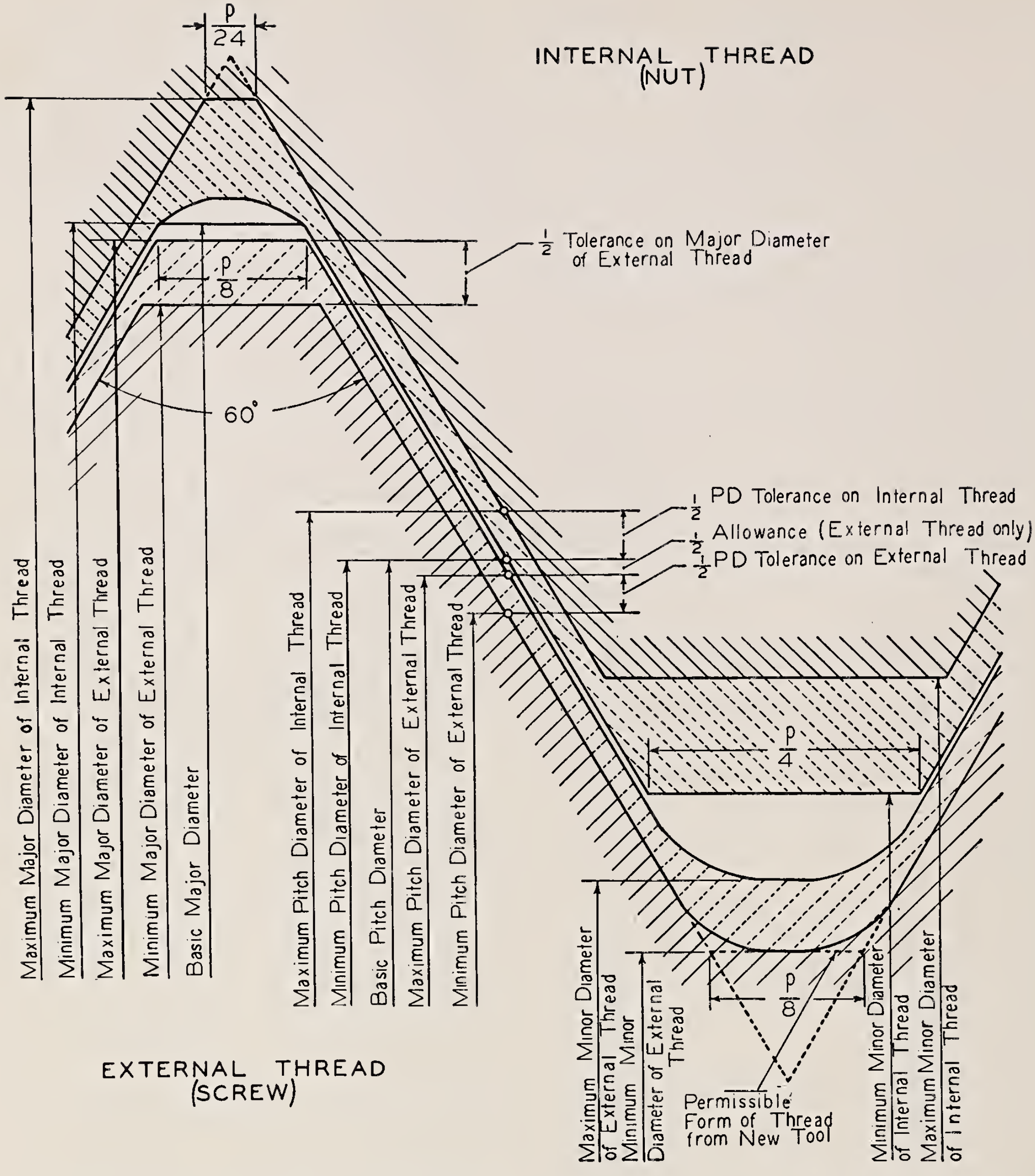


FIGURE 2. *Disposition of tolerances, allowance, and crest clearances for Unified classes 1A, 2A, 1B, and 2B.*

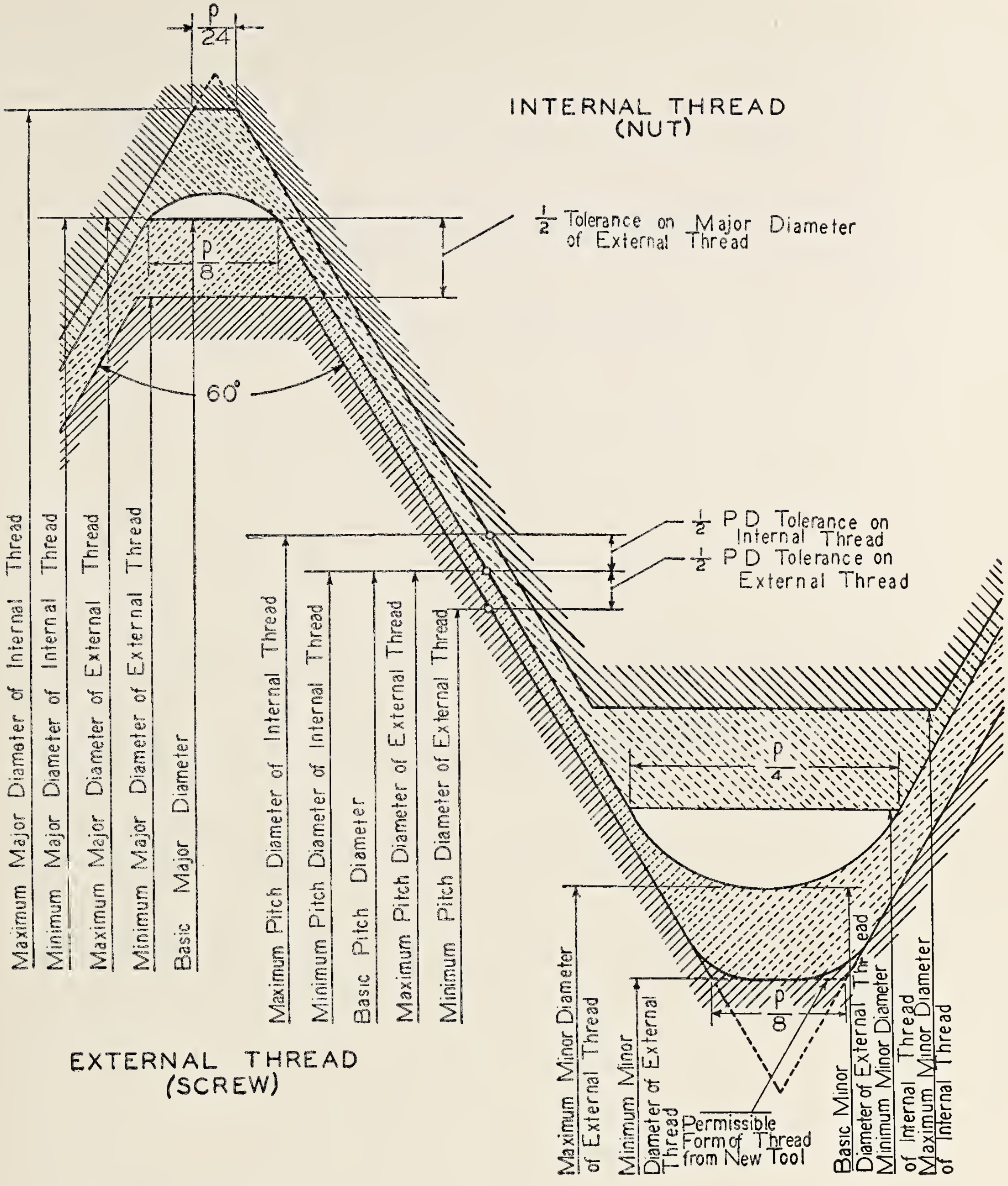


FIGURE 3. *Disposition of tolerances and crest clearances for Unified classes 3A and 3B.*

TABLE 1. *Basic thread data, Unified form of thread*

Threads per inch	Pitch	Height of sharp V-thread	Height of external thread	Height of internal thread	Depth of thread engagement	Flat at external thread crest	Truncation of external thread crest	Truncation of external thread root	Flat at internal thread crest	Truncation of internal thread crest	Flat at internal thread root	Truncation of internal thread root	Addendum of external thread	Twice the external thread addendum[1]
n	p	$H=0.86603p$	$h_s=17/24H=0.61343p$	$h_n=5/8H=0.54127p$	$h_e=5/8H=0.54127p$	$F_{cs}=p/8=0.125p$	$f_{cs}=H/8=0.10825p$	$s_{rs}=H/6=0.14434p$	$F_{cn}=p/4=0.25p$	$f_{cn}=H/4=0.21651p$	$F_{rn}=p/8=0.125p$	$f_{rn}=H/8=0.10825p$	$h_a=3/8H=0.32476p$	$2h_a=h_b=3/4H=0.64952p$
	Inch	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*	*Inch*
80	0.01250	0.01083	0.00767	0.00677	0.00677	0.00156	0.00135	0.00180	0.00312	0.00271	0.00156	0.00135	0.00406	0.00812
72	.01389	.01203	.00852	.00752	.00752	.00174	.00150	.00200	.00347	.00301	.00174	.00150	.00451	.00902
64	.01563	.01353	.00958	.00846	.00846	.00195	.00169	.00226	.00391	.00338	.00195	.00169	.00507	.01015
56	.01786	.01546	.01095	.00967	.00967	.00223	.00193	.00258	.00446	.00387	.00223	.00193	.00580	.01160
48	.02083	.01804	.01278	.01128	.01128	.00260	.00226	.00301	.00521	.00451	.00260	.00226	.00677	.01353
44	.02273	.01968	.01394	.01230	.01230	.00284	.00246	.00328	.00568	.00492	.00284	.00246	.00738	.01476
40	.02500	.02165	.01534	.01353	.01353	.00312	.00271	.00361	.00625	.00541	.00312	.00271	.00812	.01624
36	.02778	.02406	.01704	.01504	.01504	.00347	.00301	.00401	.00694	.00601	.00347	.00301	.00902	.01804
32	.03125	.02706	.01917	.01691	.01691	.00391	.00338	.00451	.00781	.00677	.00391	.00338	.01015	.02030
28	.03571	.03093	.02191	.01933	.01933	.00446	.00387	.00515	.00893	.00773	.00446	.00387	.01160	.02320
24	.04167	.03608	.02556	.02255	.02255	.00521	.00451	.00601	.01042	.00902	.00521	.00451	.01353	.02706
20	.05000	.04330	.03067	.02706	.02706	.00625	.00541	.00722	.01250	.01083	.00625	.00541	.01624	.03248
18	.05556	.04811	.03408	.03007	.03007	.00694	.00601	.00802	.01389	.01203	.00694	.00601	.01804	.03608
16	.06250	.05413	.03834	.03383	.03383	.00781	.00677	.00902	.01562	.01353	.00781	.00677	.02030	.04059
14	.07143	.06186	.04382	.03866	.03866	.00893	.00773	.01031	.01786	.01546	.00893	.00773	.02320	.04639
13	.07692	.06662	.04719	.04164	.04164	.00962	.00833	.01110	.01923	.01665	.00962	.00833	.02498	.04996
12	.08333	.07217	.05112	.04511	.04511	.01042	.00902	.01203	.02083	.01804	.01042	.00902	.02706	.05413
11½	.08696	.07531	.05334	.04707	.04707	.01087	.00941	.01255	.02174	.01883	.01087	.00941	.02824	.05648
11	.09091	.07873	.05577	.04921	.04921	.01136	.00984	.01312	.02273	.01968	.01136	.00984	.02952	.05905
10	.10000	.08660	.06134	.05413	.05413	.01250	.01083	.01443	.02500	.02165	.01250	.01083	.03248	.06495
9	.11111	.09623	.06816	.06014	.06014	.01389	.01203	.01604	.02778	.02406	.01389	.01203	.03608	.07217
8	.12500	.10825	.07668	.06766	.06766	.01562	.01353	.01804	.03125	.02706	.01562	.01353	.04059	.08119
7	.14286	.12372	.08763	.07732	.07732	.01786	.01546	.02062	.03571	.03093	.01786	.01546	.04639	.09279
6	.16667	.14434	.10224	.09021	.09021	.02083	.01804	.02406	.04167	.03608	.02083	.01804	.05413	.10825
5	.20000	.17321	.12269	.10825	.10825	.02500	.02165	.02887	.05000	.04330	.02500	.02165	.06495	.12990
4½	.22222	.19245	.13632	.12028	.12028	.02778	.02406	.03208	.05556	.04811	.02778	.02406	.07217	.14434
4	.25000	.21651	.15336	.13532	.13532	.03125	.02706	.03608	.06250	.05413	.03125	.02706	.08119	.16238

[1] Equivalent to the "basic height" h of the original American National form.

TABLE 2. *Basic dimensions of the Unified coarse thread series*

Sizes	Basic major diameter, D	Thds. per inch, n	Basic pitch diameter,[1] E	Minor diameter ext. thds. K_s	Minor diameter int. thds. K_n	Lead angle at basic pitch diameter, λ		Section at minor diameter at $D-2h_b$	Stress area [2]
	Inches		*Inches*	*Inches*	*Inches*	*Deg.*	*Min.*	*sq. in.*	*sq. in.*
¼	0.2500	20	0.2175	0.1887	0.1959	4	11	0.0269	0.0317
5/16	.3125	18	.2764	.2443	.2524	3	40	.0454	.0522
⅜	.3750	16	.3344	.2983	.3073	3	24	.0678	.0773
7/16	.4375	14	.3911	.3499	.3602	3	20	.0933	.1060
½	.5000	12	.4459	.3978	.4098	3	24	.1205	.1374
9/16	.5625	12	.5084	.4603	.4723	2	59	.1620	.1816
⅝	.6250	11	.5660	.5135	.5266	2	56	.2018	.2256
¾	.7500	10	.6850	.6273	.6417	2	40	.3020	.3340
⅞	.8750	9	.8028	.7387	.7547	2	31	.4193	.4612
1	1.0000	8	.9188	.8466	.8647	2	29	.5510	.6051
1⅛	1.1250	7	1.0322	.9497	.9704	2	31	.6931	.7627
1¼	1.2500	7	1.1572	1.0747	1.0954	2	15	.8898	.9684
1⅜	1.3750	6	1.2667	1.1705	1.1946	2	24	1.0541	1.1538
1½	1.5000	6	1.3917	1.2955	1.3196	2	11	1.2938	1.4041
1¾	1.7500	5	1.6201	1.5046	1.5335	2	15	1.7441	1.8983
2	2.0000	4½	1.8557	1.7274	1.7594	2	11	2.3001	2.4971
2¼	2.2500	4½	2.1057	1.9774	2.0094	1	55	3.0212	3.2464
2½	2.5000	4	2.3376	2.1933	2.2294	1	57	3.7161	3.9976
2¾	2.7500	4	2.5876	2.4433	2.4794	1	46	4.6194	4.9326
3	3.0000	4	2.8376	2.6933	2.7294	1	36	5.6209	5.9659
3¼	3.2500	4	3.0876	2.9433	2.9794	1	29	6.7205	7.0992
3½	3.5000	4	3.3376	3.1933	3.2294	1	22	7.9183	8.3268
3¾	3.7500	4	3.5876	3.4433	3.4794	1	16	9.2143	9.6546
4	4.0000	4	3.8376	3.6933	3.7294	1	11	10.6084	11.0805

[1] British: Effective diameter.
[2] Based on the average of the mean minor and pitch diameters of the external thread.

TABLE 3. *Basic dimensions of the Unified fine thread series*

Sizes	Basic major diameter, D	Thds. per inch, n	Basic pitch diameter,[1] E	Minor diameter ext. thds. K_s	Minor diameter int. thds. K_n	Lead angle at basic pitch diameter, λ		Section at minor diameter at $D-2h_b$	Stress area [2]
	Inches		*Inches*	*Inches*	*Inches*	*Deg.*	*Min.*	*sq. in.*	*sq. in.*
¼	0.2500	28	0.2268	0.2062	0.2113	2	52	0.0326	0.0362
5/16	.3125	24	.2854	.2614	.2674	2	40	.0524	.0579
⅜	.3750	24	.3479	.3239	.3299	2	11	.0809	.0876
7/16	.4375	20	.4050	.3762	.3834	2	15	.1090	.1185
½	.5000	20	.4675	.4387	.4459	1	57	.1486	.1597
9/16	.5625	18	.5264	.4943	.5024	1	55	.1888	.2026
⅝	.6250	18	.5889	.5568	.5649	1	43	.2400	.2555
¾	.7500	16	.7094	.6733	.6823	1	36	.3513	.3724
⅞	.8750	14	.8286	.7874	.7977	1	34	.4805	.5088
1	1.0000	12	.9459	.8978	.9098	1	36	.6245	.6624
1⅛	1.1250	12	1.0709	1.0228	1.0348	1	25	.8118	.8549
1¼	1.2500	12	1.1959	1.1478	1.1598	1	16	1.0237	1.0721
1⅜	1.3750	12	1.3209	1.2728	1.2848	1	9	1.2602	1.3137
1½	1.5000	12	1.4459	1.3978	1.4098	1	3	1.5212	1.5799

[1] British: Effective diameter.
[2] Based on the average of the mean minor and pitch diameters of the external thread.

TABLE 4. *Limits of size, Unified coarse thread series, external threads, classes 1A, 2A, and 3A*

Designation			External thread limiting dimensions [1]							
Size	Threads per inch	Thread symbol	Allowance	Major diameter			Pitch diameter			Minor diameter
				Limits		Tolerance	Limits		Tolerance	
				Max	Min		Max	Min		Max [2]
			Inch	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
1/4........	20	UNC–1A	0.0011	0.2489	0.2367	0.0122	0.2164	0.2108	0.0056	0.1876
"........	"	" –2A	"	"	.2408	.0081	"	.2127	.0037	"
"........	"	" –3A	0	.2500	.2419	"	.2175	.2147	.0028	.1887
5/16........	18	UNC–1A	.0012	.3113	.2982	.0131	.2752	.2691	.0061	.2431
"........	"	" –2A	"	"	.3026	.0087	"	.2712	.0040	"
"........	"	" –3A	0	.3125	.3038	"	.2764	.2734	.0030	.2443
3/8........	16	UNC–1A	.0013	.3737	.3595	.0142	.3331	.3266	.0065	.2970
"........	"	" –2A	"	"	.3643	.0094	"	.3287	.0044	"
"........	"	" –3A	0	.3750	.3656	"	.3344	.3311	.0033	.2983
7/16........	14	UNC–1A	.0014	.4361	.4206	.0155	.3897	.3826	.0071	.3485
"........	"	" –2A	"	"	.4258	.0103	"	.3850	.0047	"
"........	"	" –3A	0	.4375	.4272	"	.3911	.3876	.0035	.3499
1/2........	12	UNC–1A	.0015	.4985	.4813	.0172	.4444	.4367	.0077	.3963
"........	"	" –2A	"	"	.4871	.0114	"	.4393	.0051	"
"........	"	" –3A	0	.5000	.4886	"	.4459	.4421	.0038	.3978
9/16........	12	UNC–1A	.0016	.5609	.5437	.0172	.5068	.4990	.0078	.4587
"........	"	" –2A	"	"	.5495	.0114	"	.5016	.0052	"
"........	"	" –3A	0	.5625	.5511	"	.5084	.5045	.0039	.4603
5/8........	11	UNC–1A	.0016	.6234	.6052	.0182	.5644	.5561	.0083	.5119
"........	"	" –2A	"	"	.6113	.0121	"	.5589	.0055	"
"........	"	" –3A	0	.6250	.6129	"	.5660	.5619	.0041	.5135
3/4........	10	UNC–1A	.0018	.7482	.7288	.0194	.6832	.6744	.0088	.6255
"........	"	" –2A	"	"	.7353	.0129	"	.6773	.0059	"
"........	"	" –3A	0	.7500	.7371	"	.6850	.6806	.0044	.6273
7/8........	9	UNC–1A	.0019	.8731	.8523	.0208	.8009	.7914	.0095	.7368
"........	"	" –2A	"	"	.8592	.0139	"	.7946	.0063	"
"........	"	" –3A	0	.8750	.8611	"	.8028	.7981	.0047	.7387
1..........	8	UNC–1A	.0020	.9980	.9755	.0225	.9168	.9067	.0101	.8446
"..........	"	" –2A	"	"	.9830	.0150	"	.9100	.0068	"
"..........	"	" –3A	0	1.0000	.9850	"	.9188	.9137	.0051	.8466
1 1/8........	7	UNC–1A	.0022	1.1228	1.0982	.0246	1.0300	1.0191	.0109	.9475
"........	"	" –2A	"	"	1.1064	.0164	"	1.0228	.0072	"
"........	"	" –3A	0	1.1250	1.1086	"	1.0322	1.0268	.0054	.9497
1 1/4........	7	UNC–1A	.0022	1.2478	1.2232	.0246	1.1550	1.1439	.0111	1.0725
"........	"	" –2A	"	"	1.2314	.0164	"	1.1476	.0074	"
"........	"	" –3A	0	1.2500	1.2336	"	1.1572	1.1517	.0055	1.0747
1 3/8........	6	UNC–1A	.0024	1.3726	1.3453	.0273	1.2643	1.2523	.0120	1.1681
"........	"	" –2A	"	"	1.3544	.0182	"	1.2563	.0080	"
"........	"	" –3A	0	1.3750	1.3568	"	1.2667	1.2607	.0060	1.1705

TABLE 4. *Limits of size, Unified coarse thread series, external threads, classes 1A, 2A, and 3A—Continued*

Designation			External thread limiting dimensions [1]							
Size	Threads per inch	Thread symbol	Allowance	Major diameter			Pitch diameter			Minor diameter
				Limits		Tolerance	Limits		Tolerance	
				Max	Min		Max	Min		Max [2]
			Inch	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
1½........	6	UNC–1A	.0024	1.4976	1.4703	.0273	1.3893	1.3772	.0121	1.2931
"........	"	" –2A	"	"	1.4794	.0182	"	1.3812	.0081	"
"........	"	" –3A	0	1.5000	1.4818	"	1.3917	1.3856	.0061	1.2955
1¾........	5	UNC–1A	.0027	1.7473	1.7165	.0308	1.6174	1.6040	.0134	1.5019
"........	"	" –2A	"	"	1.7268	.0205	"	1.6085	.0089	"
"........	"	" –3A	0	1.7500	1.7295	"	1.6201	1.6134	.0067	1.5046
2..........	4½	UNC–1A	.0029	1.9971	1.9641	.0330	1.8528	1.8385	.0143	1.7245
"..........	"	" –2A	"	"	1.9751	.0220	"	1.8433	.0095	"
"..........	"	" –3A	0	2.0000	1.9780	"	1.8557	1.8486	.0071	1.7274
2¼........	4½	UNC–1A	.0029	2.2471	2.2141	.0330	2.1028	2.0882	.0146	1.9745
"........	"	" –2A	"	"	2.2251	.0220	"	2.0931	.0097	"
"........	"	" –3A	0	2.2500	2.2280	"	2.1057	2.0984	.0073	1.9774
2½........	4	UNC–1A	.0031	2.4969	2.4612	.0357	2.3345	2.3190	.0155	2.1902
"........	"	" –2A	"	"	2.4731	.0238	"	2.3241	.0104	"
"........	"	" –3A	0	2.5000	2.4762	"	2.3376	2.3298	.0078	2.1933
2¾........	4	UNC–1A	.0032	2.7468	2.7111	.0357	2.5844	2.5686	.0158	2.4401
"........	"	" –2A	"	"	2.7230	.0238	"	2.5739	.0105	"
"........	"	" –3A	0	2.7500	2.7262	"	2.5876	2.5797	.0079	2.4433
3..........	4	UNC–1A	.0032	2.9968	2.9611	.0357	2.8344	2.8183	.0161	2.6901
"........	"	" –2A	"	"	2.9730	.0238	"	2.8237	.0107	"
"........	"	" –3A	0	3.0000	2.9762	"	2.8376	2.8296	.0080	2.6933
3¼........	4	UNC–1A	.0033	3.2467	3.2110	.0357	3.0843	3.0680	.0163	2.9400
"........	"	" –2A	"	"	3.2229	.0238	"	3.0734	.0109	"
"........	"	" –3A	0	3.2500	3.2262	"	3.0876	3.0794	.0082	2.9433
3½........	4	UNC–1A	.0033	3.4967	3.4610	.0357	3.3343	3.3177	.0166	3.1900
"........	"	" –2A	"	"	3.4729	.0238	"	3.3233	.0110	"
"........	"	" –3A	0	3.5000	3.4762	"	3.3376	3.3293	.0083	3.1933
3¾........	4	UNC–1A	.0034	3.7466	3.7109	.0357	3.5842	3.5674	.0168	3.4399
"........	"	" –2A	"	"	3.7228	.0238	"	3.5730	.0112	"
"........	"	" –3A	0	3.7500	3.7262	"	3.5876	3.5792	.0084	3.4433
4..........	4	UNC–1A	.0034	3.9966	3.9609	.0357	3.8342	3.8172	.0170	3.6899
"........	"	" –2A	"	"	3.9728	.0238	"	3.8229	.0113	"
"........	"	" –3A	0	4.0000	3.9762	"	3.8376	3.8291	.0085	3.6933

[1] The values in this table are based on a length of engagement equal to the nominal diameter.
[2] The minimum minor diameter of the external thread may be determined by subtracting $0.6495p$ ($=h_b$) from the minimum pitch diameter of the external thread. This minimum diameter is not controlled by gages but by the form of the threading tools.

Table 5. *Limits of size, Unified coarse thread series, internal threads, classes 1B, 2B, and 3B*

Designation			Internal thread limiting dimensions [1]						
			Minor diameter			Pitch diameter			Major diameter
Size	Threads per inch	Thread symbol	Limits		Tolerance	Limits		Tolerance	
			Min	Max		Min	Max		Min [2]
			Inches	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
1/4	20	UNC-1B	0.1959	0.2067	0.0108	0.2175	0.2248	0.0073	0.2500
"	"	" -2B	"	"	"	"	.2223	.0048	"
"	"	" -3B	"	"	"	"	.2211	.0036	"
5/16	18	UNC-1B	.2524	.2630	.0106	.2764	.2843	.0079	.3125
"	"	" -2B	"	"	"	"	.2817	.0053	"
"	"	" -3B	"	"	"	"	.2803	.0039	"
3/8	16	UNC-1B	.3073	.3182	.0109	.3344	.3429	.0085	.3750
"	"	" -2B	"	"	"	"	.3401	.0057	"
"	"	" -3B	"	"	"	"	.3387	.0043	"
7/16	14	UNC-1B	.3602	.3717	.0115	.3911	.4003	.0092	.4375
"	"	" -2B	"	"	"	"	.3972	.0061	"
"	"	" -3B	"	"	"	"	.3957	.0046	"
1/2	12	UNC-1B	.4098	.4223	.0125	.4459	.4559	.0100	.5000
"	"	" -2B	"	"	"	"	.4525	.0066	"
"	"	" -3B	"	"	"	"	.4509	.0050	"
9/16	12	UNC-1B	.4723	.4843	.0120	.5084	.5186	.0102	.5625
"	"	" -2B	"	"	"	"	.5152	.0068	"
"	"	" -3B	"	"	"	"	.5135	.0051	"
5/8	11	UNC-1B	.5266	.5391	.0125	.5660	.5767	.0107	.6250
"	"	" -2B	"	"	"	"	.5732	.0072	"
"	"	" -3B	"	"	"	"	.5714	.0054	"
3/4	10	UNC-1B	.6417	.6545	.0128	.6850	.6965	.0115	.7500
"	"	" -2B	"	"	"	"	.6927	.0077	"
"	"	" -3B	"	"	"	"	.6907	.0057	"
7/8	9	UNC-1B	.7547	.7681	.0134	.8028	.8151	.0123	.8750
"	"	" -2B	"	"	"	"	.8110	.0082	"
"	"	" -3B	"	"	"	"	.8089	.0061	"
1	8	UNC-1B	.8647	.8797	.0150	.9188	.9320	.0132	1.0000
"	"	" -2B	"	"	"	"	.9276	.0088	"
"	"	" -3B	"	"	"	"	.9254	.0066	"
1 1/8	7	UNC-1B	.9704	.9875	.0171	1.0322	1.0463	.0141	1.1250
"	"	" -2B	"	"	"	"	1.0416	.0094	"
"	"	" -3B	"	"	"	"	1.0393	.0071	"
1 1/4	7	UNC-1B	1.0954	1.1125	.0171	1.1572	1.1716	.0144	1.2500
"	"	" -2B	"	"	"	"	1.1668	.0096	"
"	"	" -3B	"	"	"	"	1.1644	.0072	"
1 3/8	6	UNC-1B	1.1946	1.2146	.0200	1.2667	1.2822	.0155	1.3750
"	"	" -2B	"	"	"	"	1.2771	.0104	"
"	"	" -3B	"	"	"	"	1.2745	.0078	"

Designation			Internal thread limiting dimensions [1]						
Size	Threads per inch	Thread symbol	Minor diameter			Pitch diameter			Major diameter
			Limits		Tolerance	Limits		Tolerance	
			Min	Max		Min	Max		Min [2]
			Inches	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
1½	6	UNC–1B	1.3196	1.3396	.0200	1.3917	1.4075	.0158	1.5000
"	"	" –2B	"	"	"	"	1.4022	.0105	"
"	"	" –3B	"	"	"	"	1.3996	.0079	"
1¾	5	UNC–1B	1.5335	1.5575	.0240	1.6201	1.6375	.0174	1.7500
"	"	" –2B	"	"	"	"	1.6317	.0116	"
"	"	" –3B	"	"	"	"	1.6288	.0087	"
2	4½	UNC–1B	1.7594	1.7861	.0267	1.8557	1.8743	.0186	2.0000
"	"	" –2B	"	"	"	"	1.8681	.0124	"
"	"	" –3B	"	"	"	"	1.8650	.0093	"
2¼	4½	UNC–1B	2.0094	2.0361	.0267	2.1057	2.1247	.0190	2.2500
"	"	" –2B	"	"	"	"	2.1183	.0126	"
"	"	" –3B	"	"	"	"	2.1152	.0095	"
2½	4	UNC–1B	2.2294	2.2594	.0300	2.3376	2.3578	.0202	2.5000
"	"	" –2B	"	"	"	"	2.3511	.0135	"
"	"	" –3B	"	"	"	"	2.3477	.0101	"
2¾	4	UNC–1B	2.4794	2.5094	.0300	2.5876	2.6082	.0206	2.7500
"	"	" –2B	"	"	"	"	2.6013	.0137	"
"	"	" –3B	"	"	"	"	2.5979	.0103	"
3	4	UNC–1B	2.7294	2.7594	.0300	2.8376	2.8585	.0209	3.0000
"	"	" –2B	"	"	"	"	2.8515	.0139	"
"	"	" –3B	"	"	"	"	2.8480	.0104	"
3¼	4	UNC–1B	2.9794	3.0094	.0300	3.0876	3.1088	.0212	3.2500
"	"	" –2B	"	"	"	"	3.1017	.0141	"
"	"	" –3B	"	"	"	"	3.0982	.0106	"
3½	4	UNC–1B	3.2294	3.2594	.0300	3.3376	3.3591	.0215	3.5000
"	"	" –2B	"	"	"	"	3.3519	.0143	"
"	"	" –3B	"	"	"	"	3.3484	.0108	"
3¾	4	UNC–1B	3.4794	3.5094	.0300	3.5876	3.6094	.0218	3.7500
"	"	" –2B	"	"	"	"	3.6021	.0145	"
"	"	" –3B	"	"	"	"	3.5985	.0109	"
4	4	UNC–1B	3.7294	3.7594	.0300	3.8376	3.8597	.0221	4.0000
"	"	" –2B	"	"	"	"	3.8523	.0147	"
"	"	" –3B	"	"	"	"	3.8487	.0111	"

[1] The values in this table are based on a length of engagement equal to the nominal diameter.

[2] The maximum major diameter of the internal thread may be determined by adding $0.7939p$ ($=1\ 2/9 \times h_b$) to the maximum pitch diameter of the internal thread. This maximum diameter is not controlled by gages but by the form of the threading tools.

TABLE 6. *Limits of size, Unified fine thread series, external threads, classes 1A, 2A, and 3A*

Designation			External thread limiting dimensions [1]							
Size	Threads per inch	Thread symbol	Allowance	Major diameter			Pitch diameter			Minor diameter
				Limits		Tolerance	Limits		Tolerance	
				Max	Min		Max	Min		Max [2]
			Inch	*Inches*	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
¼........	28	UNF–1A	0.0010	0.2490	0.2392	0.0098	0.2258	0.2208	0.0050	0.2052
"........	"	" –2A	"	"	.2425	.0065	"	.2225	.0033	"
"........	"	" –3A	0	.2500	.2435	"	.2268	.2243	.0025	.2062
5/16........	24	UNF–1A	.0011	.3114	.3006	.0108	.2843	.2788	.0055	.2603
"........	"	" –2A	"	"	.3042	.0072	"	.2806	.0037	"
"........	"	" –3A	0	.3125	.3053	"	.2854	.2827	.0027	.2614
⅜........	24	UNF–1A	.0011	.3739	.3631	.0108	.3468	.3411	.0057	.3228
"........	"	" –2A	"	"	.3667	.0072	"	.3430	.0038	"
"........	"	" –3A	0	.3750	.3678	"	.3479	.3450	.0029	.3239
7/16........	20	UNF–1A	.0013	.4362	.4240	.0122	.4037	.3975	.0062	.3749
"........	"	" –2A	"	"	.4281	.0081	"	.3995	.0042	"
"........	"	" –3A	0	.4375	.4294	"	.4050	.4019	.0031	.3762
½........	20	UNF–1A	.0013	.4987	.4865	.0122	.4662	.4598	.0064	.4374
"........	"	" –2A	"	"	.4906	.0081	"	.4619	.0043	"
"........	"	" –3A	0	.5000	.4919	"	.4675	.4643	.0032	.4387
9/16........	18	UNF–1A	.0014	.5611	.5480	.0131	.5250	.5182	.0068	.4929
"........	"	" –2A	"	"	.5524	.0087	"	.5205	.0045	"
"........	"	" –3A	0	.5625	.5538	"	.5264	.5230	.0034	.4943
⅝........	18	UNF–1A	.0014	.6236	.6105	.0131	.5875	.5805	.0070	.5554
"........	"	" –2A	"	"	.6149	.0087	"	.5828	.0047	"
"........	"	" –3A	0	.6250	.6163	"	.5889	.5854	.0035	.5568
¾........	16	UNF–1A	.0015	.7485	.7343	.0142	.7079	.7004	.0075	.6718
"........	"	" –2A	"	"	.7391	.0094	"	.7029	.0050	"
"........	"	" –3A	0	.7500	.7406	"	.7094	.7056	.0038	.6733
⅞........	14	UNF–1A	.0016	.8734	.8579	.0155	.8270	.8189	.0081	.7858
"........	"	" –2A	"	"	.8631	.0103	"	.8216	.0054	"
"........	"	" –3A	0	.8750	.8647	"	.8286	.8245	.0041	.7874
1..........	12	UNF–1A	.0018	.9982	.9810	.0172	.9441	.9353	.0088	.8960
"........	"	" –2A	"	"	.9868	.0114	"	.9382	.0059	"
"........	"	" –3A	0	1.0000	.9886	"	.9459	.9415	.0044	.8978
1⅛........	12	UNF–1A	.0018	1.1232	1.1060	.0172	1.0691	1.0601	.0090	1.0210
"........	"	" –2A	"	"	1.1118	.0114	"	1.0631	.0060	"
"........	"	" –3A	0	1.1250	1.1136	"	1.0709	1.0664	.0045	1.0228
1¼........	12	UNF–1A	.0018	1.2482	1.2310	.0172	1.1941	1.1849	.0092	1.1460
"........	"	" –2A	"	"	1.2368	.0114	"	1.1879	.0062	"
"........	"	" –3A	0	1.2500	1.2386	"	1.1959	1.1913	.0046	1.1478
1⅜........	12	UNF–1A	.0019	1.3731	1.3559	.0172	1.3190	1.3096	.0094	1.2709
"........	"	" –2A	"	"	1.3617	.0114	"	1.3127	.0063	"
"........	"	" –3A	0	1.3750	1.3636	"	1.3209	1.3162	.0047	1.2728
1½........	12	UNF–1A	.0019	1.4981	1.4809	.0172	1.4440	1.4344	.0096	1.3959
"........	"	" –2A	"	"	1.4867	.0114	"	1.4376	.0064	"
"........	"	" –3A	0	1.5000	1.4886	"	1.4459	1.4411	.0048	1.3978

[1] The values in this table are based on a length of engagement equal to the nominal diameter.
[2] The minimum minor diameter of the external thread may be determined by subtracting $0.6495p$ $(=h_b)$ from the minimum pitch diameter of the external thread. This minimum diameter is not controlled by gages but by the form of the threading tools.

TABLE 7. *Limits of size, Unified fine thread series, internal threads, classes 1B, 2B, and 3B*

Designation			Internal thread limiting dimensions [1]						
Size	Threads per inch	Thread symbol	Minor diameter			Pitch diameter			Major diameter
			Limits		Tolerance	Limits		Tolerance	
			Min	Max		Min	Max		Min [2]
			Inches	*Inches*	*Inch*	*Inches*	*Inches*	*Inch*	*Inches*
1/4	28	UNF–1B	0.2113	0.2190	0.0077	0.2268	0.2333	0.0065	0.2500
"	"	" –2B	"	"	"	"	.2311	.0043	"
"	"	" –3B	"	"	"	"	.2300	.0032	"
5/16	24	UNF–1B	.2674	.2754	.0080	.2854	.2925	.0071	.3125
"	"	" –2B	"	"	"	"	.2902	.0048	"
"	"	" –3B	"	"	"	"	.2890	.0036	"
3/8	24	UNF–1B	.3299	.3372	.0073	.3479	.3553	.0074	.3750
"	"	" –2B	"	"	"	"	.3528	.0049	"
"	"	" –3B	"	"	"	"	.3516	.0037	"
7/16	20	UNF–1B	.3834	.3916	.0082	.4050	.4131	.0081	.4375
"	"	" –2B	"	"	"	"	.4104	.0054	"
"	"	" –3B	"	"	"	"	.4091	.0041	"
1/2	20	UNF–1B	.4459	.4537	.0078	.4675	.4759	.0084	.5000
"	"	" –2B	"	"	"	"	.4731	.0056	"
"	"	" –3B	"	"	"	"	.4717	.0042	"
9/16	18	UNF–1B	.5024	.5106	.0082	.5264	.5353	.0089	.5625
"	"	" –2B	"	"	"	"	.5323	.0059	"
"	"	" –3B	"	"	"	"	.5308	.0044	"
5/8	18	UNF–1B	.5649	.5730	.0081	.5889	.5980	.0091	.6250
"	"	" –2B	"	"	"	"	.5949	.0060	"
"	"	" –3B	"	"	"	"	.5934	.0045	"
3/4	16	UNF–1B	.6823	.6908	.0085	.7094	.7192	.0098	.7500
"	"	" –2B	"	"	"	"	.7159	.0065	"
"	"	" –3B	"	"	"	"	.7143	.0049	"
7/8	14	UNF–1B	.7977	.8068	.0091	.8286	.8392	.0106	.8750
"	"	" –2B	"	"	"	"	.8356	.0070	"
"	"	" –3B	"	"	"	"	.8339	.0053	"
1	12	UNF–1B	.9098	.9198	.0100	.9459	.9573	.0114	1.0000
"	"	" –2B	"	"	"	"	.9535	.0076	"
"	"	" –3B	"	"	"	"	.9516	.0057	"
1 1/8	12	UNF–1B	1.0348	1.0448	.0100	1.0709	1.0826	.0117	1.1250
"	"	" –2B	"	"	"	"	1.0787	.0078	"
"	"	" –3B	"	"	"	"	1.0768	.0059	"
1 1/4	12	UNF–1B	1.1598	1.1698	.0100	1.1959	1.2079	.0120	1.2500
"	"	" –2B	"	"	"	"	1.2039	.0080	"
"	"	" –3B	"	"	"	"	1.2019	.0060	"
1 3/8	12	UNF–1B	1.2848	1.2948	.0100	1.3209	1.3332	.0123	1.3750
"	"	" –2B	"	"	"	"	1.3291	.0082	"
"	"	" –3B	"	"	"	"	1.3270	.0061	"
1 1/2	12	UNF–1B	1.4098	1.4198	.0100	1.4459	1.4584	.0125	1.5000
"	"	" –2B	"	"	"	"	1.4542	.0083	"
"	"	" –3B	"	"	"	"	1.4522	.0063	"

[1] The values in this table are based on a length of engagement equal to the nominal diameter.
[2] The maximum major diameter of the internal thread may be determined by adding $0.7939p$ ($=1\ 2/9 \times h_b$) to the maximum pitch diameter of the internal thread. This maximum diameter is not controlled by gages but by the form of the threading tools.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1949—831563