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U.S. METRIC STUDY REPORT

INTERNATIONAL STANDARDS

U.S. METRIC STUDY

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U.S. METRIC STUDY REPORT

INTERNATIONAL STANDARDS

First of a series of reports prepared for the Congress

U.S. METRIC STUDY
Daniel V. De Simone, Director

National Bureau of Standards
Special Publication 345-1

UNITED STATES DEPARTMENT OF COMMERCE
MAURICE H. STANS, *Secretary*
NATIONAL BUREAU OF STANDARDS
LEWIS M. BRANSCOMB, *Director*

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LETTER OF TRANSMITTAL

Honorable Maurice H. Stans
Secretary of Commerce

Dear Mr. Secretary:

I have the honor to transmit to you an interim report of the U.S. Metric Study, which is being conducted at the National Bureau of Standards at your request and in accordance with the Metric Study Act of 1968.

The Study is exploring the subjects assigned to it with great care. Numerous surveys and investigations have been launched to obtain primary data with respect to the issues of metrication. In addition, we are holding a series of National Metric Study Conferences that will provide an opportunity for major groups and organizations representing the various sectors of our society to express their views with respect to these issues.

The conclusions and recommendations contained in this report reflect a substantial concern about the need to strengthen the effectiveness of the United States in international standards negotiations. Because this report has been prepared as an offshoot of our inquiry into the issues of metrication, it does not consider specific means to achieve such increased effectiveness. Rather, it calls attention to significant events and trends that have come to light in our Metric Study and have led us to certain basic conclusions. If you concur with these conclusions and our recommendations, you may wish to give further attention to the possibility of Federal leadership in encouraging greater support by U.S. industry for international standardization, the desirability of substantial Federal assistance to our private sector standardizing institutions, and other alternatives that might emerge from a thorough review of this question with such institutions and other interested parties.

Sincerely,

Lewis M. Branscomb, *Director*
National Bureau of Standards

Enclosure

FOREWORD

This is an interim report in the U.S. Metric Study. It concerns developments in the field of international standards; a subject that is little known and even less appreciated in terms of its importance to the international transfer of goods and technology.

Its purpose is to call attention to some preliminary findings and to recommend that certain actions be taken, quite apart from the ultimate issue of what the United States should do with respect to metrication. This issue will be embraced in the final report of this Study to the Congress, which will be made by the Secretary of Commerce in August of 1971.

This report was prepared by a Metric Study task force, headed by Dr. Robert D. Huntoon and including Dr. Robert D. Stiehler, Dr. A. Allan Bates, and Mr. Myron G. Domsitz. Important contributions were made by Mr. Richard O. Simpson, Deputy Assistant Secretary of Commerce for Product Standards, Dr. Allen V. Astin, Director Emeritus of the National Bureau of Standards, and Mr. Donald L. Peyton, Managing Director of the American National Standards Institute.

As in all aspects of the U.S. Metric Study, thoughtful assistance and counsel were given by members of the Metric Study Advisory Panel in the preparation of this interim report. In particular, we are grateful for the contributions made by Mr. Louis F. Polk, chairman of the panel, Mr. Francis L. LaQue, the vice chairman, and the panel's executive committee: Mr. John Clark, Dr. Doris Hanson, Mr. Vernon Jirikowic, Mr. Richard Kropf, Mr. Roy P. Trowbridge, and Dr. William E. Zeiter.

Daniel V. De Simone, *Director*
U.S. Metric Study

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I. INTRODUCTION AND SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

In the two years following the enactment of the Metric Study Act,[1] the "increasing worldwide use of the metric system," which was the primary concern leading to its passage, has expanded to encompass virtually the entire world. The one notable exception to this worldwide trend is the United States.

These years have also seen an acceleration in the internationalization of engineering standards, which use a nation's measurement language as a basis for product quality, uniformity and compatibility. Engineering standards have served as a keystone in our domestic industrial development, as they have in other industrialized nations. In Europe it is now being proposed that such standards be coupled with product certification procedures. Products not certified as satisfying the applicable standards may effectively be barred from the markets in question until proper certification is secured. This proposal, if put into effect, will signal substantial influences upon "international trade, commerce and other areas of international relations," an area of concern expressly highlighted in the Metric Study Act.

Accordingly, since these developments with respect to international standards are believed important, the purpose of this interim report is to call attention to them. The United States may or may not emerge as a fully accepted participant in this new arrangement of the world market, depending

[1] Public Law 90-472, which established the U.S. Metric Study in August 1968, is commonly referred to as the "Metric Study Act." See appendix 1 for the full text of this Act.

upon the policies established and actions taken in response to these developments within the next two to three years. If in keeping with our general policy to work toward greater openness and harmony in world affairs, the U.S. goal is full participation, certain actions must be taken soon in order to achieve this end. On the other hand, if we do not seek such participation, what the U.S. may gain or lose as a consequence should be clearly understood so that a rational choice can be made. It is the purpose of this interim report to bring these issues up for full consideration, provide a basis for their evaluation, and indicate some courses of action.

In the chapters that follow, attention is first focused upon the U.S. Metric Study itself in order to explain how it comes to pass that an international standards problem emerges from it and to put this problem in proper perspective with the rest of the Study. Proper interpretation requires an understanding, not commonly found, of engineering standards—their nature, genesis, and relation to measurement usage. In addition, the vital role they play in the development of an industrial economy needs to be understood, as does their international role, where they may defend and propagate our technology and engineering practices. Such an explanation is provided in *appendix 4* for the reader who is not already familiar with the subject of engineering standards.

Rapidly developing events and trends that have come to light in the course of the Metric Study are portrayed in the chapter entitled "Dynamic Environment," to show how these events have moved into the present stage calling for action. An analysis of their impact and the conclusions to be drawn therefrom appear under the heading of "Evaluation and Conclusions." Finally, the general nature of the action required, depending upon our national goal, is explained in the "Recommendations."

Summary of Conclusions and Recommendations

The conclusions and recommendations contained in this report reflect a substantial concern about the need to strengthen the effectiveness of the United States in international standards activities. In brief, these conclusions and recommendations are as follows.[2]

CONCLUSIONS

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Conclusion 1: The international standards issue lends some support to a metric conversion in the United States, but other important issues must also be considered and weighed before an overall judgment can be made.	25
Conclusion 2: The Metric Study cannot and should not be expected to provide answers for the nonmetric issues raised by the events and trends described in this report.	25
Conclusion 3: If the U.S. wishes to see the maximum amount of its engineering practices and standards included in the coming international standards, it must, without delay, take steps for adequate and effective participation in international standards negotiations.	25

[2] The number in the margin refers to the page in the text where the conclusion or recommendation appears.

RECOMMENDATIONS

II. NATURE OF THE U.S. METRIC STUDY

"We seek an open world—open to ideas, open to the exchange of goods and people—a world in which no people, great or small, will live in angry isolation." These words from President Nixon's inaugural address, and similar declarations by American Presidents over recent decades, provide a context for the U.S. Metric Study. American Space Technology has made every nation aware of our global interdependence. More than ever we are acutely aware of the need to learn to live together in peace and harmony on our spaceship Earth. Enterprise and Technology have produced wealth that spreads beyond national boundaries. As technology continues to advance industrial productivity, markets of global scales are needed to realize potential production and market efficiencies.

Unfortunately, environmental pollution, as well as wealth, spreads out across national boundaries. National interdependence goes beyond commercial relations, cultural contact and political accommodation. We share the same environment. We are netted together through the same communications and transportation systems. Most important of all, we live in a world in which survival is increasingly dependent on knowledge and understanding. And this knowledge, especially scientific and technical knowledge, being nature's truths, is every man's legacy. By harmonizing our actions on the basis of this universal knowledge, mankind may learn to live in harmony with nature and with itself.

As we recognize the growing interdependence of nations, we must also realize that each individual's freedom of action is necessarily limited to some degree by that interdependence. Yet this independence of the individual has been the principal source of our national strength, in both spiritual and practical terms. The achievement of international harmony does not necessarily require uniformity of customs and practices. It is essential that we identify and preserve as much freedom of action as possible in those areas where uniformity is not indeed necessary. Evaluation of the virtues of uniformity must rest on a rational evaluation of the consequences of continued non-uniformity.

In this respect, the Congressional debate leading to the passage of Public Law 90-472 represented a far more practical understanding of the nature of the metric problem than was reflected in the turbulence of earlier Congressional debates on this subject. Many times in the last hundred years passions have been inflamed on both sides of this issue, but rarely did the debate rise above a purely emotional level. This time the Congress, after eleven years of discussion, did not ask, "devise a plan for conversion to metric usage," or even, "answer the question: should the United States convert to metric usage?" Instead, the Congress asked the Department of Commerce to "determine the impact of increasing worldwide use of the metric system on the United States . . . ." We were further asked to consider "the desirability and practicability of increasing use of metric weights and measures," but also to study "the feasibility of retaining and promoting . . . engineering standards based on the customary measurement units. . . ." Finally, we are to "evaluate the costs and benefits of alternative courses of action which may be feasible for the United States."

The Congress specifically directs that in carrying out this investigation we should examine the impact of current trends and possible U.S. courses of action on international trade and commerce, U.S. national security, our international relations, and the possible practical difficulties that might be encountered should the metric system be increasingly used in this country.

The law requires that we give special attention to the "advantages, disadvantages and problems associated with possible changes in either the system of measurement units or the related dimensional and engineering standards currently in use in the United States." In this connection the law recognizes that international harmonization of industrial practices is not a one-way street. U.S. technology and practices are adopted in the industrial life of every nation on earth, at least to some degree. Thus, we must distinguish very carefully between changes in measurement language and requirements for industrial redesign. We must determine where U.S. self-interest lies with respect to international harmonization of industrial standards, and then must carefully examine the extent to which our measurement language influences our objectives in international standards negotiations.

Thus, the Congress has asked us to attempt a thorough and rational analysis of the impact on the United States of present world trends with respect to measurement language. Conformity with the world trend toward metrication is not to be accepted as an inviolable postulate, nor is it to be stricken aside as alien to our culture.

Planning and execution of the study have been assigned to the National Bureau of Standards, an institution with extensive experience in measurement and its applications, large-scale involvement in the development of the nation's voluntary engineering standards, and national acceptance as a resource for unbiased technically based studies.

In keeping with this tradition, the National Bureau of Standards is now engaged in the implementation of a study plan developed in consultation with its Advisory Panel.[3] The study undertakes to provide what perhaps no other nation has yet achieved: a rational evaluation of the nation's alternative courses of action, openly arrived at, with full participation from all sectors of the society.

The metric system is a measurement language. To be more precise, since there are some variations among metric systems, we use the term to mean the International System (SI) adopted in 1960 by the General Conference of Weights and Measures, in which the United States was a participant. This is an international treaty organization, established by the Treaty of the Meter in 1875, to which the U.S. and forty-two other nations formally adhere. The International System is the first essentially complete, internationally harmonized system of compatible scientific measurement units. It is based on the meter, kilogram, and second, but of course also includes thermal, electrical, mechanical, radiometric and photometric units. All modern industrial nations (in particular the signatories to the Treaty of the Meter) assure the compatibility of their scientific measurement system, at the highest levels of precision, through SI standards and their intercomparison. To this extent, the United States has been metric for nearly a hundred years. The measurement standards, as maintained at the National Bureau of Standards, are all SI Standards. The U.S. customary measurement standards (pound-yard-second-Fahrenheit) are exactly defined by a specified numerical ratio to the fundamental SI Standards. Thus, our customary measurement standards are, in fact, *derived* from SI Standards.

The United States is formally and legally bi-lingual with respect to measurement systems. Since the middle of the last century, the United States, by act of Congress, has declared metric units legal in Commerce and in other uses. In actual practice, of course, scientists and engineers are multi-lingual. That is, we use many different systems of measurement units interchangeably, creating and adapting each to the needs of specialized fields of research. That this is so is of little public consequence. It is only important to realize that under some circumstances it is not only possible but desirable to permit the co-existence of more than one system of measurement language. So long as we know the quantitative relationship between measurement languages—that is, so long as each measurement language is precisely defined with respect to a formally adopted base language (SI)—we can translate exactly from one language to another. We must, however, not underrate the importance of properly handling the question of diversity versus uniformity in our measurement language.

Moreover, technology is changing the impact of metrication. For example, in this country a very large fraction of consumer goods are now sold in prepackaged form with weights and measures established at the factory and printed on the package. For these products, a change to metric language is a software change, quite different from the hardware change required when materials are served in bulk and the measuring instrument must be at the retail outlet. The rapid growth of numerically controlled

[3] See appendix 2 for the membership of this advisory panel and the salient provisions of its charter.

machine tools again brings in the possibility of mixed production of metric and customary designed objects, fabricated on the same machine and subject to control by properly translated programs. The Metric Study hopes to identify and document circumstances such as these which, if extrapolated some years into the future, will give a clear picture of the environment within which a future metric conversion might take place. Similarly, there may be other effects, such as a very high degree of interlocking of many industries dependent upon the same set of standardized components and materials based on customary units, that will make conversion increasingly difficult. It is thus essential that the Study undertake to measure not only the present circumstances with respect to metric usage, but expected changes in the near future.

Clearly, the almost worldwide use of the metric system must be accepted as a fact of life, and the U.S. must learn to live with it. Adjustments within the U.S. are being made and will continue to be made in the absence of any recommendations from our Study. Examples surround us, ranging from simple to complex. The American visitor abroad makes mental adjustments for distance and temperature announcements, the physicist switches language when he listens to the engineer. Manufacturers who prepackage for both American and foreign markets, such as our neighbors in Latin America, commonly print both English and metric weights on the package. The pharmaceutical industry is substantially converted to metric usage, and the ball bearing industry is rapidly in the process of the same transition. Newspapers display air pollution regulations in metric dimensions. Farmers use fertilizers whose standards are in metric units. Swimming pools are commonly built to an integral number of meters in length in order to facilitate international swimming competitions. And doctors write Rxs in the understandable metric units. These are but a few examples.

The formulation of a Study plan consonant with the foregoing philosophy and circumstances—and, in fact, the development of the philosophy itself—has been a major undertaking of the Study. The structure of the plan and the status of the numerous surveys and investigations that are underway are described in *appendix 3* of this report.

The essence of the plan is that courses of action that are feasible for the U.S. must be examined for costs and benefits in all importantly relevant sectors of our society. Based upon this information, necessary tradeoffs should be identified, consequences quantified, or otherwise described, and the results injected into our legislative and executive political machinery for resolution.

The legislative history of the Metric Study Act makes clear that the Study should not become too narrowly focused upon the metrication issue. The Study Group was therefore charged to see that concern for the pros and cons of metrication would not be allowed to obscure possible findings, such as, for example, that worldwide metrication is but one aspect of a broader undertaking to compensate for some unique advantages already enjoyed by the U.S. without benefit of metrication, in which case some course of action in addition to, or instead of, further metrication may be required.

The wisdom of this legislative precaution has already been demonstrated.

Evidence has appeared which indicates that worldwide metrication may be coupled to and, in part, be a manifestation of a much broader effort to develop an integrated market, in Europe for a start, comparable to that enjoyed by the U.S. domestically. International product quality assurance, backed by seals of compliance, may become another basis for forging such an integrated market. International standards are being used as the basis for definition and verification of product quality and compatibility. SI is to be the primary language for the standards, but agreements about quantitative parameters will predominantly reflect the technology and engineering practices of the dominant participants in international standards negotiations.

The chapters that follow show the nature of these developments, their interesting but secondary dependence upon metrication, their rapidity of development, and the need for the U.S. to decide upon its response to these developments, without awaiting the outcome of the Metric Study. This need is felt to be sufficiently urgent to warrant this interim report, which is being submitted in accordance with the provisions of Public Law 90-472, the Metric Study Act.

III. THE DYNAMIC ENVIRONMENT

A. International Trade and Metrication

The Metric Study Act directs the Secretary "to determine the impact of increasing worldwide use of the metric system on the United States," and in particular, to give attention to "international trade, commerce, and in military and other areas of international relations." The statute and its legislative history make clear that this "increasing worldwide use of the metric system" is a principal cause for concern. If the nature of this increase is such as to have strong effects on international trade (for example, various restrictive laws), then the basis of concern in this country may be heightened.

The Congress therefore has a strong interest in the interplay between metrication and areas of international relations, including foreign trade. Theoretically, at least, this interplay may be manipulated to help or hinder free trade and involves both the language of measurement and the consequent engineering standards that determine such things as the size of a nut or bolt. The measurement language used to describe U.S. products or to measure them for sale abroad should be a relatively minor impediment to the trading process:

> "The metric system per se is not the real meat of the subject but, rather, is the catalyst which is causing most of us to do some soul-searching about our national and international standards activities and the relatively poor progress we are making in comparison with the stepped up activities in most of the other countries. We tend to blame our poor performance on the difference in the units of measure that are

used to describe our standards and some of this may be justified, but units of measure are not the *only* reason."[4]

Engineering standards are involved, because U.S. products may not be compatible with other products in the foreign market, if they are made to different engineering standards. This can have a very direct effect upon the *two-way* flow of trade and upon the engineering practices or technology of each participating nation.[5] Incompatibilities of this kind arise naturally out of the standards process itself and are not necessarily an artificial restraint on trade. However, the use of standards can be so manipulated as to become an artificial barrier. Consequently, the U.S. Metric Study has been examining and following recent events concerning standards development in other countries, to the extent that these events may be related to the increasing worldwide use of the metric system.

In this chapter we present, without interpretation, a series of events and trends in the dynamic environment in which the U.S. Metric Study is immersed, and which must be taken into account in any assessment of the impact of metrication on international trade. There is a sense of urgency in all of this that may not be apparent:

> "I find it hard to explain just why international standards should be important . . . . But the conviction is strong, nevertheless. I could point to growing imports of materials and equipment from overseas. I could note that our overseas subsidiaries are having to develop an independent standards program because U.S. based standards aren't responsive to their needs. But these are little clouds, no bigger than a man's hand. They can't account for my view that we in the U.S. have only a few years to develop a strengthened and expanded system of *national* standards, and that these national standards must then be advanced to the level of international standards."[6]

B. Events

1. In January 1970 Australia declared its intent to proceed toward metrication of its standards and commerical practices. The Prime Minister declared[7]:

> "Following detailed consideration of the recommendations made by the Senate Select Committee on the adoption of the Metric System of Weights and Measures, the Government has decided that Australia should convert to the Metric System as soon as possible. . . . The Government's aim is to complete the changeover during a period of ten years, although conversion will be completed much sooner than this in

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[4] From "The Effect of Metrication Upon U.S. Engineering Standards," a paper presented by William K. Burton, Metric System Development Manager, Ford Motor Co., at the Standards Engineers Society Convention, September 23, 1970.

[5] Appendix 4 shows how this can happen.

[6] From "Standards Management in the Process Industries," a paper presented at the Standards Engineers Society Convention, September 21, 1970, by W. G. Canham, Engineering Standards Manager for the Monsanto Co.

[7] P.M. No. 12/1970, 19 Jan. 1970.

some sectors. . . . By allowing time for natural obsolescence and depreciation of plant and machinery, the cost of conversion will be greatly reduced. Experience in other countries such as Japan—where conversion is complete—has shown that by forethought and good planning these costs can be greatly reduced. . . ."

2. In January 1970 Canada released a "White Paper" proposing a general policy concerning metric conversion, noting that:

> "The Government believes that the question of metric conversion is one on which it is no longer possible to suspend judgment. . . . The Government believes that adoption of the metric system of measurement is ultimately inevitable—and desirable—for Canada. . . . The Government accordingly accepts eventual conversion as a definite objective of Canadian policy. . . . If the inevitablility of eventual change is accepted, then the need to begin the process of change as soon as possible is obvious. . . . Accumulated investments around the older system increase with time, and opportunities for conversion are missed as obsolete assets are replaced. . . . There would need to be increased participation in international standards development if the long-run trade advantages of conversion are to be secured. . . ."

3. In 1969 the International Organization for Standardization (ISO) published its 1000th Standard Recommendation (ISO R-1000), which "strongly recommends" maximum use of SI units in writing ISO standards. The International Electrotechnical Commission (IEC), the electrical affiliate of ISO, is pursuing the same policy. The authoritative journal of the British Standards Institute (*BSI News*) in its June 1969 issue, stated:

> "The publication of R-1000 by ISO marks, appropriately . . . the establishment . . . of the first truly international system of units. ISO/R-1000 provides rules for the use of the *Systeme International d'Unites* (SI Units) . . . and by recommending an internationally agreed selection of multiples of these units . . . provides a valuable guide to avoid the danger of each country and each industry making its own selection [of units]."

4. A Tripartite Accord among the United Kingdom, France, and West Germany was developed between 1967 and 1970. This agreement establishes an international system covering electronic components, which:

a. Harmonizes standards for products in international trade based upon available IEC recommendations in SI Units, and
b. Sets up an international scheme for quality assurance and product certification to be used in common by signatory nations.

5. The "EXACT" organization, (International Exchange of Authenticated Component Performance Test Data), sponsored by the Swedish Government and participated in by Norway, Denmark, Finland, and Austria, has set out to do much the same thing in the field of data exchange for electronic components as does the Tripartite Accord described above.

EXACT had its birth in the OECD; following a lack of complete support from the OECD membership, the present group decided to proceed on its own. Whether the EXACT activity will continue an independent course is uncertain. The EXACT group invited U.S. membership, but the Electronic Industries Association has refrained from endorsing such participation.

6. The Economic Commission for Europe (ECE), at a meeting in February 1970 of government officials responsible for standardization policies, endorsed a proposal that standards used in international trade should be harmonized on the basis of ISO-IEC recommendations. At this meeting, ECE also endorsed in principle a proposal that quality assurance and product certification programs relating to international trade should be based on ISO-IEC recommendations, as follows:

> "ECE governments should encourage their national standards bodies to harmonize as far as possible their national standards with international recommendations . . . in particular, those of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). . . . The meeting discussed the question of the technical barriers to trade which result from disparate arrangements for issuance of national or international certificates of conformity with standards, specifications, or regulations. A number of delegations emphasized the importance of this problem and noted with satisfaction the efforts already being made to find a solution by arranging for one country to accept the certificates of another. These delegations also expressed the hope that further additional schemes for the acceptance of national certificates on a multilateral basis and on conditions to be determined would be made. . . ."

7. In March 1970 the Committee for the Coordination of European Standards in the Electrical Field (CENEL) accepted responsibility for administering an international product certification program for electronic components, as proposed in the Tripartite Accord noted in 4 above. CENEL includes all of the nations of the European Economic Community (EEC) and of the European Free Trade Association (EFTA). It now appears that the Tripartite activity will be absorbed in the CENEL-managed plan, and that all western European countries will participate. This group of nations has a combined population that is approaching 300 million.

8. At the May 1970 meeting of the IEC in Washington, the United States proposed that the IEC establish a worldwide quality-control and certification program. The U.S. hopes that this IEC activity will supersede any of the regional operations such as EXACT and that proposed for CENEL administration, and therefore open the door for U.S. participation. Clearly, the standards employed would be those of the IEC. The Committee of Action of the IEC expects to have a report showing what needs to be done by the time of the next IEC meeting in May 1971.

9. In June 1970 the House of Commons of Canada passed Bill C-163, providing for the establishment of a Standards Council of Canada. The purpose of the Council is to promote voluntary standardization, both domesti-

cally and internationally. The Council is given the power to represent Canada in the IEC, ISO and other relevant international organizations; to make recommendations with respect to the use of, or conversion to, the International System of Units in Canadian industry, trade and commerce; to accredit organizations in Canada engaged in standards formulation, testing and certification; and to promote arrangements with similar organizations in other countries with respect to standards, testing and certification.

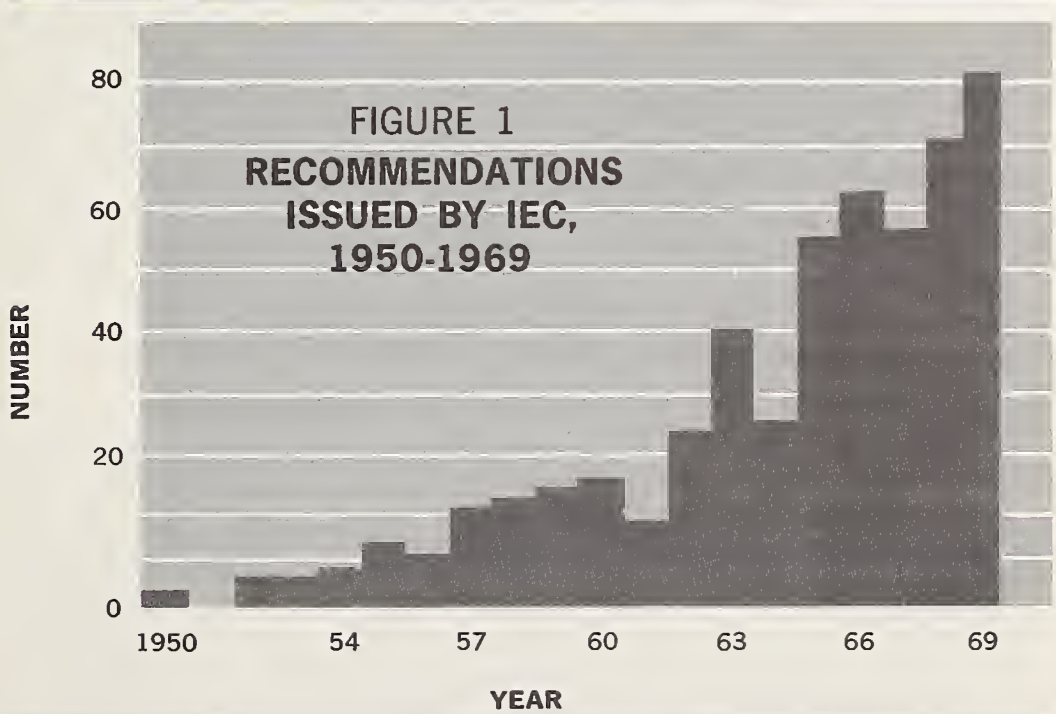
C. Trends

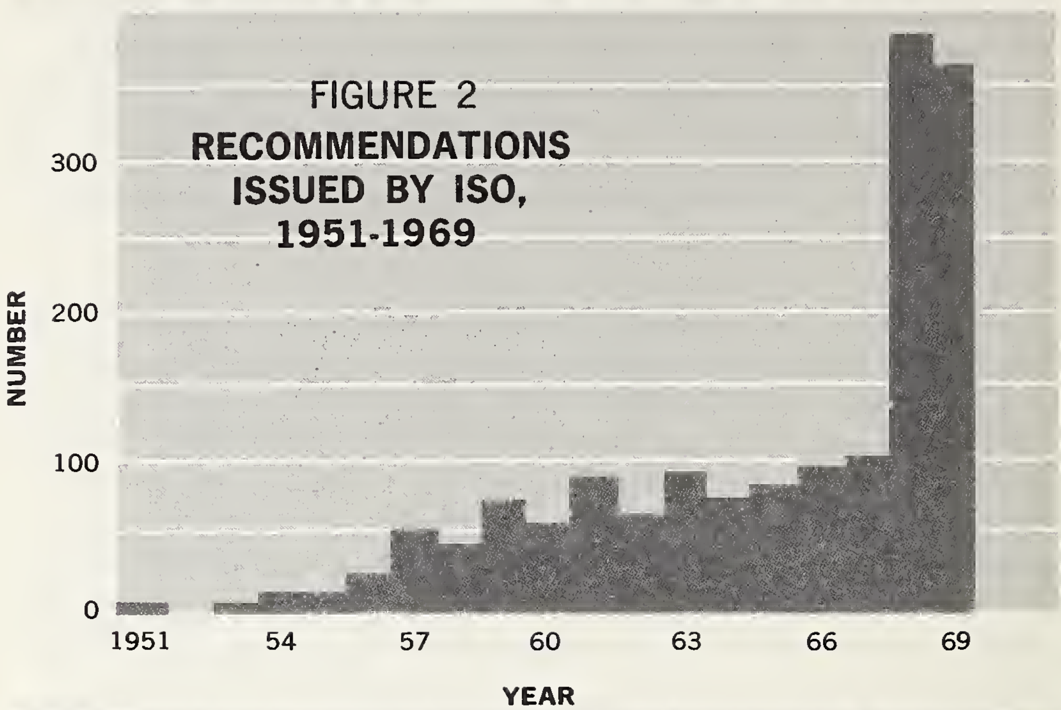
In addition to the foregoing events which are definite and specific, a number of trends worthy of attention appear to be developing. These are:

1. A marked acceleration in the production of international standards by the IEC and the ISO. Figure 1 shows, year by year, the standards issued (including revisions) by the IEC. Figure 2 gives similar information for the ISO. Since the curves present an oversimplified view to stress the rate of increase, tables I and II have been prepared to give a more representative picture. For the IEC the table shows that more than 80% of the standards now in effect were promulgated in the last decade. For the ISO the figure is closer to 90%.

Crude extrapolation (factor of 3 in every 5-year period taken from the tables) indicates that the next ten years will provide 9 times as many standards as are now on the books. Thus, the tenfold increase needed by the world's economy, as described in *appendix 4*, could be accomplished in the next decade.

2. As the international standards organizations (ISO and IEC) accelerate their production of standards, there is evidence of a trend among European





nations and in developing nations to diminish their individual production of standards and adopt as their national standards ISO-IEC international standards. As the drive in Europe for harmonization of electrical and electronic standards accelerates, it appears that the standardization efforts of European countries are shifting from the writing of national standards to the writing of IEC standards. Already, European nations are issuing IEC documents as national documents, sometimes by reference, sometimes by placing them under a new cover giving national identity, and sometimes by incorporating minor editorial changes. Furthermore, as the European delegates recognize and attach more importance to their common interests, they can be expected to approach unanimity in their viewpoints, with the possibility of bloc voting by the CENEL membership at IEC meetings. In the more highly industrial nations this trend emerges in the form of a leap-frogging action. In the case of Holland, for example, the standards-setting body in certain instances now

TABLE I. IEC Recommendations

1906–1938	60 issued, 14 revised since 1950, 3 still active, the remainder superseded or discontinued.	*Percent* 1
1938–1949	None issued	....
1950–1954	13 issued, 4 revised	3
1955–1959	53 issued, 16 revised	13
1960–1964	94 issued, 32 revised	24
1965–1969	272 issued, 42 revised	59
Total 1950–1969	432 issued, 94 revised	100

TABLE II. ISO Recommendations

		Percent
1950–1954	11 issued	1
1955–1959	126 issued	10
1960–1964	283 issued, 1 revised	23
1965–1969	786 issued, 36 revised	66
Total 1950–1969	1206 issued, 37 revised	100

skips the development of a national standard. In participates strongly in the development of the international standard and then adopts the result as a national standard. In the United Kingdom and Germany a similar approach is developing.

3. In the United Kingdom the process of metrication is being used as an occasion to "clean house" with regard to standards and related industrial practices. Old standards of diminishing usefulness are being discarded rather than translated into metric language (SI Units). Product lines are being redesigned on the basis of simplified practices based on systems of metric preferred number dimensions. Production costs will thus be reduced and competitive commercial positions improved. As Lord Ritchie-Calder, the Chairman of the British Metrication Board, has explained:

> "There are, of course, many good reasons for going metric. I might mention the great opportunity which metrication offers to increase efficiency through technical innovation, modern precision, improvement in design and rationalisation. I think we here will all agree that at the moment there is an incredible clutter, like going into a lumber room, or even an archaeological spoil-heap, and trying to fit the past into the future. The scope for improvement is enormous. For example, I have been told that one large company expects to reduce its range of fasteners from 405 sizes to under 200. Another company will replace more than 280 types of imperial size ball races with 30 types of metric ball races. What we are talking about is the opportunity which going metric gives to eliminate wasteful duplication in design and manufacture, and also in stock holding, because of the need to accommodate customers still using imperial sizes. This will very quickly mean substantial, and in some cases very substantial, reductions."

As other nations go metric, similar housecleaning is likely. Metrication, of course, does not require or insure the elimination of outmoded standards, but it provides an incentive and an opportunity.

4. The Tripartite Agreement, mentioned earlier, contemplates that a group of nations (three to begin with) will be formed for purposes of facilitating international trade among the member nations of the group. The standards to be used by the group shall be those of ISO or IEC, insofar as they are available. Producers in each member nation shall maintain quality assurance practices and testing methods agreed upon by all. A product may be certified by any one member nation as having met an agreed quality practice and testing

by an approved method. Such a certified product will then be acceptable without further test or question in all member nations of the group.

This seemingly complicated system for international approval of products could actually greatly simplify and facilitate trade, especially in products of high technological content. How far this plan will go is not ascertainable at this time. The European Economic Community (EEC) has already proposed over twenty major products or product areas to which applicability of the plan will be studied. Many of these are areas in which the United States has a large export trade.

Again, it must be emphasized that the plan does not require adherence to a particular measurement system and the U.S. could probably belong, if it is willing to meet the other requirements relating to product evaluation and certification.

Examination of the dynamic environment would be incomplete without a look at the domestic scene, including some earlier unsuccessful efforts to improve U.S. participation and effectiveness in international standards.

D. American National Standards Institute (ANSI)

In 1966 the USA Standards Institute, now known as ANSI, was established. This provided an impetus for increased U.S. participation in ISO and IEC activities, and this participation has grown to the point where ANSI states that at the present time "The U.S. is represented in all ISO committees where the U.S. industrial interest provides reasonable justification." Other aspects of ANSI involvement deserve attention.

1. Participation in ISO committee activities by itself is not enough; it must be effective. Effectiveness can only be determined by a complete analysis on a committee-by-committee basis.

2. Private support by member companies pays for ANSI operations, but this support is diminishing and there appears to be a lack of understanding among these members of the administrative costs faced by ANSI in support of technical delegations to the ISO and IEC. Also, ANSI enjoys neither government financial support nor the official recognition that is characteristic of its counterparts in other nations. In countries such as France, Germany, and the U.K., for example, the government provides such support and official recognition to its standards institution.

3. Due to the financial squeeze, participation in some 25 technical committees is being reviewed to see how many can be dropped or curtailed along with several secretariats. The United States now participates in 91 of the 131 ISO committees.[8]

4. ANSI is primarily responsive to the needs of its voluntary industrial and other memberships and is not subject to government regulation or control in connection with voluntary standards, an arrangement that has the advantage of greater flexibility.

5. At the present time in the United States there is not sufficient authority vested in the standards-making organizations or representatives of industry who work and negotiate in international standards activities to commit the

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[8] See appendix 4.

nation to modify its standards constructively with ISO or IEC standards recommendations. In many instances, U.S. participants approve ISO standards which do not conform to U.S. domestic standards because the U.S. participants recognize the need for an international standard for use by other countries. In some instances, the international standard may be inferior to the U.S. standard. In other instances, it may have more severe requirements than are felt to be necessary in the U.S. And in still other cases the metric aspects of the standard may not be at all applicable in the U.S. market place. In general, there is a *laissez faire* attitude on the part of U.S. participants.

E. Legislation

Serious, but unsuccessful, attempts within the Congress have been made in the last few years to provide better support for U.S. participation in the development of international standards.

On August 30, 1966, H.R. 17424 was introduced in the 89th Congress, 2nd Session. An identical bill, H.R. 17598, was introduced on September 8, 1966. In the Senate, S.3791 was introduced on August 31, 1966. The declared purpose of these bills was "to promote and support adequate representation for United States interests in voluntary international commercial standardization activities and to authorize the establishment and support of appropriate central information clearinghouses for commercial or procurement standards and standards activities for the benefit of producers, distributors, users, consumers, and the general public."

Hearings were held on the House bills by an ad hoc Subcommittee of the Committee on Science and Astronautics on September 20, 21, and 22, 1966. Dr. J. Herbert Hollomon, Assistant Secretary of Commerce for Science and Technology, testified in favor of this legislation on September 20, 1966 (the transcript of his comments appears on pages 8-27 of the record of the hearings). The Committee, however, did not report out either of the bills.

Again, in 1967 bills were introduced in the 90th Congress (S.997, H.R. 1213 and H.R. 6278). No action, however, was taken on these bills.

In each of the annual submissions by the National Bureau of Standards to the Department of Commerce from 1965 to 1969 on proposed legislative items, support was voiced for passage of legislation to promote greater U.S. involvement in international standards activities. In late 1968 the proposed legislation was redrafted in the form of a concurrent resolution of the Congress. The resolution would express the sense of the Congress that the U.S. should participate vigorously in international standardization activities to promote compatibility between voluntary international standards and the standards followed in this country, and thereby facilitate broad domestic access to international trade. To date, the proposed legislation has not been submitted to the Congress.

IV. EVALUATION AND CONCLUSIONS

Because of the stress on international trade to be found in the legislative history of the Metric Study Act, an analysis of some pertinent statistics will be helpful.

In 1969, the Gross National Product (GNP) of the United States was $931 billion; exports were $38 billion and imports were $36 billion. U.S. exports thus amount to approximately 4% of the GNP. Comparable figures for other nations show a much larger percentage involvement in foreign trade: Japan, 9.6%; England, 16%; W. Germany, 14.5%; France, 11.5%. In absolute amount, however, the U.S. leads the world.

An attempt has been made to estimate the fraction of imports and exports that could be considered measurement-standards sensitive. In terms of what are considered reasonable criteria to the Metric Study Group, some 455 classes of manufacturing from the Standard Industrial Code (SIC) have been identified as measurement-standards sensitive. Examination of trade statistics shows that these 455 classes accounted for $11 billion of exports and $4 billion of imports in 1969. Thus, in terms of exports and imports that are measurement-standards sensitive, there was a favorable balance of $7 billion for the U.S. in 1969. There is clearly much at stake in the export and import of these kinds of products, although the extent to which the measurement-standards factor affects the trade balance is unknown. The U.S. Metric Study is currently surveying a sample comprising 750 firms in these 455 SIC categories to see how these firms in their expert judgment assess the impact of measurements and standards in their foreign trade.

In addition to the question of international trade, certain other factors need to be considered. These may be grouped into three related, but somewhat independent, categories, as was pointed out in chapter III.

(1) Those that relate to the measurement language.
(2) Those that relate to standards development and harmonization.
(3) Those that relate to standards utilization and application.

An understanding of the relationships between these three goups is essential to a proper interpretation of the events and trends that have occurred in the world of measurement and standards.

INFLUENCE OF COMMON LANGUAGE ON STANDARDS

Having a common measurement language based on identical units encourages standards harmonization but does not insure it. For example, in the electrical field, where there has been complete international agreement on the units to be used, differences in practice and convention continue to cause difficulties. These would not disappear, even if the United States were to convert to metric throughout the society, because in the electrical field the U.S. is *already* metric. Thus, despite universal metric usage in the electrical field, there are different electrical standards in the world. U.S. delegates have had to persist in arguing against provisions in standards that would favor the 50 hertz (cycles per second) and 220 volt electrical distribution system commonly used in Europe, just as they have had to argue for equal treatment of the inch and the meter. Thus, in spite of the common measurement language (both sides of the Atlantic use the hertz and the volt), the U.S. emerged with a 60 hertz, 110 volt system. With the extensive body of practice that has built up around each, changing either would involve a whole continent. This is a clear case where international agreement was needed *before* practices became firmly established around separate national standards, and yet there was *no* difference in measurement language. The world now lives with two sets of electrical standards, both based on the metric system, and manufacturers must meet each if they wish to deal in both markets.

Differences in such things as symbols, wire color conventions, and instruction manuals continue to cause problems that could discriminate against products manufactured in the United States. Sometimes these differences are not resolved. European and American color television standards are a good example. Differences in these standards were dramatically emphasized when satellite communication became possible. Complex converters had to be introduced to allow interchange of programs. Moreover, U.S. television programs cannot be taped here and fed directly into transmitters of European origin. One important U.S. industrial executive has asserted that the failure of the Europeans to adopt a color television system compatible with ours cost U.S. industry many millions of dollars.

Different attitudes toward acceptable levels of risk in safety standards may result in such divergent points of view that the issuance of a safety standard may be long delayed, or permanently stalled. Although engineering standards are supposedly developed by resolving purely technical questions, in fact they are arrived at through the reconciliation of conflicting economic interests, each usually committed to a particular set of engineering practices. Thus, the strength with which an advocate argues is often affected by the relative technological strength of the industry in his country, trade balances and other economic factors, political matters, national pride and prestige, and questions of national security. And as we have seen in the electrical case, it must not be assumed that the adoption of a single system of units of measurement will automatically bring about agreement in all areas of standardization. The electrical example shows, in fact, how harmonization of standards can fail in the absence of timely international collaboration, even though a common measurement language may have existed throughout the span of technological development.

The whole purpose of harmonization is to arrive at compatible or identical standards and to describe them in whatever language is necessary. The above examples demonstrate that the existence of a common language of measurement is not enough to assure harmonization. Moreover, it should be noted that the continued existence of harmonizing bodies is evidence that harmonization can be and is achieved in spite of measurement language differences.

UTILIZATION OF STANDARDS

In the absence of some means to insure the application and use of a standard, its mere existence is of little value. Clearly, the U.S. voluntary system and the emerging worldwide voluntary system provide no legal sanctions or penalties, except in those designated cases involving health and safety.

The ultimate basis for adoption and use of standards is product survival in the market place, domestic or international. A superior product at comparable price or an equivalent product at a lower price gets wide acceptance. Wide sale of a product gives the components or materials of which it is made a wider share of the market and automatically brings their existing standards into wide use. In fact, through such circumstances, the standards for the components become de facto national or even international standards.

Many U.S. products enjoyed this kind of strong position in world markets for some time. As a consequence, there resulted in some circles an arrogant or at least unwise point of view, reflected in such statements as "Why should I worry about international standards? My product is clearly superior, and if they want it, they can accept my domestic standards." In such a situation the good product drives the poorer from a free market. Hardware for oil exploration and drilling and automobile wheel rim sizes are cases in point. The inch-based U.S. national standards in these two cases have become accepted worldwide, even though most countries use metric language to describe them.

However, where products built to different standards are truly competitive (i.e., one is not clearly superior to the other or market controls do not work against one to the advantage of the other), other mechanisms come into play. In the case of dimensional standards, mismating in the assembly process makes non-standardization obviously disadvantageous and market rejection automatic. And as has already been noted, government intervention can impose restrictions or assure compliance in cases relating to health and safety.

In the case of standards of quality or performance (i.e., non-dimensional standards) the lack of compliance is usually not so obvious.[9] Some form of testing or standardized evaluation of quality control procedure is required, usually on a sampling basis. For the more sophisticated technological products of today, product evaluation or quality control is expensive. Any means whereby the testing procedures and costs can be reduced contributes to the competitive advantage of the product. One obvious means to reduce testing is to certify the products found to meet standards so they need not be tested again. In the United States, the Underwriter Laboratory seal of approval is such a certification for certain products. In the absence of such a seal of approval, imagine the costs if every store or distributor or consumer had to check appliances and other products to see if they met standards.

INTERNATIONAL STANDARDS ISSUE DIFFERENT FROM ISSUE OF METRICATION

The Metric Study, by virtue of the relation between metrication and standardization, must and does become involved with the larger problem (including non-metrication aspects) of standards development, harmonization and utilization in trade.[10] Important as this standards problem is, however, it fails to include other important issues that must be considered in making any decision with respect to metrication.[11]

The two problems intertwine because they have aspects in common and are thereby coupled. Figure 3 indicates the relationship, although not necessarily the actual extent of overlap.

Issues and problems of quality assurance and certification against a set of international standards and their relation to U.S. industry, consumers, and economic development are clearly outside the scope of the Metric Study.

Yet the development of a workable set of international standards that will cause minimal inconvenience to our technology and practices and provide a proper basis for world markets does depend to a degree upon our measurement usage and falls clearly within the scope of the Study. Fortunately, however, the coupling is loose enough so that the issues and problems associated with standards development and enforcement need not await resolution of the central issues of the Metric Study.

METRICATION ISSUE OPEN

The facts, events, and trends highlighted in this report are not sufficient to settle the issue of metrication in the United States. They do show, however, that metrication would tend to make standards harmonization less difficult and expensive, and they also show that it would be illusory to expect metrication alone to lead directly to harmonized standards. Our technological standards and practices, whether metric or English-based, can be

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[9] See appendix 4.
[10] See appendix 4.
[11] See appendix 3.

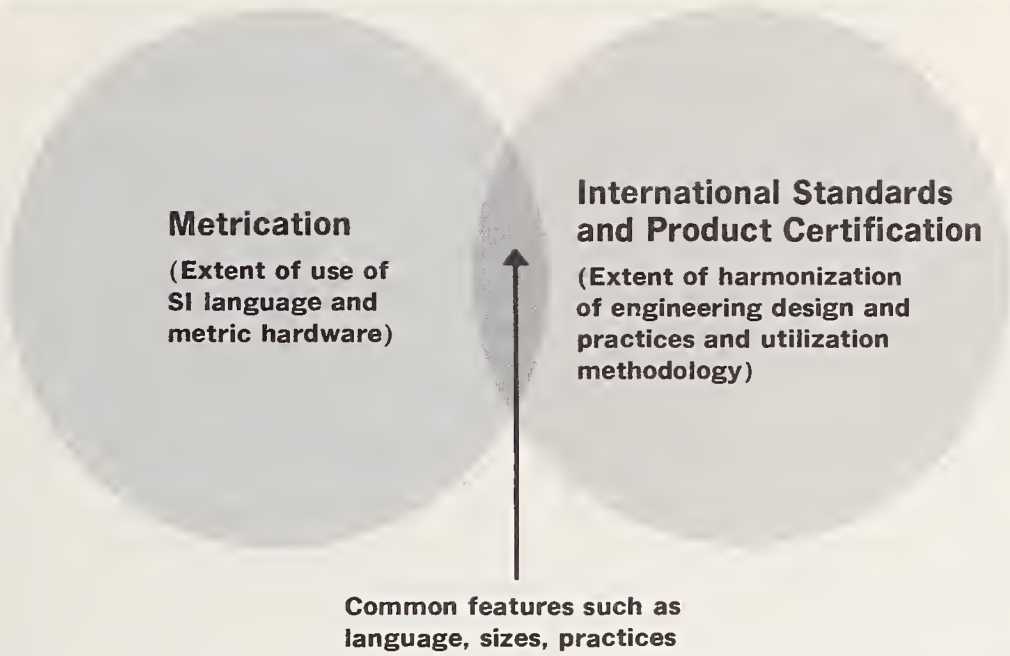

FIGURE 3

fostered and promoted only by adequate representation and participation in the organizations which set them and enforce them. We thus reach the following conclusions:

> *Conclusion 1:* The international standards issue lends some support to a metric conversion in the United States, but other important issues must also be considered and weighed before an overall judgment can be made.
>
> *Conclusion 2:* The Metric Study cannot and should not be expected to provide answers for the non-metric issues raised by the events and trends described in this report.

CRITICAL DECADE AHEAD

From the U.S. point of view, the next decade will be the critical one in the international standards development process. Almost all (90%) of the international standards needed for a technological world economy remain to be established. The ISO and IEC, in spite of their past cumbersome and, to some degree, inefficient ways, have demonstrated a remarkable increase in output in the last 15 years—about a 2-1/2 to 3-fold increase every five years. Continuation of this pattern of accelerated output should give a reasonably sufficient repertoire of standards in another ten years. This leads to a third conclusion:

> *Conclusion 3:* If the U.S. wishes to see the maximum amount of its engineering practices and standards included in the coming international standards, it must, without delay, take steps for adequate and effective participation in international standards negotiations.

Two points about this third conclusion require emphasis:

a. The question of the extent to which participation in international standardization is in the best interest of the United States must be decided on the basis of considerations that are beyond the scope of the U.S. Metric Study.
b. This decision need not (and should not) await the outcome of the Metric Study.

STANDARDS COMPATIBILITY WOULD FACILITATE METRICATION

As has been stressed throughout this report, the most difficult and costly aspect of metrication has to do with changes in the physical embodiment of things and other features determined by engineering standards. Consequently, if the need for such changes is reduced, the cost of metrication would be lessened, too. One way to reduce the need for such changes is to make U.S. engineering standards more compatible with international recommendations. It follows that since increased and more effective U.S. participation in international standards-making activities would tend to reduce the degree of incompatibility between our standards and those that are internationally recommended, the costs of metrication in the U.S.—*should* this course be followed here—would be reduced. A fourth conclusion may therefore be stated:

> *Conclusion 4:* If the United States increases and makes more effective its participation in international standards-making activities, then the degree of incompatibility between U.S. domestic standards and international recommendations would be reduced, and *a U.S. metrication program would be facilitated,* should we take this course.

BALANCE OF PAYMENTS

The balance of payments includes importantly, but is not limited to, the export-import trade balance. An unfavorable export-import trade balance of $1 billion for a year or more is at the present time considered serious enough to invoke corrective actions (e.g., tourist restrictions).

Yet, as we have noted, U.S. exports estimated to be measurement-standards sensitive account annually for a $7 billion net balance against similar imports. A fifth conclusion therefore appears warranted.

> *Conclusion 5:* Relatively modest changes in the import-export pattern of measurement sensitive goods can have a serious impact on the U.S. balance of payments. Hence, the relation between standards, standards utilization and trade should be the subject of careful study to develop the policy basis for U.S. participation in international standards development and utilization.

This must be done promptly to take advantage of the critical decade we are now entering. The International Trade Survey now being conducted as a part of the Metric Study should give some important information on the subject.

PRODUCT CERTIFICATION

Perhaps the most important aspect of engineering standards is the way the participating nations make use of them. Ideally, complete harmonization of all national standards into a working set of international standards could pave the way for a free and competitive world market, provided the participating nations strive for such a market. International standards provide a means for fostering or hindering trade; in the latter case, as a non-tariff trade barrier. Product certification, coupled with international standards development, may be used to open or shut markets. The Tripartite Agreement and associated events indicate that the nations involved are well aware of the possible advantages of the standards-certification scheme and are moving to utilize it.

To be effective, the product certification provided by the authorized institution in each nation, must be based upon a common set of standards. The international standards produced by the ISO and the IEC form a most obvious beginning and are the basis of the present product certification agreement. But they are not essential. Any set agreed upon can be used. Whether U.S. practice and standards will be compatible with the international standards will depend upon the extent and success of U.S. participation in the negotiations, *if* it elects to expend the additional effort.

The required certification of compliance with the applicable standards is the crucial issue for the United States. The rules of the Tripartite Agreement require each nation to have an authorized institution for the certification procedures. Moreover, the institution must speak for its own government, and be acceptable to the other nations. The central benefit of membership in this scheme is that full faith and credit is given by member countries to the certification of any member. A certification in one is good for all. It is not yet certain that the U.S. will be accepted for membership even if it meets the requirements, which at present it is not undertaking to accomplish.

On the other hand, products of *non*-member countries are placed at competitive disadvantage because they must be tested and certified before entry into the market is permitted. As a beginning, the Tripartite Agreement is being tried on electronic components with IEC standards. If, however, there are indications of success in the electronic area, some twenty other product classes are under consideration for similar treatment using ISO standards.

This certification scheme leaves the United States with two choices if it wishes to continue exporting subject products to certification countries:

(1) To enter into and fulfill the requirements of the certification agreement, or
(2) To make products clearly superior to the certification standards (as judged by the customers and the acceptance officials) and to insure that the export products do, in fact, meet the superior standards.

If the U.S. makes choice (1) but does not participate actively in the standards development process in IEC or ISO, it will be faced with *metric-*

based standards that must be met. However, if it does participate fully in the development of ISO and IEC standards, it can achieve at least some compromises that are favorable to the U.S.

If it makes choice (2), it can unilaterally use its own national standards based upon any convenient measurement system. But this requires maintenance of superior technology, superior products for international trade, and some means to see that inferior products are not allowed to be exported to certification countries. Meeting the first condition would be difficult enough, for the U.S. is no longer unchallenged in the technological arena—the easy front runner that it was, for example, in the case of transistors and integrated circuits. Only in a fraction of cases can choice (2) be expected to function.

Thus, there emerges an answer to a stated requirement of the Metric Study Act to "study" the feasibility of retaining and promoting by international use dimensional and other engineering standards based upon the customary measurement units of the U.S. The feasibility of such action turns essentially upon negotiations to harmonize U.S. standards with those of other nations. The international use of standards based upon U.S. customary units will stand or fall upon (a) the success of negotiations, (b) clear product superiority, and (c) some basis for insuring that our exports can be accepted as conforming to clearly stated standards without the costly burden of additional testing.

Additional conclusions can now be stated:

Conclusion 6: SI usage in international standards as a language does not of itself pose any serious complications to the U.S.

Conclusion 7: Product certification emerges as a primary consideration in the utilization of standards.

Conclusion 8: Some product certification scheme for exports will probably be required to maintain a competitive position if European plans are successful. It can be either a plan compatible with those now developing in Europe or a distinctively U.S. approach, conceived to provide adequate assurance that U.S. export products meet a set of explicitly stated standards.

Conclusion 9: If the U.S. elects to certify products in terms of IEC-ISO standards, it must recognize that the critical decade of standards development is here and take the necessary steps for participation.

INDUSTRIAL STRATEGIES

If it should emerge that the international standards situation places classes of U.S. products at a disadvantage in foreign markets, U.S. firms can be expected to develop counter-strategies. In fact, some firms are already doing this.

The electronic components industry illustrates three points of view that depend upon the nature of the company.[12] The point of view of the U.S.-

[12] Based upon an analysis by the Deputy Assistant Secretary of Commerce for Product Standards.

based manufacturer who exports his products to Western Europe is that the certification scheme (under the Tripartite Agreement) will adversely affect his business. The view of the U.S. manufacturer with a subsidiary in Western Europe (with partial manufacturing facilities) is that he is concerned, but his remedy is to move the balance of his manufacturing to Western Europe. The point of view of the U.S. subsidiary having an integrated manufacturing facility in Western Europe is that he is for the certification scheme and sees that it will cut his costs of doing business.

This divergence in viewpoint, if found to be characteristic of U.S. industry generally, may well emerge as a roadblock to full U.S. participation in international standards development and a threat to the long standing free trade policy of the U.S. Government.

V. RECOMMENDATIONS

The specific conclusions reached in the preceding analysis lead to one general conclusion: The environment in which the Metric Study is enmeshed has not been static; rather, it has been changing as a result of the events and trends that have been identified in this interim report. These have presented an international standards problem that is broader than the issue of metrication. It is a problem that needs attention now, at the opening of a critical decade for the development of international standards.

Possible courses of action with respect to this problem include:

(1) Increased participation by the United States in the development of international standards.

(2) U.S. adherence to an international agreement requiring product certification procedures.

(3) A unilateral plan of standards and product certification by the United States that is compatible with emerging international schemes and aimed at keeping a good competitive position for the United States in international trade.

Action is needed to develop a U.S. policy and strategies to implement it, and such action should not await the outcome of the Metric Study. Accordingly, the following recommendations are made:

1. The Department of Commerce should take appropriate steps to determine whether the economic impact of agreements such as the Tripartite Agreement can be expected to affect the U.S. balance of payments significantly or otherwise work against the best interests of the United States.

2. The Department of Commerce should devise, in concert with other interested Federal agencies and responsible standardizing institutions, a

firm U.S. policy about participation in international standards activities, including what role the Government should play and provisions for furthering the public interest as well as the competitive position of U.S. Industry in world trade.

3. If such a policy dictates increased participation, appropriate steps should be taken to see that such participation is sufficient to meet the rapidly increasing international standardization activities that have been predicted for this decade.

4. The Department of Commerce should, in concert with other interested Federal agencies, initiate action to determine whether or not the United States should participate in international product certification agreements. If adherence to such agreements is deemed desirable, an appropriate mechanism for certification within the U.S. should be developed. If adherence is not believed warranted, the U.S. should ensure that an appropriate alternative strategy is devised and followed.

5. Finally, the action indicated above should be taken without awaiting the outcome of the U.S. Metric Study, but drawing upon it for relevant information.

Appendix 1

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* The principal participating agencies are the National Bureau of Standards and the Bureau of Domestic Commerce in the Department of Commerce, and a special study team in the Department of Defense. In addition, over 30 other independent Federal agencies and departments are participating in the U.S. Metric Study.

Appendix I

Public Law 90-472

An Act

82 STAT. 693

To authorize the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Commerce is hereby authorized to conduct a program of investigation, research, and survey to determine the impact of increasing worldwide use of the metric system on the United States; to appraise the desirability and practicability of increasing the use of metric weights and measures in the United States; to study the feasibility of retaining and promoting by international use of dimensional and other engineering standards based on the customary measurement units of the United States; and to evaluate the costs and benefits of alternative courses of action which may be feasible for the United States. Metric system. Study.

Sec. 2. In carrying out the program described in the first section of this Act, the Secretary, among other things, shall— Investigation and appraisal requirements.

(1) investigate and appraise the advantages and disadvantages to the United States in international trade and commerce, and in military and other areas of international relations, of the increased use of an internationally standardized system of weights and measures;

(2) appraise economic and military advantages and disadvantages of the increased use of the metric system in the United States or of the increased use of such system in specific fields and the impact of such increased use upon those affected;

(3) conduct extensive comparative studies of the systems of weights and measures used in educational, engineering, manufacturing, commercial, public, and scientific areas, and the relative advantages and disadvantages, and degree of standardization of each in its respective field;

(4) investigate and appraise the possible practical difficulties which might be encountered in accomplishing the increased use of the metric system of weights and measures generally or in specific fields or areas in the United States;

(5) permit appropriate participation by representatives of United States industry, science, engineering, and labor, and their associations, in the planning and conduct of the program authorized by the first section of this Act, and in the evaluation of the information secured under such program; and

(6) consult and cooperate with other government agencies, Federal, State, and local, and, to the extent practicable, with foreign governments and international organizations.

Sec. 3. In conducting the studies and developing the recommendations required in this Act, the Secretary shall give full consideration to the advantages, disadvantages, and problems associated with possible changes in either the system of measurement units or the related dimensional and engineering standards currently used in the United States, and specifically shall— Results of changes in measurement system.

(1) investigate the extent to which substantial changes in the size, shape, and design of important industrial products would be necessary to realize the benefits which might result from general use of metric units of measurement in the United States;

(2) investigate the extent to which uniform and accepted engineering standards based on the metric system of measurement units are in use in each of the fields under study and compare the extent to such use and the utility and degree of sophistication of such metric standards with those in use in the United States; and

(3) recommend specific means of meeting the practical difficulties and costs in those areas of the economy where any recommended change in the system of measurement units and related dimensional and engineering standards would raise significant practical difficulties or entail significant costs of conversion.

Sec. 4. The Secretary shall submit to the Congress such interim reports as he deems desirable, and within three years after the date of the enactment of this Act, a full and complete report of the findings made under the program authorized by this Act, together with such recommendations as he considers to be appropriate and in the best interests of the United States. Report to Congress.

Sec. 5. From funds previously appropriated to the Department of Commerce, the Secretary is authorized to utilize such appropriated sums as are necessary, but not to exceed $500,000, to carry out the purposes of this Act for the first year of the program. Funds.

Sec. 6. This Act shall expire thirty days after the submission of the final report pursuant to section 3. Expiration date.

Approved August 9, 1968.

Appendix 2

U.S. Department of Commerce
National Bureau of Standards

METRIC SYSTEM STUDY ADVISORY PANEL[13]

CHARTER

Preamble

Public Law 90-472 authorizes the Department of Commerce to undertake a study of the advantages and disadvantages of increased use of the metric system in the United States. The Secretary of Commerce has assigned responsibility for carrying out the study to the National Bureau of Standards. Section 2 (5) of the Act states that the study should:

> ". . . permit appropriate participation by representatives of United States industry, science, engineering, and labor, and their associations, in the planning and conduct of the program . . . and in the evaluation of the information secured . . ."

The objectives of the Advisory Panel shall be to permit such participation by representatives of all segments of the economy.

Establishment

The Metric System Study Advisory Panel is hereby established to permit the participation of representatives of industry, science, engineering, and labor as directed in Section 2 (5) of the Act. The Panel will serve in an advisory capacity to the Secretary of Commerce, the Director of the National Bureau of Standards, and the Metric System Study Group.

* * * *

s/Rocco C. Siciliano

Date: May 16, 1969

Acting Secretary of Commerce

[13] Informally referred to as the "National Metric Advisory Panel."

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[14] Member of the executive committee, which serves as the working group for the advisory panel and is convened, upon call of the Chairman, between meetings of the full panel. The full panel meets approximately four times per year.

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Appendix 3

THE U.S. METRIC STUDY PLAN

The Metric Study Act proposes for investigation a set of questions having implications in almost every aspect of our domestic life and conditioning our external behavior in the community of nations.

A nation's measurement usage is both a part of its language and, in a sense, a way of life. It is a special element of the parent language, mostly technical, relating to quantitative expression of our observations of the world around us. Like the rest of the language, it has its idioms, dialects, and semantic problems. In common with its parent language, it finds translation a nuisance and susceptible to error. Moreover, each user believes his language is the best and wishes all others would cooperate by using it. Differences can be tolerated and adjustments made. But this sub-language of measurement has developed, by virtue of its relative simplicity, a unique aspect: It appears feasible for the whole world to use one common sub-language of measurement, and most of the world is gearing up to do just that. One need not dwell upon the well-known advantages of a common language, nor upon the equally well-known problems of changing a lifetime of usage to a new one.

As a way of life, the consequences of measurement affect us in complex and diverse ways. Measurement usage comes to determine not only the way we communicate among ourselves, but also the sizes or other characteristics of things we make and the recipes or machines we use for making them. On the language or communication side, we deal with thought processes and the spoken or written expressions of them, conveniently summed up in the modern expression, "software." In contrast is the term "hardware," an expression of broad general scope relating to the physical entities we make and use: things such as refrigerators, automobiles, radios, shoes; and materials such as steel, rubber, silicon crystals, candy.

Changing software involves one class of actions, as we have seen. Changing hardware is something else, and involves, for example, changing machines, reorganizing systems, revising engineering practices, or even modifying the levels of safety and performance we may prescribe.

Consequently, when a change in measurement usage is under consideration, it must be made clear whether the change involves software only, hardware only, or both. History is replete with highly emotional and inevitable conflicts arising from such lack of specificity. "Conversion to the metric system" has come to mean change to forms of hardware characteristic of the uses of metric language. Others use the term to mean software changes only and bring upon themselves the wrath of those who fear hardware changes, but might well tolerate a software change. Strict care in this regard is an essential ingredient of a study plan. The Metric Study Act avoids the sometimes inflammatory terms "conversion," and instead uses the expression, "increase in metric usage."

Though not used in the Act, metrication is a convenient term to indicate generally what is under consideration. It means, for purposes of our study, any act tending to increase the use of the metric system (SI), whether it be increased use of metric units or engineering standards based on such units. It should be noted here, too, that the metric system of measurement, like any other language, has its dialects. Hence, unless otherwise specified, whenever there is reference to the "metric system" in our study, we mean the modernized metric system known as "SI," the International System of Units (see the attachment to this appendix for details).

In actual practice, metrication usually involves a mix of changes in language (units) and hardware (engineering standards). Thus, for example, the mix specified for the Metric Study is given in the instructions for questions 12, 13, 14 of the Manufacturing Industry Questionnaire included in appendix 5.

Immediately following passage of the Metric Study Act, implementation of its provisions for public representation and participation began. An Advisory Panel was appointed by the Secretary of Commerce as one means "to permit appropriate participation by representatives of United States industry, science, engineering, and labor, and their associations, in the planning and conduct of the U.S. Metric Study and in the evaluation of the information secured." [15] In addition to this involvement in the study, a comprehensive series of national hearings—conferences was devised to give all relevant sectors of our society an opportunity to participate.

The blueprint for the Metric Study was forged in complete cooperation with the Panel, beginning in September 1969 with its chairman, and continuing on through December 1969, when the final plan was endorsed by the Panel's executive committee. It should be noted that throughout this period there were invaluable contributions by the Panel in its joint effort with the U.S. Metric Study Group to arrive at a workable plan that would lead to worthwhile results. Moreover, the Panel, through its intimate contacts with the various sectors of the society, continues to be an active partner in the data gathering phase.

Formulation of the Study plan began with an interpretation of the general objectives stated in the Act. This led to the construction of a more specific set of undertakings that would yield the desired information:

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[15] The membership of the Advisory Panel is given in appendix 2.

(1) Identify the impacts upon the U.S. that can be attributed to metrication in the world.
(2) Evaluate these impacts in key sectors of the society.
(3) Determine what adjustments are now taking place in these sectors.
(4) On the basis of realistic assumptions, examine feasible courses of action for the U.S., involving no national coordination on the one hand, and a coordinated national program toward metrication on the other.
(5) Evaluate each proposed course of action for its likely future impact upon the relevant sectors of our society and upon our national security and international trade.
(6) Evaluate feasible courses of action not involving metrication (such as an effort to expand the use of U.S. inch-based standards internationally).

In this connection consider carefully

(a) Why among all the major nations of the world has not the U.S. already found it necessary or desirable to metricate?
(b) Is U.S. action other than metrication warranted?

(7) Prepare a report indicating the alternatives considered, the various sectors of the society that were studied, findings and evaluations; and structure the report so that the results can be presented to the political decision makers, executive and legislative, for final resolution.

In short, the interpretation of the Metric Study Act can be characterized thus:

(1) Identify and evaluate impacts upon the U.S. attributable to metrication in the world.
(2) Propose realistic and feasible courses of action for the U.S. to follow, including but not limited to those involving probable concerted metrication on our part.
(3) Identify their probable future impacts and evaluate them similarly.
(4) In the search for impacts consider our international activities as well as all relevant domestic sectors.

The resulting Study Plan included a preliminary phase in which likely major impacts were identified, their target sectors designated, some relevant courses of action developed, and their likely impacts estimated. The preliminary phase permitted informed judgments to be made, upon which the main strategy for the Study could be based. Without this basis, the Study would rapidly have ballooned into a vast undertaking utterly impossible to complete.

The main strategy involves:

(1) Completion of impact determinations begun in the preliminary phase for the purpose of selecting courses of action and identifying likely target sectors.
(2) Investigation and evaluation of costs and benefits, in these target sectors, of the proposed courses of action.

Practical constraints limit the alternative courses of action to a very few and the target sectors to a small but reasonable number. This is in accordance with the intent of the Congress, as expressed in the legislative history of the Metric Study Act.

THE ALTERNATIVES

Alternative One is for the government to do nothing, which means in this case, to allow events to develop with no overt formal action to alter the pattern of voluntary adjustments now emerging. As we have seen, this pattern is leading to limited metrication and must be considered as a course of action, certainly feasible, leading to metrication.

Another possibility, but not to be entertained, is to arrange for some mandated action to *reverse the trend* toward metrication, in favor of a return to more complete use of "customary" hardware and software. Since this would be impractical, to say the least, and would further isolate the United States from the rest of the world, it is believed neither desirable nor worthy of serious attention. In fact, brief preliminary examination of this possibility brought forth no discerning body of opinion in support of such action. At the conclusion of the preliminary phase, therefore, it was dropped from further consideration.

In writing the Metric Bill, the Congress was careful to avoid giving the impression that instantaneous mandatory conversion was contemplated. No nation that has undergone a metric transition has ever accomplished it in that manner. We do not believe that instantaneous mandatory conversion is a policy alternative that requires serious study and therefore have not included this possibility as an alternative to be studied.

Another possibility is for the government to lead in the adoption of a national plan. Two conversion periods merit attention: 10 years and "opa change on a national level, i.e., to change according to a coordinated national plan. Two conversion periods merit attention: ten years and "optimum," and these lead to alternatives two and three.

Alternative Two: Consider a coordinated national program of metrication, designed to be completed over a 10-year period. Ten years has been selected arbitrarily, but is the period adopted by the British and Australians as the appropriate timetable for this process. New Zealand has opted for 7 years.

Alternative Three: Consider a coordinated national program scheduled at the "optimum" rate. Since many sectors of the economy are deeply interlocked with respect to materials, components, and software, and each may find a different time scale to be a suboptimization of the total economy, the determination of an "optimum" conversion period is a difficult problem to solve. Accordingly, the study plan requires each affected sector of the economy to try to estimate what would be the optimum time scale for *it* to convert, on the assumption that other sectors of the economy have made the necessary changes to permit orderly conversion by the sector in question.

The Study seeks quantitative cost information from selected manufac-

ERRATA

U. S. Metric Study

Special Publication 345–1

The fifth paragraph on page 42 of SP 345–1 which reads:

> Another possibility is for the government to lead in the adoption of a na–
> tional plan. Two conversion perio ds merit attention: 10 years and "op–
> a change on a national level, i.e., to change according to a coordinated na–
> tional plan. Two conversion periods merit attention: ten years and "op–
> timum," and these lead to alternatives two and three.

should be changed to read:

> Another possibility is for the government to lead in the adoption of a na–
> tional policy with respect to adaptation or conversion and to coordinate such
> a change on a national level, i.e., to change according to a coordinated na–
> tional plan. Two conversion periods merit attention: ten years and "op–
> timum," and these lead to alternatives two and three.

The Foreword on page VII

Second line after the word "standard" semicolon to be changed to a comma

turers with respect to metrication in the two time frames indicated, with an expectation that the data will allow some qualitative judgment about the relative merits and costs of different rates of metrication.

These three alternatives comprise the set to be used in the Study. They all involve metrication in some degree and are thus subject to the criticism of being focused too much on metrication. The fact is, however, that this nation has been part metric for more than 100 years and is steadily increasing its metric usage. In the absence of contrary overt action, indications are that it will continue to do so, although sporadically and hesitantly, in the absence of a commitment by the rest of the society to join in the change.

The sectors of our society in which the benefits and costs of these three alternatives are to be assessed include, but are not limited to:

(1) Manufacturing Industry
(2) Nonmanufacturing firms
(3) Department of Defense
(4) Federal Agencies other than military
(5) International Trade
(6) Commercial Weighing and Measuring activities
(7) State and Local Governments
(8) Educational System
(9) Citizens in general and as consumers
(10) Labor
(11) Engineering Standards

Should significant facts or opinions emerge to indicate the need to incorporate other cross sections of our society, these will be incorporated if time and other circumstances permit.

As a practical matter, the Study has been structured into fourteen major activities, essentially related to the sectors of the society listed above, and whose description follows, with an indication of their present status (October 1, 1970).

SURVEYS AND INVESTIGATIONS

1. A general survey of the manufacturing industry through a sample of almost 4,000 firms. The questionnaire used in this general survey asks questions with respect to the current and anticipated use of metric units and metric based standards, advantages and disadvantages to the firm of an assumed program of national metrication, and the firm's positions on possible international and domestic competition and other views regarding metrication.

2. Special cost analyses by over 150 manufacturing firms that have volunteered to estimate, under specified assumptions in a hypothetical program of metrication, the net costs of metrication to them. Each of these cost analyses will try to estimate the net costs with respect to such factors as personnel education; engineering, research, and associated documentation; manufacturing and quality control; records and accounting; standards activities; warehousing; and sales and services.

3. A random-sample survey by telephone interview of some 3,000 non-

manufacturing firms, ranging from agricultural establishments to financial institutions. The questions in this survey differ from those in the survey of manufacturing firms because of the obvious differences in the activities of such firms, but are nevertheless designed to elicit information with respect to the key issues of the U.S. Metric Study.

4. An intensive study by the Department of Defense of the metric study issues in terms of defense readiness and other national security considerations. In brief, the Department of Defense is attempting to estimate the cost of maintaining constant mission capability during an assumed 10-year metrication period and to identify the advantages and disadvantages that may be experienced during and after that period.

5. A survey of some 35 Federal agencies, other than the Department of Defense, to determine the effects of alternative courses of action on the operations of these agencies, as well as on their areas of national responsibility. This survey will try to assemble data as to which Federal agencies use the metric system and to what extent, which of them plan to increase metric usage voluntarily irrespective of any national decision regarding metrication, what the effects would be on agency missions should such a decision be made and put into effect, and what the probable effects would be on the area of national activity (e.g., transportation) for which the agency is responsible.

6. A special study of international trade, which is being conducted by the Bureau of Domestic Commerce of the Department of Commerce. This inquiry will be addressed to over 750 firms that are engaged in the international trade of manufactured products that are "measurement sensitive"—i.e., are more likely to be affected by differences in measurement practices and engineering standards than are, for example, shipments of bulk goods such as grain. Three broad classes of data will be sought. First, questions will be asked as to the foreign operations of the firm. Next, firms will be asked to try to rank the factors that influence international trade, such as superior quality of product, more advanced technology, better financing, better servicing, and to compare these factors with whatever influence a different measurement system may have on exports and imports. Finally, the respondents in this survey will be asked to predict the magnitude of their international trade activities in 1975 under two different assumptions for comparison: the United States as still "customary" (inch-pound) versus the United States as a "metric" (meter-kilogram) country.

7. An analysis of the history of metric debate in this country, which is expected to provide valuable insights. This analysis will provide a historical review (1866-1968) of the legislative activities pertaining to proposals to introduce the metric system into the United States, highlight the campaigns waged by pro- and anti-metric factions during the period, and examine the consequences of these campaigns.

8. A study of commercial weighing and measuring activities at the State and local level and of the problems of converting devices in this field. The purpose of this study will be to estimate the cost of adapting or replacing commercial weighing and measuring devices to record in metric units, determine the practical difficulties that would be experienced in such a changeover, and identify ways and means by which these difficulties could be minimized or at least substantially reduced.

9. An analysis of the other effects that a nationwide program of metrication would have on State and local governments. This analysis will be made by a group[16] representing State, county and city associations and conferences and will focus on the probable effects of a metrication program on State and local government operations in addition to the commercial weighing and measuring activities mentioned above.

10. A study of the consequences that a metrication program would have on the educational system, as well as the positive role that the system would play in such a program. This study is aimed at formal educational activities, including elementary, secondary, higher and vocational education. It will identify advantages and disadvantages that could be expected to accrue in a national metrication program and will attempt to quantify the costs and benefits.

11. A survey to determine the impact of metrication on citizens in general, particularly with respect to consumer activities. This survey will be conducted with a sample of approximately 1,400 family units representative of all family units in the continental United States. It will seek such information as the nature of problems expected to be encountered by individuals if there were a coordinated national program to change to the metric system, what the attitudes and opinions are toward a change, the level of knowledge of the customary system and metric system of measurement, the types of measuring devices and activities that would be affected by a change to metric, and an estimate of the costs involved.

12. An analysis of the likely effects of metrication on labor. This analysis is being conducted in cooperation with organized labor and will focus primarily on worker-owned tools and employee education and retraining. In addition, a special conference on labor will be held as part of the National Metric Study Conferences.

13. A series of seven National Metric Study Conferences to provide an opportunity for representatives of major trade associations, professional societies and other groups to address themselves to the fundamental issues of the U.S. Metric Study. These conferences have been designed to encourage comment from all sectors of the society. Moreover, they are intended as a means for developing, as widely as possible, a deeper appreciation and understanding of the many economic, social, technical, international and political factors that must be taken into account when a society as complex and diverse as ours considers the implications of changing a way of life.

14. A comparative survey of selected U.S. engineering standards and their international counterparts and an analysis of the extent to which the nature of our measurement system is a significant factor in determining the effectiveness of the United States in international standards negotiations. The fields selected for investigation are ferrous metals, nonferrous metals, plastics, rubber, pipe and tubing, antifriction bearings, threaded fasteners, electrical and electronic equipment, and building materials and construction.

When the data from all of the above activities have been received, collated

[16] This group is the State-County-City Service Center and represents the Council of State Governments, International City Management Association, National Association of Counties, National Governors Conference, National League of Cities, and the U.S. Conference of Mayors.

and analyzed, reports will be prepared on the various subjects under consideration: manufacturing, nonmanufacturing, international trade, labor, consumers, education, national security, Federal Government, State and local government, commercial weights and measures, historical analysis, and the seven national conferences. These subjects are not mutually exclusive; nor are they being investigated in isolation or by means of a single source. In the case of education, for example, information is being sought not only by means of interviews and questionnaires, but also through expert consultants and a Conference on Education.

The National Metric Study Conferences deserve special mention, since they were planned to be more than just a means for gathering information. In addition, they were conceived as a forum wherein recognized representatives of the various sectors of our society would be given an opportunity to express their views with respect to the issues posed by the Metric Study Act, in keeping with its call for the widest possible participation in the Study. Moreover, these conferences offer the possibility of developing a national consensus or understanding with regard to the subject at hand. Whatever the ultimate decision of the Congress, such a consensus would be extremely valuable if not indispensable.

All of the inquiries and investigations in the Metric Study will attempt to develop quantitative estimates of the costs and benefits that would likely result under the different assumptions that have been discussed. It needs to be made clear, however, that at best the estimates that will be supplied to us by firms and other sources will, in the aggregate, be inflated with respect to costs and say little about the present net worth of the benefits allegedly to be derived in future years. Moreover, the assembly of aggregative national figures, such as the net effect upon GNP of action or inaction with respect to metrication, will not be possible in the study. Nor will it be feasible for the study to assign weights to the various costs and benefits, even assuming they can be quantified—e.g., what political weights are to be assigned among the costs and benefits associated with, say, national security, education, consumer interests, manufacturing inconveniences, international good will? The assignment of weights in these instances (including the concomitant trade-offs) is the function and prerogative of the President and the Congress. Indeed, it is possible that the ultimate findings of the U.S. Metric Study may be susceptible to conflicting conclusions and recommendations.

Consequently, it would be illusory to expect that the Metric Study will result in a balance sheet having a net sum of costs and benefits upon which the decision to go or not to go metric can be made directly and with confidence. There will be no such sum. In this regard, it is instructive to consider the British view:

> "It is fanciful to attempt any sort of estimate of the cost of metrication to the economy as a whole. Partly because of the nature of the problem and partly because any attempt to assess the cost of metrication involves taking a view of a very varied collection of future decisions, it is difficult to estimate what future expenditure will be incurred, even within an individual undertaking. The costs of metrication are in many cases inextricably intertwined with the cost of much wider changes.

> This would make it impossible, even retrospectively, to determine what proportion of expenditure should be attributed to metrication itself and what to other changes being made at the same time."[17]

Nevertheless, much valuable information will be developed in the 14 surveys and investigations described above and the results of the U.S. Metric Study will more than justify the effort to provide a more solid basis upon which decisions can be made.

What the Metric Study has, in fact, been planned to do is to reduce, to the extent possible with the resources at hand, the many uncertainties that exist with respect to the issue of metrication and to set to rest many of the myths and misunderstandings that are entertained because of these uncertainties.

The reports on each of the surveys and investigations identified will do much to dispel these myths and misunderstandings. These reports are expected to be completed by January 1971 and, after having been reviewed by the Commerce Department, the Study's advisory panel, the Commerce Technical Advisory Board and others, will be synthesized to form the basis for the final report of the Secretary of Commerce to the Congress. The draft of this final report will undergo similar review, and, in addition, review by the President's Science Advisory Committee, following which the Secretary will decide upon his recommendations and submit them, together with his report on the U.S. Metric Study, to the Congress. This submittal will be made in August 1971.

Whatever the outcome of this study, in terms of the choice among alternatives, its fundamental strategy, calling for the widespread participation of all sectors of our society in the resolution of the issues that have been posed, should help to build a national consensus for the ultimate decision. In short, the entire metric study program is in keeping with the traditions of our democracy.

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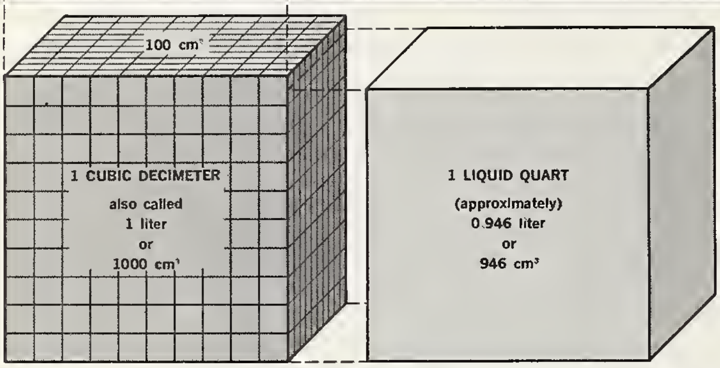
[17] *Going Metric: The First Five Years*, p. 70, Report of the British Metrication Board, 1970.

The Modernized Metric System

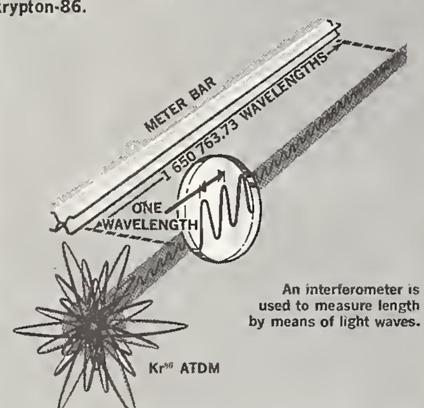


THE International System of Units—officially abbreviated SI—is a modernized version of the metric system. It was established by international agreement to provide a logical and interconnected framework for all measurements in

The Six Base Units of Measurement

Length METER—m

The meter is defined as 1 650 763.73 wavelengths in vacuum of the orange-red line of the spectrum of krypton-86.



The SI unit of area is the square meter (m^2). Land is often measured by the hectare (10 000 square meters, or approximately 2.5 acres).

The SI unit of volume is the cubic meter (m^3). Fluid volume is often measured by the liter (0.001 cubic meter).

National Bureau of Standards Special Publication 304 A

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price 25 cents

References:

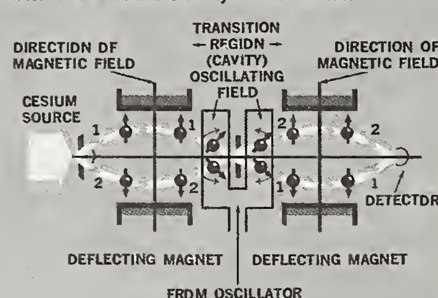
NBS Spec. Publ. 330, International System of Units (in press)

NBS Misc. Publ. 247, Weights and Measures Standards of the United States, A Brief History, 40 cents

NBS Misc. Publ. 286, Units of Weight and Measure, Definitions and Tables of Equivalents, $2.25

Time SECOND—s

The second is defined as the duration of 9 192 631 770 cycles of the radiation associated with a specified transition of the cesium atom. It is realized by tuning an oscillator to the resonance frequency of the cesium atoms as they pass through a system of magnets and a resonant cavity into a detector.



A schematic of an atomic beam spectrometer. The trajectories are drawn for those atoms whose magnetic moments are "flipped" in the transition region.

The number of periods or cycles per second is called frequency. The SI unit for frequency is the hertz (Hz). One hertz equals one cycle per second.

Standard frequencies and correct time are broadcast from NBS stations WWV, WWVB, WWVH, and WWVL, and stations of the U.S. Navy.

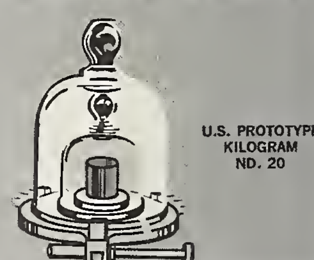
Many shortwave receivers pick up WWV on frequencies of 2.5, 5, 10, 15, 20, and 25 megahertz. The standard radio broadcast band extends from 535 to 1605 kilohertz.

Dividing distance by time gives speed. The SI unit for speed is the meter per second (m/s).

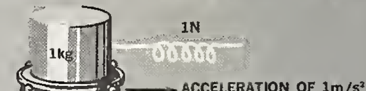
Rate of change in speed is called acceleration. The SI unit for acceleration is the meter per second per second (m/s^2).

Mass KILOGRAM—kg

The standard for the unit of mass, the kilogram, is a cylinder of platinum-iridium alloy kept by the International Bureau of Weights and Measures at Paris. A duplicate in the custody of the National Bureau of Standards serves as the mass standard for the United States. This is the only base unit still defined by an artifact.



Closely allied to the concept of mass is that of force. The SI unit of force is the newton (N). A force of 1 newton, when applied for 1 second, will give to a 1 kilogram mass a speed of 1 meter per second (an acceleration of 1 meter per second per second).



$$1N = \frac{1kg \cdot 1m}{1s^2}$$

One newton equals approximately two tenths of a pound of force.

The weight of an object is the force exerted on it by gravity. Gravity gives a mass a downward acceleration of about $9.8 m/s^2$.

The SI unit for work and energy of any kind is the joule (J).

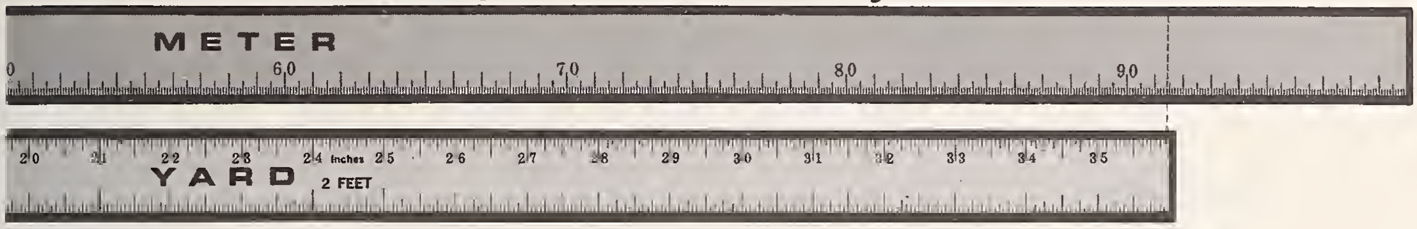
$$1J = 1N \cdot 1m$$

The SI unit for power of any kind is the watt (W).

$$1W = \frac{1J}{1s}$$

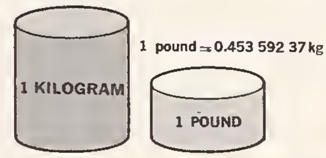
The International System of Units (SI) and its relationship to U.S. customary units

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards



science, industry, and commerce. SI is built upon a foundation of base units and their definitions, which appear on this chart. All other SI units are derived from these base units. Multiples and submultiples are expressed in a decimal system. Use of metric weights and measures was legalized in the United States in 1866, and our customary units of weights and measures are defined in terms of the meter and the kilogram. The only legal units for electricity and illumination in the United States are SI units.

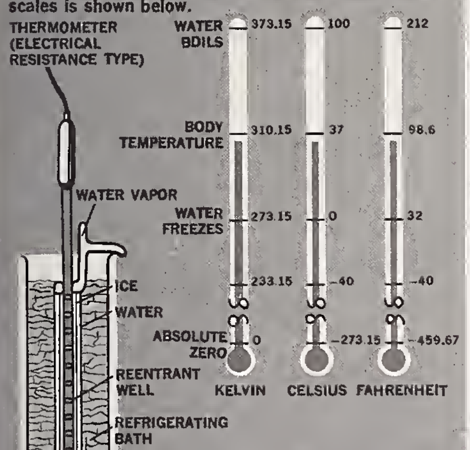
The comparative dimensions of the meter and the yard, the liter and the quart, and the kilogram and the pound are shown.



definitions, abbreviations, and some SI units derived from them

Temperature KELVIN–K

The thermodynamic or Kelvin scale of temperature used in SI has its origin or zero point at absolute zero and has a fixed point at the triple point of water defined as 273.16 kelvins. The Celsius scale is derived from the Kelvin scale. The triple point is defined as 0.01 °C on the Celsius scale, which is approximately 32.02 °F on the Fahrenheit scale. The relationship of the Kelvin, Celsius, and Fahrenheit temperature scales is shown below.



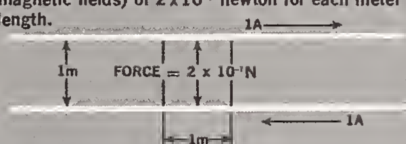
Temp F+40=1.8(Temp C+40)
Temp F=1.8(Temp C)+32
Temp C=(Temp F−32)/1.8
Temp K=Temp C+273.15

TRIPLE POINT CELL

The triple point cell, an evacuated glass cylinder filled with pure water, is used to define a known fixed temperature. When the cell is cooled until a mantle of ice forms around the reentrant well, the temperature at the interface of solid, liquid, and vapor is 0.01 °C. Thermometers to be calibrated are placed in the reentrant well.

Electric Current AMPERE–A

The ampere is defined as the magnitude of the current that, when flowing through each of two long parallel wires separated by one meter in free space, results in a force between the two wires (due to their magnetic fields) of 2×10^{-7} newton for each meter of length.



The SI unit of voltage is the volt (V).

$$1V = \frac{1W}{1A}$$

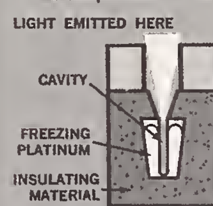
The SI unit of electrical resistance is the ohm (Ω).

$$1\Omega = \frac{1V}{1A}$$

Luminous Intensity CANDELA–cd

The candela is defined as the luminous intensity of 1/600 000 of a square meter of a radiating cavity at the temperature of freezing platinum (2042 K).

LIGHT EMITTED HERE



The SI unit of light flux is the lumen (lm). A source having an intensity of 1 candela in all directions radiates a light flux of 4π lumens.

A 100-watt light bulb emits about 1700 lumens

COMMON EQUIVALENTS AND CONVERSIONS

Approximate Common Equivalents		Conversions Accurate to Parts Per Million	
1 inch	= 25 millimeters	inches x 25.4*	= millimeters
1 foot	= 0.3 meter	feet x 0.3048*	= meters
1 yard	= 0.9 meter	yards x 0.9144*	= meters
1 mile	= 1.6 kilometers	miles x 1.609 34	= kilometers
1 square inch	= 6.5 sq centimeters	square inches x 6.4516*	= sq centimeters
1 square foot	= 0.09 square meter	square feet x 0.092 903 0	= square meters
1 square yard	= 0.8 square meter	square yards x 0.836 127	= square meters
1 acre	= 0.4 hectare †	acres x 0.404 686	= hectares
1 cubic inch	= 16 cu centimeters	cubic inches x 16.3871	= cu centimeters
1 cubic foot	= 0.03 cubic meter	cubic feet x 0.028 316 8	= cubic meters
1 cubic yard	= 0.8 cubic meter	cubic yards x 0.764 555	= cubic meters
1 quart (lq)	= 1 liter †	quarts (lq) x 0.946 353	= liters
1 gallon	= 0.004 cubic meter	gallons x 0.003 785 41	= cubic meters
1 ounce (avdp)	= 28 grams	ounces (avdp) x 28.3495	= grams
1 pound (avdp)	= 0.45 kilogram	pounds (avdp) x 0.453 592	= kilograms
1 horsepower	= 0.75 kilowatt	horsepower x 0.745 700	= kilowatts
1 millimeter	= 0.04 inch	millimeters x 0.039 370 1	= inches
1 meter	= 3.3 feet	meters x 3.280 84	= feet
1 meter	= 1.1 yards	meters x 1.093 61	= yards
1 kilometer	= 0.6 mile	kilometers x 0.621 371	= miles
1 sq centimeter	= 0.16 square inch	sq centimeters x 0.155 000	= square inches
1 square meter	= 11 square feet	square meters x 10.7639	= square feet
1 square meter	= 1.2 square yards	square meters x 1.195 99	= square yards
1 hectare †	= 2.5 acres	hectares x 2.471 05	= acres
1 cu centimeter	= 0.06 cubic inch	cu centimeters x 0.061 023 7	= cubic inches
1 cubic meter	= 35 cubic feet	cubic meters x 35.3147	= cubic feet
1 cubic meter	= 1.3 cubic yards	cubic meters x 1.307 95	= cubic yards
1 liter	= 1 quart (lq)	liters x 1.056 69	= quarts (lq)
1 cubic meter	= 250 gallons	cubic meters x 264.172	= gallons
1 gram	= 0.035 ounces (avdp)	grams x 0.035 274 0	= ounces (avdp)
1 kilogram	= 2.2 pounds (avdp)	kilograms x 2.204 62	= pounds (avdp)
1 kilowatt	= 1.3 horsepower	kilowatts x 1.341 02	= horsepower

† common term not used in SI

* exact

THESE PREFIXES MAY BE APPLIED TO ALL SI UNITS

Multiples and Submultiples	Prefixes	Symbols
1 000 000 000 000 = 10^{12}	tera (tĕr′ȧ)	T
1 000 000 000 = 10^{9}	giga (jĭ′gȧ)	G
1 000 000 = 10^{6}	mega (mĕg′ȧ)	M *
1000 = 10^{3}	kilo (kĭl′ō)	k *
100 = 10^{2}	hecto (hĕk′tō)	h
10 = 10	deka (dĕk′ȧ)	da
0.1 = 10^{-1}	deci (dĕs′ĭ)	d
0.01 = 10^{-2}	centi (sĕn′tĭ)	c *
0.001 = 10^{-3}	milli (mĭl′ĭ)	m *
0.000 001 = 10^{-6}	micro (mī′krō)	μ *
0.000 000 001 = 10^{-9}	nano (năn′ō)	n
0.000 000 000 001 = 10^{-12}	pico (pē′kō)	p
0.000 000 000 000 001 = 10^{-15}	femto (fĕm′tō)	f
0.000 000 000 000 000 001 = 10^{-18}	atto (ăt′tō)	a

*Most commonly used

Appendix 4

ENGINEERING STANDARDS

A. Background

The intimate relationship between units of measurement and engineering standards is recognized in Public Law 90-472, which states that "the Secretary shall give full consideration to the advantages, disadvantages, and problems associated with possible changes in either the system of measurement units or the related dimensional and engineering standards currently used in the United States." Further, PL 90-472 authorizes the Secretary of Commerce "to study the feasibility of retaining and promoting by international use of dimensional and engineering standards based on the customary measurement units of the United States." In the survey of engineering standards, the study has revealed that the measurement system is only one factor involved in the promotion of our national standards for international use. A factor that appears to be at least equally important is participation in committees, subcommittees, and working groups of international standardizing organizations. Currently, U.S. participation in such committees ranges from none to very high, depending on the industry concerned.

An understanding of the standards setting process throughout the world is helpful to an appreciation of the significance of the dynamic environment of today.

Wherever a multiplicity of practices is both possible and likely to occur, group cooperation for the achievement of some desirable social goal may require the acceptance, by the members of the group, of some joint decision to use one or a limited number of the possible alternatives. When the activities involved relate to social behavior the agreements (standards) are called laws. When related to religious behavior they are canons. And when related to manufacturing, testing, measurement practices and conventions, properties and performance of materials, or to the performance or characteristics of things, they are variously called standards of practice, code regulations, or conventions. All of these latter are commonly lumped together under the term "engineering standards."

The essential ingredients for arriving at such standards are:

(1) A set of alternatives,
(2) A method for agreeing upon a selection to be used,
(3) A group which agrees to abide by the selection, and
(4) Means for insuring compliance.

History is replete with chronicles of struggles to impose standards upon a reluctant society (e.g., crusades) or to unify a disparate set (e.g., conflicts of law). Engineering standards are no exception. Once set and embodied in our technology, products and applications, they may be difficult to change. The controversies over metrication in times past have revolved mostly around the standards issue, although often disguised as a language problem.

To return from this historical digression, the number of alternatives in any specific situation may range from a minimum of two (e.g., right or left handed screw threads, or right or left side of road for driving) to an unlimited number ranging over all the products and conventions in which our society is involved—for example, all possible sizes for shoes, hats, clothes, electrical outlets and plugs, doors, windows, bricks, tires, wires, drills, screws.

The cooperating group may extend from a buyer and a seller, to a company, to an industry, to a nation or even to the whole world, which is the matter of immediate concern. This group also generally involves competing interests whose desires and goals for choices among alternatives may differ, as they do between producers, assemblers, consumers, or buyers and sellers.

It may also include those who actually had no effective voice in the selection or agreement and may or may not feel bound to it, and some who do not choose to follow the agreement for selfish or unselfish reasons.

The decisions reached about the alternatives to be selected may be legally binding (i.e., mandatory) or voluntary, to be used at the will of the participants. Likewise, in this country as well as in others, the decisions (standards) may at times be propagated by one subgroup (such as producers or assemblers) and presented as an accomplished fact to another subgroup, such as consumers. Within the United States, standardization has been permissive and voluntary, with a few exceptions relating to standards based upon specific Federal, state or local legislation and concerned with health, safety or fraud. Other exceptions are regulations promulgated by the regulatory agencies such as the Federal Aviation Administration, Food and Drug Administration, or Federal Trade Commission.

The pattern of standards development has evolved into two main classes. At the industry level, standards are developed by materials and parts producers and device assemblers and presented to the ultimate consumer in the market place. Alternatively, the standards may be promulgated as procurement specifications by a *buyer* that is sufficiently large and important to have the standards met—for example, the Federal Government. In this connection it should be noted that when products are made to meet Federal Government specifications, others may also buy them and the specifications may become de facto national or even international standards through producer and consumer usage. A large fraction of these specifications has achieved this status. In fact, military and other federal specifications include more standards for consumer goods than those issued by all private organizations combined. Clearly, the two methods of arriving at standards—one initiated by the supplier and the other by the buyer—will often yield different decisions, with differing sets of advantages and disadvantages. A third class, where the ultimate consumer would set standards, has not emerged, probably because of lack of organization and competence among the body of consumers.

Where small groups which have developed standards seek to get together to form a larger aggregate of cooperation, they must resolve the differences in standards to arrive at a new set for the enlarged group. This process is called coordination or harmonization of standards. If the standard is established, first off, for the enlarged group, the costly waste motions of standard setting followed by later change and readjustment within the groups is eliminated. At the international level, Holland and other countries are now following this principle, as was noted in chapter III.

Let us consider now how the need for standards arises, i.e., why such decisions need to be made. Consider first the simplest kind of transaction. An innovator develops a product and puts it on the market. If it sells and business grows, he is required to produce more and more of the same. If he is to continue to expand his operation, he must not degrade the product quality or performance in the interest of greater production. He needs some bench marks or standards against which to assess his product for continued conformity. As others move into the manufacturing scene, they may make use of the same reference bench marks. Thus, standards of a single company can become national standards.

With expansion, the purchase of components and materials spreads. These intermediates also are more acceptable if they meet standards established for them. Moreover, those who manufacture them can achieve economies of large volume if all purchasers buy in terms of a common set of standards. This process ultimately works to a whole market standard or set of standards to which all parts suppliers work and from which purchasers purchase and around which their products are designed.

Improvements in the product require similar standards and these, in turn, reflect down the line as new standards for the "intermediates" or parts.

Where there is a large market for a product, standards provide an essential ingredient for the economies of scale which allow either reductions in cost or improvements at no increase in cost.

Where the market is fragmented as it might have been, but is not, among the 50 states so that products must differ for each market, a vast multiplicity of standards of local value only emerge. Standards for intermediates thus differ, too, and production on a large or industrial scale becomes difficult or impossible.

A clear example of fragmentation of standards within the U.S. is displayed by the construction industry with its 6,000-odd local jurisdictions, each with its own building code. A building code is essentially an assembly of standards relating to parts, materials and finished structures unique to the local area. Standards for materials and parts common to all codes can be manufactured on a national scale. The rest must be manufactured on small scale locally or more expensively fabricated on site by hand labor.

As a result, housing costs price a multitude of families out of the housing market. Unification, coordination, and development of common standards could provide economies of scale resulting in reduced cost and more and better, though not necessarily distinctive, homes. However, this loss of uniqueness can be compensated for by combinations of options from among a list of broadly based standardized assemblies, as is done in the auto industry.

Where a purchaser is large, such as a national or state government, it can issue specifications, which must be met by the products it desires to buy. If the buyer is large enough, these specifications can be so determining in the setting of industrial standards that they become de facto standards. The U.S. Department of Defense is one such large buyer. Their purchases in terms of military specifications ("mil-specs") have assumed this position for many foreign and domestic producers. It should be noted, however, that in the U.S. many civilian standards are included in the "mil-specs" where usable.

Where the buyer alone sets the standards, he can choose whatever quality level he wishes to pay for, even going so far as to push the producers to innovations beyond the current state of the art.

Where the producer is entirely in control of the process, his standards tend to become those which give greater economies in manufacturing within performance parameters he chooses. While the goals of the manufacturer and user are not necessarily opposed to each other, they may often require mutual adjustments.

B. Nature of Engineering Standards

An engineering standard is a technological practice described in a document to assure dimensional compatibility, quality and performance, uniformity of evaluation procedure, or uniformity of engineering language. Typical examples are documents prescribing screw thread dimensions, clothing sizes, chemical composition and mechanical properties of steel, methods of test for sulfur in oil, and codes for highway signs. The same standard may have requirements both for dimensions and quality or performance, and prescribe the methods of test. Generally, separate standards are issued for dimensional specifications, quality specifications, methods of test, and descriptive practices. The role of measurement units varies for these different groups. Therefore, they are discussed separately in this report, even though dimensional specifications, quality specifications, methods of test, and descriptive practices may appear as provisions in a single standard.

Dimensional Specifications

Standards of this type are essential either for the product or system to function or for interchangeability of parts. For example, the distance between rails (gage) and between wheels in a railroad must conform to a standard in order to have the railroad function. On the other hand, standards aimed toward interchangeability of parts may be applicable to production of an entire industry or of a single company. For instance, automobile tires are interchangeable on an industry-wide level; whereas, the wheels on which they are mounted are generally interchangeable only on vehicles produced by a single company since the number and spacing of the bolt holes in the wheels have not been standardized for the industry.

The most important point to be made here is that *sizes in dimensional specifications are usually simple multiples or submultiples of the measurement unit employed by the society.* As a consequence, the system of units is very important in such standards.

Quality and Performance Specifications

The purpose of these standards is to assure (1) a quality level adequate for the required service, and (2) uniformity in quality from one item to another. Quality level is a dominant factor in safety standards—for example, seat belt standards and specifications for steel forgings for pressure vessel shells. In specifications relating to quality and performance, measurement units serve simply as a language and, hence, are not critical. However, standards expressed in different systems of units create problems of understanding analogous to those presented by expressions in different national tongues. Also, minor incompatibilities due to measurement units can result from the rounding off of requirements in the system of units used.

Methods of Test

These standards provide a common basis for evaluating materials and products. They establish standardized procedures for determining critical dimensions or product quality, and are essential for determining compliance of a product with a specification. A typical method is mechanical testing of steel products. Methods of test can generally be based on any measurement units, and the results of test can be transformed from one system of units to another. Thus, basic units of measurement in methods of test, as in quality or performance specifications, serve simply as a language and do not compound differences, as they do in the case of dimensional standards.

Descriptive Standards

These standards include codes, symbols, sampling and other statistical practices, terminology, format for engineering drawings, and other descriptive engineering practices. Typical examples are sample size to estimate the average quality of a lot or process, color coding of electronic components, codes for highway signs, identification colors for pipes conveying gases and liquids, international codes for the abbreviation of titles of periodicals, and the nuclear energy glossary. Although measurement units are not involved, descriptive standards may be as incompatible as dimensional specifications. For example, the practice of keeping to the left side of the road in some countries and to the right side in others is not amenable to a compromise; it has to be one way or the other.

Compatibility of Standards

Two standards are compatible when the same engineering practice is prescribed. It is not necessary that the same measuring units and written words be used. For example, certain pipe standards in many countries are compatible even though each country uses its customary units and written language in the standard. On the other hand, standards for pipe thread in England and the United States are not compatible, even though both are expressed in the same measurement unit and written language.

Thus, it is the engineering practice rather than the measurement units that determines compatibility or incompatibility of standards. The importance of measurement units is their role in developing the engineering practice.

In the past, most products made in a series of sizes conformed to whole numbers, multiples of binary fractions, or simple decimals in the system of units used. For example, steel bar and rod are usually made in the United States in increments of 1/16 inch in the small sizes, 1/8 inch in the intermediate sizes, and 1/4 inch in the larger sizes. In metric countries, the increments are 1, 2, or 5 millimeters. As a consequence, the two standards are not compatible. In order to resolve this problem and to select sizes on a rational basis, the tendency today is to use a system proposed by Charles Renard in 1879. This system, known as preferred numbers, is based on a geometrical (rather than arithmetical) progression for selecting sizes. For applications requiring an arithmetical progression for sizes (for example, in building construction) the modular system is being used in standards. Whether perferred numbers or modules are used for determining sizes, a choice must be made for the *base* size. A base module of 100 millimeters is not sufficiently compatible with one of 4 inches (101.6mm). Likewise, a preferred number series based on U.S. customary units is not compatible with one based on SI units, unless the difference of 1.6% can be tolerated. In a few instances, worldwide agreement exists on sizes, based on either U.S. customary or metric units. For most products, however, agreement does not exist and the practice in one or both standards must be changed to achieve compatibility.

Extent of Use and Significance

It is difficult to determine the number of engineering standards in the four categories described above: dimensional specifications, quality specifications, method of test, and descriptive practices. However, an examination of 1200 ISO (International Organization for Standardization) recommendations issued to date, shows that dimensional specifications comprise about 25% of the total number, quality specifications about 15%, methods of test about 45%, and descriptive practices about 15%. Thus, in 75% of these cases the international adoption of a U.S. standard is not likely to be governed by measurement units. Even among the 25% that are dimensional specifications, measurement units are not at issue where sizes are already agreed upon internationally. For the other dimensional specifications that are now incompatible there may be an opportunity to adopt a more rational series of sizes.

The introduction of SI units into engineering standards is only one facet of metrication. It is a step now being taken by national standardizing organizations and is not dependent on the entire country changing its measurement units. It appears to be a wise step in fostering the use of U.S. standards internationally. Critical problems arise mainly in dimensional specifications where there is incompatibility between U.S. and metric sizes. Even the conflict in these standards can be resolved within the framework of present measurement units, as evidence by the current use in the United States of products whose sizes are based on metric units and in metric countries of products whose sizes are based on inch units.

This illustrates again the basic point that the sizes (or values) are paramount and the measurement language in which they are described is secondary. The U.S. should be willing to accept ISO-IEC standards in whatever *language* they are written, provided they have sufficient merit, and focus its negotiation efforts to arrive at standards in accord with our practices.

C. Development Process for Engineering Standards

Engineering standards are developed and promulgated at three levels: by single firms or entities, by national bodies, and by international organizations. The degree of required coordination increases as a standard progresses from the single to the national to the international organization.

Standards Issued by a Single Organization

These standards, which are issued by a local government or a single company (either a producer or consumer), are generally poorly coordinated. They include local building codes, company purchase specifications, and producer's specifications for the products he sells or uses in his manufacturing process. The objective of these standards is to assure interchangeability of parts, maintain product quality levels, or both. Codes issued by local governments prescribe minimum quality levels for building construction and repair. Insofar as they are incompatible with other standards for the same product, they restrict trade and are frequently used to foster proprietary interests.

National Standards

Standards used throughout a country and issued by an organization within the country are national standards. In the United States they emerge in different ways. Some are recognized by a national coordinating body, such as the American National Standards Institute (ANSI). Some become adopted by industry-wide use, without any formal adoption process. In either case they are called national standards if their scope is national.

In Russia and a few other countries, they are issued by the government and are mandatory. In the U.S. and in most other countries, only regulatory standards are mandatory. Most engineering standards are voluntary. Unlike most countries, many organizations in the United States issue standards that are recognized nationally. They include the government; organizations of government officials, such as the American Association of State Highway Officials and the Association of Official Analytical Chemists; and private organizations, such as ANSI, the American Society for Testing and Materials (ASTM), American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronic Engineers (IEEE), Society of Automotive Engineers (SAE), industrial trade associations, and other groups. The degree of coordination depends on the organization issuing the standard. Standards issued by ANSI probably represent the greatest degree of voluntary standards coordination and are recognized internationally as our national standards. Most of these standards are developed by member organizations of ANSI, ANSI's role being to ensure maximum coordination. National standards may restrict trade, but they tend to be less restrictive than standards issued by a single organization. To the extent that national standards incorporate sizes characteristic of the nation's measurement language, they may result in trade restrictions in international commerce.

International Standards

The International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO) have become the worldwide leaders in international standardization. There are also regional organizations. The Pan American Standards Commission (COPANT) operates in the Western Hemisphere. The International Commission on Rules for the Approval of Electrical Equipment (CEE), the Economic Commission for Europe (ECE), and the Committee for the Coordination of European Standards in the Electrical Field (CENEL) are concerned with standardization in Europe. The USA is represented in IEC, ISO and COPANT by the American National Standards Institute. Because of the worldwide representation in IEC and ISO, their recommendations with respect to standards reflect the greatest degree of coordination. Although member bodies of IEC and ISO are not required to use the international standards and recommendations, many countries are adopting them as their national standards. IEC and ISO recommendations reflect the engineering practices of the nations that participate in drafting them. As a consequence, a nation which does not participate at the drafting stage may later find its standards and practices different and suffer a consequent disadvantage in international trade unless it changes its standards to conform with ISO and IEC recommendations. Some of the existing IEC and ISO recommendations include two systems of units and two series of sizes based on the inch and meter, respectively. However, the present trend is to give preference to SI units.

In the future, national standards which do not include SI are not likely to receive due consideration in the development of international standards, and the nations concerned will be at a disadvantage in future dealings with nations using SI. This trend was recognized by the American Society for Testing and Materials (ASTM) when it issued the ASTM Metric Practice Guide in 1964. ANSI policy as adopted in 1969, "supports and encourages use of SI Units in addition to other units in all standards submitted to the International Organization for Standardization (ISO) and their use, in addition to other units, in all ISO Recommendations." ASME, SAE and other standardization organizations have taken similar action.

When there has been active participation by the United States in an ISO or IEC Committee, U.S. engineering practices have usually been considered favorably in drafting the international recommendation, and in many cases reflected in the final output. For example, the ISO recommendations for both the metric and inch screw threads are based on the cross-section shape as specified in our U.S. national standard. On the other hand, as a result of our indifference and lack of participation, our practices have not been considered in many committees. In sum, *active participation on the drafting committees is believed essential if we are to have our practices reflected in international recommendations.* Our delegates on IEC and ISO committees must be competent and must serve for extended periods of time to be effective.

D. Magnitude of the Undertaking

Except for the few regulatory standards issued by some government agencies, the use of engineering standards in the United States is voluntary. Their effectiveness depends on the extent to which the voluntary standards are included in procurement contracts. Even though voluntary, the need for standards has long been recognized, at both the national and international level. Yet, there has never been a single organization in the United States covering the entire gamut of engineering standards. However, ANSI and its predecessors have often expressed a willingness to consider favorably such a role, and have initiated unsuccessful efforts to be awarded a national charter for this purpose.

Standardization activities have grown without coordination and have been fragmented among about 400 organizations, many of which are older than ANSI. Indeed, only a small portion of our national standards are developed directly by the ANSI. Over 40 other organizations in the United States issue standards that may be adopted by ANSI as American National Standards. In addition, there are national standards for biological materials, drugs, and foods which are not included in the scope of ANSI's activities or those of its member organizations.

Fragmentation and lack of central responsibility have led to duplication of effort and confusion. For example, standards for steel pipe are issued by three Federal agencies and five private organizations. Some of these standards are essentially duplicates, others differ to some extent.

The development of multiple standards, where one could easily suffice, not only complicates and multiplies the effort in the standards process, it runs contrary to the basic principles upon which good and useful standards are based. The manufacture and distribution of moderately different, but nominally identical, products is equivalent to producing for a fragmented market. Costs increase, reflecting manufacturing modifications and distribution complications. If carried far enough, standards duplication can lead producers to frustration and to rejection of the whole idea of costly participation in the standards process. The increased costs can also lead buyers to alternative products and sources of supply, where the standards process has been used more effectively.

Most standards pertain to industrial materials, intermediate parts, assemblies or products used by large companies or government agencies. For example, the Department of Defense has issued almost 35,000 specifications and standards in addition to some 5,000 Federal specifications it has found useful. This number greatly exceeds the combined total of standards issued by all voluntary standards organizations in the United States, a total that is estimated to be slightly over 20,000. Since the number of standards issued by standards-making organizations is not complete, many federal and military specifications (whatever their origin) have through use become de facto national standards. Because the number of standards extant in the U.S. is only a rough estimate, the rate of increase cannot be determined. All of the existing standards are not needed and the number of redundant standards cannot be estimated accurately. We know, however, that the number is increasing, since, as a consequence of economic growth and need, the number issued always exceeds the number discontinued.

There are relatively few national standards for products used in industry (e.g., tractors, machine tools) and fewer still for products used by the consuming public. In the 1970 ANSI catalog only 125 standards are listed for consumer goods. Many of these are for home construction items such as electrical, gas, and oil burning equipment, and aluminum windows and construction materials. This small number does not necessarily reflect the total number of standards which benefit the consumer. The standards for intermediates in the complex of mass production operations indirectly affect him. The economies resulting from the use of standard nuts, bolts, wires, sheet steel, fasteners, T.V. wire forms, vacuum tubes, transistors, and the like are reflected in consumer products. Play of the market place identifies the survivors.

The use of standards on the part of the consumer in purchasing is a newly emerging phenomenon associated with products of increased sophistication and technological content. Its success requires some means for financing, on behalf of the consumer, his participation in the expensive and highly technical standards development process.[18] The government injects the public interest by sponsoring and aiding the development of mandatory standards to protect health and safety. And ANSI procedures allow public review and comment on all standards proposed for approval as an American National Standard. Nevertheless, there appears to be a growing public demand for increased participation of the consumer, through his government representatives or otherwise, in the standards development process, which affects him in important ways.

E. U.S. Participation in International Standards

Participation by the United States in international standardization has fluctuated over the years. At the end of the 19th century, there were many members of the International Association for Testing Materials (IATM) in the U.S. In 1898, these members formed the American Section of IATM, which was incorporated four years later under the name of American Society for Testing Materials (ASTM).

At the 1904 meeting of the International Electrical Congress held in St. Louis, a resolution was passed leading to the formation of the International

[18] For example, the development of color television signal format standards, a complex technical problem with great impact upon the consumer, required millions of engineering man hours.

Electrotechnical Commission (IEC) in 1906 and the USA National Committee for IEC in 1907. Interest in international standardization reached a peak at the beginning of World War I. At that time, 623 of the 2849 members of IATM (more than 20%), were in the U.S. Germany was second with 446 members. To promote the international use of ASTM standards, twenty specifications for steel products were published in the English, French, German, and Spanish languages by ASTM in 1913. Subsequently, the U.S. Department of Commerce translated ASTM standards having an important bearing on the export trade and distributed them to consular offices throughout the world.

U.S. interest in international standardization continued during and after World War I, but decreased markedly after IATM ceased to function in 1915. The five principal societies issuing standards in the U.S. began discussions in 1916 on ways and means of achieving cooperation in the issuance of engineering standards and formed in 1918, with three government departments, the American Engineering Standards Committee. This Committee maintained informal communication with other national standardizing organizations and in 1926 helped to organize the International Standards Association (ISA), a federation of 18 national standardizing bodies. The Committee was superseded in 1928 by the American Standards Association (ASA), an expanded organization whose members were 40 national technical societies, trade associations, and Government departments. ASA represented the United States on ISA, but ISA and the new IATM (also formed in 1926) did not revive the interest in international standardization that existed prior to World War I. Both the new IATM and ISA ceased to function when World War II started.

The need for international standardization was recognized by the Allied Nations. In 1944, they formed the United Nations Standards Coordinating Committee. The need for continuing the work of the committee after the war led to the establishment of the International Organization for Standardization (ISO) in 1946. IEC, which was able to survive both World War I and II, affiliated with ISO in 1947, but retained its organizational autonomy. These two organizations have become predominant in international standardization. ASA has represented the U.S. in IEC since 1931 through the U.S. National Committee for IEC and in ISO since it was founded in 1946. In a reorganization of ASA in 1966, the name was changed to United States of America Standards Institute. The name was again changed in 1969 to American National Standards Institute. In order to harmonize national standards based on customary inch units, the American-British-Canadian Conference on the Unification of Engineering Standards was organized in 1945 and continued until England formally began its change to the metric system.

Interest in international standardization within the U.S. has grown greatly since World War II. Participation of the U.S. National Committee in IEC has increased. In some ISO technical committees the U.S. has become very active, including nine of the twelve most active committees, and the U.S. is secretariat of one of the three most active committees. Some of these committees represent industries particularly sensitive to the base measurement units; for example, aircraft and space vehicles, and textile machinery. Other countries have developed similar interest. Germany and Japan are now translating many of their standards into foreign langugages, just as the U.S. did between 1913 and 1930. Japan's success since 1945 in establishing standards for high-quality products, implemented by quality control and certification programs, is the forerunner of similar programs now being developed among European countries. These programs are discussed in chapter III of this report.

In order to obtain perspective on the number of standards required for international commerce, it is necessary to ascertain the number of standards used nationally. Private organizations in the United States have issued over 20,000 standards, but many of them are duplications. On the other hand, many additional standards are needed, particularly for consumer goods. Thus, 20,000 standards appears to be a lower limit. An estimate of the upper limit is 40,000, since the Department of Defense utilizes nearly this number in the form of federal and military specifications and standards. This number includes standards for most industrial products, food, clothing, and other consumer goods used in the civilian economy, as well as for items utilized exclusively by the Department of Defense.

These numbers are appreciably higher than the numbers issued by standardization organizations in other countries, as can be seen in the following tabulation:

Association Francais de Normalization	[19] 7,000
British Standards Institution	[19] 5,500
Deutschen Normenausschuss	11,000
Ente Nazionale Italiano di Unificazone	[19] 6,000
Gosudarstvennyj Komitet Standartov, USSR	13,000
Indian Standards Institution	5,000
Japanese Standards Association	[19] 7,000

Nonetheless, the number of standards is increasing rapidly in other countries. India, a developing nation, expects to have over 10,000 standards at the completion of the Fourth Plan. Considering the number of standards in the U.S. and in other countries, an estimate of 20,000 standards seems reasonable for the number of IEC and ISO recommendations or standards required. Since these two international bodies have issued less than 1700 from their founding through 1969, an increase by a factor of 10 or more appears necessary to meet the needs of a technological world economy. To put it another way, more than 90% of the expected requirements for international standards remain to be considered.

Part of the disparity between the repertoire of international standards needed and those in existence must be charged to the problems associated with any attempt at coordination or adjustment of views among nations. In this respect the international standards process is no exception. Five years or more are required in the development of an IEC or ISO recommendation. Even so, a rough review of the accomplishments of these standardizing bodies raises questions regarding the slowness and inefficiency of some of

[19] Does not include standards for food, drugs, and other biological materials.

the technical committees that develop the recommendations (standards). The productivity of the IEC and ISO committees established before 1965 and of those with the U.S. as Secretariat is as follows:

Recommendations issued	Number of committees			
	All committees		U.S. Secretariat	
Number	IEC	ISO	IEC	ISO
0	3	23	0	3
1	4	17	1	2
2	9	11	2	1
3	5	5	3	1
4–15	26	28	0	0
16–30	7	14	1	3
over 30	2	12	0	1
Total	56	110	7	11

These data show that a few committees have been very active and that many have been almost inactive. The performance of committees with the U.S. as secretariat is no better than that of other committees. Admittedly, counting standards is a poor basis for evaluation of committee performance, but the numbers indicate that the less active committees do have the potential ability to double the rate of development of international standards.

Another factor in the disparity is indifference. U.S. participation is illustrative. A rough estimate of 50% participation can be made on the basis of the following information for ISO:

Organizational unit	Participation by U.S.	
	Number	Percent
131 Technical committees	91	69
209 Subcommittees	138	66
593 Working groups	251	42
933 Organizational units	480	51

Participation in IEC cannot be readily ascertained since each national committee is automatically included as a participating member of each technical committee and subcommittee. Information on participation at the working group level is not available, but members of the U.S. National Committee have made rough estimates of 50%.

Effective representation is probably less than indicated by the above figures, since U.S. delegates do not attend many IEC and ISO meetings of groups on which there is nominal participation. It is at IEC and ISO meetings, particularly at the working group level, that the international recommendations are developed and the practices of countries represented are naturally given greatest consideration.

Counting memberships is at best a hazardous means for assessing the effectiveness of U.S. participation. The alternative of subjective assessment, committee by committee and member by member, would be very difficult. Quantitative evaluations do not exist. A part of the apparent indifference may be an inability to foresee the effect that IEC and ISO recommendations will have on national standards and international trade. In the past, the effect has been very small, primarily because of the few recommendations issued. However, this situation should change rapidly during the next 10 years.

The cost of sending delegates overseas to meetings is an important deterrent to participation in many international committees. The travel expenses of a delegate to an overseas meeting average about $800. Thus, to send two delegates to each of the estimated 1100 meetings of committees, subcommittees, and working groups of IEC and ISO each year would cost nearly $2,000,000. This cost does not include salaries of delegates for time spent at meetings and committee activities between meetings; nor does it include costs of administration. The American National Standards Institute estimates the cost of administering U.S. participation in an international standards committee at $5000 per year. Supporting a committee secretariat adds sizable additional expenses, bringing the cost, according to ANSI estimates, to about $15,000.

In contrast, the travel costs of participation for European nations are obviously much less. In any case whether travel cost or indifference is the reason for the relatively low level of participation by the United States, the fact is that the U.S. supports only 50 secretariats of technical committees and subcommittees of ISO and IEC, compared with about 100 each for England and France.

Appendix 5

SELECTED QUESTIONNAIRES BEING EMPLOYED IN THE U.S. METRIC STUDY

(1) Manufacturing Industry Survey

- Information and Instructions
- General Data (Part A)
- Cost Data (Part B)

(2) International Trade Survey

- Impact of Metrication on U.S. Imports
- Impact of Metrication on U.S. Exports

(3) Federal Government Survey

- Areas of National Responsibility
- International Operations

(4) Survey of Nonmanufacturing Firms

- Initial Contact Interview
- Second Interview (Part A)
- Second Interview (Part B)
- Existing Measurement System
- Future Measurement System

U. S. Department of Commerce
National Bureau of Standards

BoB # 41-S70016
Approval expires June 30, 1971

U.S. METRIC STUDY

(under Public Law 90-472, August 9, 1968)

MANUFACTURING INDUSTRY SURVEY

Information and Instructions

Additional information or copies of the questionnaire may be obtained from:

Manufacturing Survey Team
U. S. Metric Study
National Bureau of Standards
U. S. DEPARTMENT OF COMMERCE
Washington, D. C. 20234
Phone: (301) 921-2658

U.S. METRIC STUDY— MANUFACTURING INDUSTRY QUESTIONNAIRE

INTRODUCTION

Public Law 90-472, August 9, 1968, copy attached, authorizes the Secretary of Commerce to conduct a program of investigation, research, and survey "to determine the impact of increasing worldwide use of the metric system on the United States" and to "appraise economic . . . advantages and disadvantages of the increased use of the metric system in specific fields and the impact of such increased use on those affected".

By the time of the enactment of the Law practically all of the countries of the world had adopted the metric system of measurement, with the British Government, in 1965, announcing their intention of converting all manufacturing and other sectors of their economy to the metric system with a planned completion data of 1975 and with the South African Government in 1967 deciding to follow suit.

In 1969 the New Zealand Government announced their intention of making the metric system their national system of weights and measures and in January 1970, the Australian and the Canadian Governments announced the same intention.

The data collected in this survey will be presented in the Department of Commerce Report to Congress on an industry-wide basis and in such form that individual company data cannot be isolated.

SCOPE AND PURPOSE

The purpose of this questionnaire is to obtain information that will assist in determining what course of action with respect to metrication the United States should follow.

This questionnaire is on a Company-wide* basis for one 4-digit product group regardless of how many establishments of your company participate in the manufacture of that product group. It has two parts: Part A, which pertains to general facets of metric usage, and Part B, which deals with the subject of "added costs" that would be attributable to increased use of the metric system. Much of the information requested in Part A is conjectural rather than factual, while the data requested in Part B requires an extensive in-depth and relatively expensive internal study by the respondent. All recipients are requested to complete Part A; the completion of Part B is optional. If you plan to respond to Part B please communicate with the Manufacturing Survey Team (address and phone number on front cover page) for further background.

Your replies will be of great value in enabling the Secretary of Commerce to propose an appropriate course of action for consideration by the United States. However, the questions and assumptions do not imply what course of action may be recommended by the Secretary in his report to the Congress.

This questionnaire is based on the 4-digit Standard Industrial Classification (SIC) as defined in the Bureau of the Budget SIC Classification Manual. A separate form should be used for the group of products constituting each 4-digit SIC to be reported. If you require information regarding the products classified within each SIC industry, please consult with your Comptroller or your nearest Department of Commerce Field Office, or the U.S. Metric Study Manufacturing Survey Team (address on front cover page).

DEFINITIONS

The following definitions are applicable to Parts A and B:

(1) **Domestic production:** your production in the United States, including Puerto Rico.

(2) **Customary system:** the system of measurement units (yard, pound, second, degree Fahrenheit, and units derived from these) most commonly used in the United States. Synonyms "English system", "U.S. system". These are not to be confused with "Imperial system", which describes a related but not completely identical system currently in use in the United Kingdom and other English-speaking countries.

(3) **Metric system:** the measurement system based generally on the meter as a unit of length, the kilogram as a unit of mass, the second as a unit of time, the kelvin or the degree Celsius (formerly degree Centigrade) as a unit of temperature and units derived from these. This system has evolved over the years

* For purposes of this survey "Company" is defined to include the parent firm and all domestic subsidiaries it owns or controls.

and the modernized version today is identified as the "International System of Units" (SI). The above units and other SI units are listed in the Annex of ISO Recommendation R 1000.

(4) **Metrication:** any act tending to increase the use of the metric system.

(5) **Engineering standard:** a practice established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents prescribing screw thread dimensions, chemical composition and mechanical properties of steel, dress sizes, safety standards for motor vehicles, methods of test for sulphur in oil, and codes for highway signs. Engineering standards may be designated in terms of the level of coordination by which they were established (e.g., company standards, industry standards, national standards).

(6) **Shop drawings:** drawings or prints with dimensions, tolerances, and other specifications from which parts are fabricated.

(7) **Research & development:** laboratory activity directed toward development of new kinds of products and processes but not immediately associated with production.

U.S. METRIC STUDY— MANUFACTURING INDUSTRY QUESTIONNAIRE

PART A—GENERAL DATA
(SEE YELLOW QUESTIONNAIRE)

The purpose of this Part is to obtain information as to the present impact within the United States of the increasing worldwide and domestic use of the metric system and as to the probable future advantages and disadvantages of this increasing metric usage under two assumed courses of action: (1) no coordinated action on a national scale with regard to metrication; i.e., a continuation of the present practice of using the metric system or retaining the customary system when either appears to be economically and technically preferable to the other as a matter of individual company policy, or (2) a coordinated national program of metrication based on voluntary participation involving most sectors of the economy including education.

GUIDELINES

Your attention is directed to the document titled "Orientation for Company Metric Studies" (attached hereto) prepared by the Metric Advisory Committee of the American National Standards Institute (ANSI). This document can serve as a source guide to supply you with background information and should prove of value in answering some of the questions in this Questionnaire. Other guidelines pertaining to specific questions have been included in the Instructions to those questions.

Other background materials are also attached for your information and reference. These include "ASTM Standard Metric Practice Guide", ISO Recommendation R1000", "Measuring Systems and Standards Organizations", and "The Modernized Metric System" (NBS Special Publication 304A).

Although many of the questions ask for information that is conjectural rather than factual, the acquisition of this information is necessary for the study. Furthermore, it is evident that this information as obtained from individual companies will be more reliable than if obtained from other sources. Accordingly, your best estimates are earnestly solicited.

Since precise answers to many of the questions may be difficult to develop, considered estimates will suffice in those cases.

INSTRUCTIONS

IMPORTANT. Please note that except for question 1, which solicits information as to the number of employees in your Company* in the United States, and questions 18, 19, and 21, which solicit general comments, all other questions ask for company data applicable ONLY to the 4-digit SIC product group covered by this questionnaire. If a question or a segment of a question is not applicable (NA) to your type of business indicate that fact by the notation NA, but please be careful to differentiate between the use of NA and zero.

We may wish to communicate with your company regarding some item in this report. Accordingly, please designate at the end of the questionnaire the person you wish us to contact.

* For purposes of this survey "Company" is defined to include the parent firm and all domestic subsidiaries it owns or controls.

U.S. METRIC STUDY— MANUFACTURING INDUSTRY QUESTIONNAIRE

PART B—COST
(SEE BLUE QUESTIONNAIRE)

INTRODUCTION

The purpose of this Part is to obtain information as to the costs and savings that would accrue to the manufacturing industry if the country were to follow a coordinated national program of metrication based on voluntary participation involving most sectors of the economy, including education.

The data collected in this survey will be presented in the Department of Commerce Report to Congress on an industry-wide basis and in such form that individual company data cannot be isolated.

THIS COST QUESTIONNAIRE APPLIES TO YOUR DOMESTIC PRODUCTION ONLY

The attention of respondents is directed to "Orientation for Company Metric Studies" (attached hereto) prepared by the Metric Advisory Committee of the American National Standards Institute (ANSI) to establish a basis for estimating added costs on an optimum schedule.

Other background materials are also attached for your information and reference. These include "ASTM Standard Metric Practice Guide", "ISO Recommendation R1000", "Measuring Systems and Standards Organizations", and "The Modernized Metric System" (NBS Special Publication 304A).

Please note that this Part of the Manufacturing Industry questionnaire is designed to report your in-house added cost only on a company basis.

DEFINITIONS

"Added cost" due to increased use of the metric system in a new or redesigned product is the increment of cost directly attributable to the use of the metric system over and above what the cost would have been had the new or redesigned product been designed and manufactured by using customary units.

"Net added cost" of metrication is added cost as defined above decreased by the savings during the transition period that accrue as a result of the use of the metric system rather than the customary system.

"Value of sales" represents net selling values, F.O.B. plant, after discounts and allowances and excluding freight charges and excise taxes.

"Value of materials" as used in this questionnaire includes cost of purchased materials and parts, including standard parts and standard materials incorporated in the finished product (whether purchased or produced in-house), supplies, fuel, and electrical energy.

"Standard parts" are parts for which standards have been established on a national basis. These parts are interchangeable and normally can be purchased "off-the-shelf"; such as nuts, bolts, tires, sparkplugs, lamps, vacuum tubes, electric motors, and bearings.

"Standard materials" are sheet, plate, wire, bar stock, etc. manufactured to specified thicknesses, cross-sections, and shapes established on a national basis. These materials can normally be purchased "off-the-shelf".

"Optimum period" is that period of time in which the transition of the product from customary units to metric units can be accomplished at minimum cost to your company; it is normally the period during which the product is substantially redesigned.

ASSUMPTIONS

The assumptions stated herein are for the purpose of estimating "added cost" during the transition period for converting to metric production under a coordinated national program of metrication based on voluntary participation. They do not imply what course of action may be recommended or what course of action the country may follow after completion of the study.

Assume that:

1. The use of metric units and metric engineering standards will be increased only for new or redesigned products or new or redesigned parts of the product. Unless there are distinct advantages in changing, the production of an existing item will remain unchanged un-

til the normal design life cycle of that product is completed and a new metric-designed product replaces it.

2. In-house designed products or components will be designed in metric units on a schedule that is compatible with normal obsolescence of tooling or with economically feasible conversion of tooling from customary to metric units. Existing items of production equipment will be used until their normal life cycles are completed. The only changes or conversion to metric units will be in dials, gages, some feed-rate controls and indicating devices. Such changes will be made on an economic basis, (i.e. when the demand for metric designed parts or products requires a change).

3. Out-of-house production materials and components based on metric engineering standards will become available during the transition period at no substantial increase in cost.

4. Costs resulting from mating metric components with carry-over existing customary components at their interface are added costs.

5. The transition period will be the "optimum period" for most companies. However, for companies that produce product groups that are standard parts and/or standard materials, the transition period is not an "optimum period" but is a period that is dictated by the demands of the customers.

6. The metric system will be taught in all U. S. schools during the transition period and the general public will concurrently be gaining familiarity with this system of measurement.

GENERAL INSTRUCTIONS

All elements of your manufacturing process, for the SIC product group reported on, should be investigated and any identifiable added costs associated with each element resulting from adoption of metric usage instead of customary usage should be noted.

There are two alternative Part B (blue) questionnaires. The one headed "Section 1" is for use by most companies. However, if this response covers a product group that comprises standard parts and/or standard materials, use the one headed "Section 2".

The list of areas of investigation that follows is identical with the list in item g. of both Sections of the questionnaire. Respondents are requested to consolidate the added costs determined for all elements into the applicable listed areas of investigation of item g.

In some of the areas such as "Engineering & Research" or "Records & Accounting," there may be savings of a continuing nature that would start to be realized during the transition period. To the extent practicable, any such savings during the transition period should be computed and a net cost determined. In some cases, such net costs may be negative (i.e. where savings exceed costs).

The areas to be studied include:

1. Personnel Education
2. Engineering & Research & Associated Documentation
3. Manufacturing & Quality Control
4. Records & Accounting
5. Standards Association Activity
6. Warehousing
7. Sales & Services
8. Other

Guidelines for those areas of study follow:

1. Only those workers who will be affected by the introduction of metric units will need training. In some cases, a short briefing or orientation is all that is necessary; in others, more detailed and formal instructions may be required.

2. a. What changes in engineering drawings over and above normal redesign changes, if any, will be necessary. What are the associated costs? What about new metric rulers, tables, handbooks, etc?

b. In your research department, determine what equipment will need new dials or changed indicators; what new test equipment, such as gage blocks and other metric standard devices, will need to be purchased, etc?

3. a. What existing production equipment needs new or modified dials, verniers, indicators, and the like, to read out in metric units? Will any production equipment actually need replacement of feed-screws and what are the costs of replacement? In the latter case it may prove more economical to modify the feed-screw indicator to metric readings. Which precision machine tools will need optical position indicators in metric and which will need metric digital readout? Machines on which the feed rate is dependent on the pitch of the feed-screw, such as milling machines, require special in-

vestigation. In some cases, the lead-screw drive arrangement may need to be changed. It is assumed that when a modification is expensive, it would be applied only in machines whose life before obsolescence is long.

b. What calipers, micrometers, and other tools that are furnished by your company will need to be replaced?

c. A review of the equipment used in quality control and the testing of the finished product should be made. Any added costs in changing dials, gages, etc., or even the replacement of certain equipment that cannot be changed to metric readout should be noted.

4. Included in this category are records, bookkeeping, billing, and other associated paperwork.

5. Added costs resulting from increased activity on standards organizations should be included. However, the added costs for the development of company standards will be covered in whichever department has that responsibility (e.g. Engineering or Design).

6. Added costs may accrue because of the necessity of additional inventories. These should be determined for the transition period.

7. Added costs in connection with sales, such as sales catalogues, service and replacement parts, advertising, and the like should be estimated.

8. Other elements peculiar to your operations will occur to you during your investigations. These should be noted and any added costs determined.

A different form should be used for each 4-digit SIC Product Group that you report. For small companies this will be the principal SIC product group only but other SIC product groups may be included with it if it is not practicable to sever them. Added costs should be evaluated as the total dollar added costs occurring over the transition period, based on 1969 dollars, for the SIC product group produced by your company. Since the task of calculating added costs for all products in this SIC Product group by your company may be great, it may be expedient and possible to use a representative sample consisting of one or more typical items or products selected from the group of products being reported to serve as a basis for estimating the cost for the entire SIC product group of the company. However, with the exception of question e in Section 1 or question f in Section 2, the information requested is for the total of all items in the 4-digit SIC product group produced by your company.

INSTRUCTIONS FOR SECTION 1:

a. State the SIC 4-digit product group covered by this questionnaire. It should be the same as that shown to the left of your company name and address in Part A.

b. Check the box that includes the value of sales for all products produced by your company in the stated 4-digit SIC product group.

c. Note that a percentage is requested, the ratio of value of materials to your total value of sales of this 4-digit SIC product group produced by you, multiplied by 100.

d. A percentage is requested, the ratio of total "in-house net added cost" of metrication to your total value of sales of this 4-digit SIC product group produced by you, multiplied by 100. In the determination of total in-house net added cost it should be remembered that (1) any added cost of standard parts and standard materials are to be excluded and (2) savings are to be subtracted from added costs thus resulting in a total in-house net added cost of metrication. In cases in which this net added cost is negative, the percentage reported will be negative and should be prominently so marked.

f. Enter the number of years that you have determined is the optimum period of transition for this SIC product group produced by your company.

g. If the net added cost (added cost minus savings) is negative for any item or area of investigation, the percentage reported will be negative and should be prominently so marked. However, the sum of 1 through 8 should total 100 (or minus 100 if the percentage value in d is negative).

h. Because of the interrelationships, or interlocking, of various industries we would like to determine what the cost impact would be if your company converted this product to metric measurement during a coordinated national program of metrication of 10-year duration based on voluntary participation. Your considered estimate will be appreciated.

INSTRUCTIONS FOR SECTION 2:

a. State the SIC 4-digit product group covered by this questionnaire. It should be the same as that shown to the left of your company name and address in Part A.

b. Check the box that includes the value of sales for all products produced by your company in the stated 4-digit SIC product group.

c. Note that a percentage is requested, the ratio of value of materials to your total value of sales of this 4-digit SIC product group produced by you, multiplied by 100.

d. A percentage is requested, the ratio of the total in-house net added cost for development of capability to supply standard parts and/or standard materials to both customary standards and metric standards as metric standards are developed to your total value of sales of this 4-digit SIC product group produced by you, multiplied by 100. In the determination of total in-house net added cost it should be remembered that (1) any added cost of standard parts and standard materials other than the product group reported is to be excluded and (2) savings are to be subtracted from added costs thus resulting in a total in-house net added cost of metrication. In cases in which this net added cost is negative, the percentage reported will be negative and should be prominently so marked.

e. A percentage is requested, the ratio of the annual in-house net added cost for maintaining capability to supply standard parts and/or standard materials to both customary standards and metric standards to your total value of sales of this 4-digit SIC product group produced by you, multiplied by 100.

g. If the net added cost (added cost minus savings) is negative for any item or area of investigation, the percentage reported will be negative and should be prominently so marked. However, the sum of 1 through 8 should total 100 (or minus 100 if the percentage value in d or e is negative).

We may wish to communicate with your company regarding some item in this report. Accordingly, please designate at the end of the questionnaire the person you wish us to contact.

FORM NBS-510
(4-70)

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. METRIC STUDY
MANUFACTURING INDUSTRY QUESTIONNAIRE
PART A.—GENERAL DATA

Budget Bureau Approval No. 41-S70016

Approval Expires June 30, 1971

A. SIC Product Group (CC 1-4)

B. Control No. (CC 5-8)

C. Company name and address

D. Is this Company owned or controlled by another company?

☐ Yes ☐ No

E. If yes, give name and address of that company

1. Number of employees in your company in the United States. (Check appropriate box) (CC 10)

☐ a. 1 to 49
☐ b. 50 to 249
☐ c. 250 to 499
☐ d. 500 to 999
☐ e. 1,000 to 2,499
☐ f. 2,500 to 10,000
☐ g. Over 10,000

2. Total 1969 value of sales for this SIC product group. (Check appropriate box). (CC 11)

☐ a. Up to $1 million
☐ b. Over $1m to $5m
☐ c. Over $5m to $10m
☐ d. Over $10m to $25m
☐ e. Over $25m to $50m
☐ f. Over $50m to $100m
☐ g. Over $100m to $250m
☐ h. Over $250m to $500m
☐ i. Over $500m to $1 billion
☐ j. Over $1 billion

3. Are you also completing Part B for this SIC Group? (CC 12) ☐ a. Yes ☐ b. No

4. Identify specific product or products included in this group:

	Card Col.	YES (a)	NO (b)
5. Are you now using metric measurement units and/or metric engineering standards in your domestic operations in any of categories listed in question 5a? (See top of next page for categories.) (NOTE: If answer is No, proceed to question 6).	13		
a. If answer is yes, estimate the approximate percentage of metric usage for each type of activity for the indicated years (percent related to total of indicated category). Enter NA for any activities not applicable to your operations. (Please differentiate between NA and zero.) Please make an entry in all blocks. NOTE: When both customary and metric dimensions are employed concurrently, such as on labels, the percentage desired is that portion of the category with the metric notation related to the total amount in that category; e.g., in 5a (5), if 65% of the canned product of a cannery has both metric and customary weights (ounces and grams) on the label, 15% has metric weights only (grams), and 20% has customary units only (ounces), the stated percentage should be 80; similarly for 5a (2). Include all domestic activity or production in the statistics even though the end item or product is not for domestic use. Item 5a (5) relates primarily to companies that package their product (e.g., paint, canning, pharmaceutical, refining, and milling).			

5.	ACTIVITY	Card Cols.	5 yrs. ago (1965)	Current (1970)	Future (1975)
a.	(1) Design, Engineering, Shop Drawings (% related to total man-hours in this activity)	14-22			
	(2) Catalogues (% related to total number of catalogues)	23-31			
	(3) Research and Development (% related to total man-hours in this activity)	32-40			
	(4) Manufacturing process, including tooling and test equipment (% related to total man-hours in this activity)	41-49			
	(5) Labeling (% related to total product packaged)	50-58			
	(6) Other (specify)	59-67			

		Card. Cols.	YES (a)	NO (b)
b.	If you are presently using metric measurement units in any of your shop drawings:			
	(1) Do you use metric dimensions exclusively?	68		
	(2) Do you use dual dimensions?	69		
	(3) Do you use both metric and customary drawings?	70		

		Card Cols.	YES (a)	NO (b)	DON'T KNOW (c)
c.	If your use of metric measurement units and/or metric engineering standards have you experienced advantages in the following areas: (Check applicable boxes)				
	(1) Training personnel	10			
	(2) Economy in engineering design and drafting	11			
	(3) Fewer sales items to comprise complete lines (e.g., fewer sizes of bearings or machine screws in standard line, etc.)	12			
	(4) Fewer production items in inventory (e.g., fewer sizes of taps to match fewer sizes of machine screws, etc.)	13			
	(5) Economies in the manufacturing process	14			
	(6) Expanded exports	15			
	(7) Decrease of competitive imports	16			
	(8) Improved competitive position	17			
	(9) Increase of domestic sales	18			
	(10) Simplified specifications, cataloguing and records	19			
	(11) Improved Intra-company liaison and records	20			
	(12) Other advantages (list)	21			

		Card Cols.	YES (a)	NO (b)	DON'T KNOW (c)
d.	In your use of metric measurement units and/or metric engineering standards, have you experienced disadvantages in the following areas: (Check applicable boxes)				
	(1) Training personnel	22			
	(2) Dual dimensioning or duplication of drawings	23			
	(3) More sales items to comprise complete lines (e.g., more sizes of bearings or machine screws in standard line, etc.)	24			
	(4) More production items in inventory (e.g., more sizes of bearings or machine screws etc.)	25			
	(5) Increased waste in the manufacturing process	26			
	(6) Difficulty in obtaining metric sized parts and tools	27			
	(7) Increase of competitive imports	28			
	(8) Impaired competitive position	29			
	(9) Decrease of domestic sales	30			
	(10) Conflict with existing statutes	31			
	(11) Impaired Intra-company liaison and records	32			
	(12) Other disadvantages (list)	33			

5.

e. In your opinion how do advantages and disadvantages relate to each other? (CC 34)

- ☐ (1) advantages outweigh disadvantages
- ☐ (2) disadvantages outweigh advantages
- ☐ (3) No significant difference
- ☐ (4) Don't know

(NOTE: If you answered "yes" to 5, proceed to question 7.)

6. Are you currently planning to introduce the use of metric measurement units and/or metric engineering standards in your domestic operations by the end of 1975 regardless of any action that the nation as a whole might take? ☐Yes ☐No (CC 35)

a. If yes, indicate the approximate percentage of metric usage for each type of activity by the end of 1975 (% related to total of category). Enter NA for any activities not applicable to your operations. (Please differentiate between NA and zero.) NOTE: When both customary and metric dimensions are employed concurrently, such as on labels, the percentage desired is that portion of the category with the metric notation related to the total amount in that category; e.g., in 6a (5), if 65% of the canned product of a cannery has both metric and customary weights (ounces and grams) on the label, 15% has metric weights only (grams), and 20% has customary units only (ounces), the stated percentage should be 80; similarly for 6a (2). Include all domestic activity or production in the statistics even though the end item or product is not for domestic use. Item 6a (5) relates primarily to companies that package their product (e.g., paint, canning, pharmaceutical, refining, and milling).

ACTIVITY	Card Col.	Percent
(1) Design, Engineering, Shop Drawings (% related to total man-hours in this activity)	36-38	%
(2) Catalogues (% related to total number of catalogues)	39-41	%
(3) Research and Development (% related to total man-hours in this activity)	42-44	%
(4) Manufacturing process including tooling and test equipment (% related to total man-hours in this activity)	45-47	%
(5) Labeling (% related to total product packaged)	48-50	%
(6) Other (list)	51-53	%

(NOTE: If you answered "no" to both 5 and 6, proceed to question 8.)

7. If you are using or plan to use metric measurement units and/or metric engineering standards in your domestic operations, what factors were instrumental in your decision to take this course of action (Check 1 or more):

INSTRUMENTAL FACTORS	Card Col.	YES (a)	NO (b)
(1) Economies resulting from simplification due to the use of metric units	54		
(2) Expectation of increased export market	55		
(3) Economy of importation of standard metric components	56		
(4) Advantages resulting from having one basic system of measurement in your worldwide production	57		
(5) Mating with standard metric design components	58		
(6) Other factors (specify)	59		

8. If you are using any materials or components designed to metric engineering standards in your domestic operations, do these standards cover the items listed below?

NOTE: Bear in mind that even though the product you manufacture may be described in customary units, some materials or components may be based, in whole or in part, on metric engineering standards; e.g., spark plugs, certain types of bearings, fasteners, or sheet metal, especially if they are imported. (Check appropriate box)

ITEMS	Card. Col.	YES	NO	DON'T KNOW
(1) Fasteners (nuts, bolts, etc.)	60			
(2) Electrical connectors and fuses	61			
(3) Pipe and pipe fittings	62			
(4) Metric sizes of sheet, barstock, etc.	63			
(5) Bearings	64			
(6) Other areas (specify)	65			

	Card. Col.	YES (a)	NO (b)
9. Are any of your U.S.-made products in this SIC product group exported?	66		

a. If yes, what percent is exported (related to total value of sales)? (CC 67)
☐ Less than 5% ☐ 5% to 25% ☐ More than 25%

b. If your product is exported, does this export necessitate changes or modifications in the following categories?
NOTE: Item b (1) refers to metric notations of weight, size or volume on the label or package; e.g., on candy bars, packaged flour, or canned vegetables. Item b (6) on the other hand refers to the container itself. If you have to package paint in liter can sizes (1.057 U.S. quarts) for export you would check "Yes" for b (6) as well as for b (1). If you export paint in quart sizes and have the notation .946 liter on the can, you would check "No" for b (6), but at the same time you would check "Yes" for b (1).

CATEGORY	Card Col.	YES (a)	NO (b)
(1) Metric measurement units in labeling	68		
(2) Metric measurement units in instructions	69		
(3) Metric measurement units in descriptions	70		
(4) Metric measurement units on your dials, gages, etc.	71		
(5) Design of product to metric modules	72		
(6) Metric size containers	73		
(7) Metric engineering standards	74		
(8) Other modifications (specify)	75		

	Card Col.	YES (a)	NO (b)
10. Do you have manufacturing agreements or operations in foreign countries?	76		
a. If yes, does this manufacture involve metric units and/or metric engineering standards?	77		
11. If you manufacture in the United States under an agreement with a foreign company is the product or process described in metric measurement units?	78		
a. If yes, are the metric units translated into customary units in your operations?			

NOTE: In your answers to questions 5 to 11 inclusive you supplied information regarding your current and anticipated use of the metric system and the current and expected impact of this usage. The nature of those questions is such that they elicited information based on the existing environment of no coordinated action on a national scale with regard to metrication and a continuation of the present practice of using the metric system or retaining the customary system when either appears to be economically and technically preferable to the other as a matter of individual company policy.

The following three questions (12, 13, and 14) are to be answered based on the assumption by you, solely for the purpose of answering these three questions, that there will be a coordinated national program of metrication based on voluntary participation in accord with which:

1. The use of metric units and metric engineering standards will be increased only for new or redesigned products or new or redesigned parts of the product. Unless there are distinct advantages in changing, the production of an existing item will remain unchanged until the normal design life cycle of that product is completed and a new metric-designed product replaces it.

2. In-house designed products or components will be designed in metric units on a schedule that is compatible with normal obsolescence of tooling or with economically feasible conversion of tooling from customary to metric units. Existing items of production equipment will be used until their normal life cycles are completed; the only changes or conversion to metric units will be in dials, gages, some feed-rate controls, and indicating devices. Such changes will be made on an economic basis (i.e., when the demand for metric designed parts or products requires a change).

3. Out-of-house production materials and components based on metric engineering standards will become available during the transition period at no substantial increase in cost.

4. The transition period for your product group will be the time in which the transition of the product from customary units and customary engineering standards to metric units and metric engineering standards where appropriate can be accomplished at minimum cost to your company.

5. The metric system will be taught in all U.S. schools during the transition period and the general public will concurrently be gaining familiarity with this system of measurement.

12. What advantages or disadvantages do you foresee from the standpoint of the domestic operations of your company if a coordinated national program of metrication based on voluntary participation is followed in most sectors of the economy.

		Card Col.	YES (a)	NO (b)	DON'T KNOW
a.	With respect to advantages:				
(1)	Training personnel	10			
(2)	Economy in engineering design and drafting	11			
(3)	Fewer sales items to comprise complete lines (e.g., fewer sizes of bearings or machine screws in standard line, etc.)	12			
(4)	Fewer production items in inventory (e.g., fewer sizes of taps to match fewer sizes of machine screws, etc.)	13			
(5)	Economies in the manufacturing process	14			
(6)	Expanded exports	15			
(7)	Decrease of competitive imports	16			
(8)	Improved competitive position	17			
(9)	Increase of domestic sales	18			
(10)	Simplified specifications, cataloguing and records	19			
(11)	Improved Intra-company liaison and records	20			
(12)	Other advantages (list)	21			
b.	With respect to disadvantages:				
(1)	Training personnel	22			
(2)	Dual dimensioning or duplication of drawings	23			
(3)	More sales items to comprise complete lines (e.g., more sizes of bearings or machine screws in standard line, etc.)	24			
(4)	More production items in inventory (e.g., more sizes of bearings or machine screws, etc.)	25			
(5)	Increased waste in the manufacturing process	26			
(6)	Difficulty in obtaining metric sized parts and tools	27			
(7)	Increase of competitive imports	28			
(8)	Impaired competitive position	29			
(9)	Decrease of domestic sales	30			
(10)	Conflict with existing statutes	31			
(11)	Impaired Intra-company liaison and records	32			
(12)	Other disadvantages (list)	33			

c. In your opinion how do advantages and disadvantages relate to each other? (CC 34)

☐ (1) advantages outweigh disadvantages ☐ (3) No significant difference
☐ (2) disadvantages outweigh advantages ☐ (4) Don't know

NOTE: Answering question 13 is optional for suppliers of standard materials and standard parts.

13. What is your estimate of the number of years necessary to achieve your maximum increased metric usage with minimum cost and disruptions to your company under a coordinated national program of metrication based on voluntary participation covering essentially all sectors of the economy? (CC 35-36) ______________ years

14. If your company were to substantially convert to metric measurement units and/or metric engineering standards under a coordinated national program of metrication based on voluntary participation covering essentially all sectors of the economy, do you anticipate that this would have any effect on your sales because of importation of metric products (assume year 1980 but base your answer on 1969 dollars)? (Check one) (CC 37)

☐ (a) No effect ☐ (b) Loss of sales ☐ (c) Don't know

a. If "loss of sales" is checked, what, in your opinion, would this loss be in 1980 as percent of your current domestic sales based on 1969 dollars? (Check one) (CC 38)

☐ (a) Up to 5% ☐ (c) 10–20% ☐ (e) Don't know
☐ (b) 5–10% ☐ (d) Over 20%

15. If your product is not now exported would you expect to export it if your company substantially converts to metric measurement units and/or metric engineering standards (assume year 1980)? (CC39) ☐ (a) Yes ☐ (b) No

16. If your product is now exported, do you anticipate that if your company were to substantially convert to metric measurement units and/or metric engineering standards this would have any effect on your export sales (assume year 1980 but base your answer on 1969 dollars)? (Check one) (CC 40)

☐ (a) No effect ☐ (c) Decrease in export sales
☐ (b) Increase in export sales ☐ (d) Don't know

a. If "Increase in export sales" is checked, what, in your opinion, would this increase be in 1980 as % of your current export sales based on 1969 dollars? (Check one) (CC 41)

☐ (a) Up to 10% ☐ (c) 25–50% ☐ (e) Don't know
☐ (b) 10–25% ☐ (d) Over 50%

b. If "Decrease in export sales" is checked, what, in your opinion, would this decrease be in 1980 as % of your current export sales based on 1969 dollars? (Check one) (CC 42)

☐ (a) Up to 10% ☐ (c) 25–50% ☐ (e) Don't know
☐ (b) 10–25% ☐ (d) Over 50%

17. Please check block that most closely indicates the current attitude of your company toward increased metric usage regarding this SIC product group: (CC 43)

☐ (a) Strongly for ☐ (c) Neutral ☐ (e) Strongly against
☐ (b) Mildly for ☐ (d) Mildly against

18. Do you believe that increased metric usage is in the best interests of the United States? (CC 44)

☐ (a) Yes ☐ (b) No

19. If it is found that increased metric usage is in the best interests of the United States, which of the following courses of action, in your opinion, is preferable? (CC 45)

☐ (a) No national program of metrication ☐ (b) A coordinated national program based on voluntary participation ☐ (c) A mandatory program based on legislation

20. If it is found that increased metric usage is in the best interests of the United States, in your opinion, should any engineering standards based on the customary system of measurement units and applicable to this SIC No. be retained and promoted for international use? (CC 46)

☐ (a) Yes ☐ (b) No ☐ (c) Don't know

a. If yes, please list the one or two most important standards applicable to this SIC No.

____

____

21. General comment, if any, on the subject of metric usage in your company. Comments should be made on a separate attachment.

(It is not necessary to answer this question, but any opinion on the general subject of metrication will be appreciated. For example, are there any problems peculiar to your company not covered in this questionnaire? Other questions or comments regarding metrication may occur to you.)

Reported by (Signature, name, address)

Person whom we should contact if needed:

Date reported	Phone:

FORM NBS-510
(4-70)

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Bureau Budget No.
41-S70016
Approval Expires June 30, 1971

U. S. METRIC STUDY
MANUFACTURING INDUSTRY QUESTIONNAIRE
PART B.–COST – SECTION 1

For companies reporting on product groups other than standard parts and/or standard materials

Company name:

a. Product group covered (4-digit SIC #)

b. Total value of sales by your company of this SIC product group for the year 1969 (Check appropriate box)

☐ a. Up to $1 million
☐ b. Over $1m to $5m
☐ c. Over $5m to $10m
☐ d. Over $10m to $25m
☐ e. Over $25m to $50 m
☐ f. Over $50m to $100m
☐ g. Over $100m to $250m
☐ h. Over $250m to $500m
☐ i. Over $500m to $1 billion
☐ j. Over $1 billion

c. Total value of materials (see definition) as a percent of your total value of sales for the year 1969 for this product group . . . . ________ %

d. Estimated total in-house net added cost of metrication for this product group over the optimum period as a percent of the total value of your 1969 sales for this product group . . . . ________ %

e. If you used a sample product for making this evaluation, what percent of the total value of sales indicated in b. did this sample represent? . . . . ________ %

f. What is your optimum period for this product group? . . . . ________ yrs.

g. Percent of item (d) attributed to the following (total = ± 100%)

1. Personnel Education . . . . ________ %
2. Engineering and Research and Associated Documentation . . . . ________ %
3. Manufacturing and Quality Control . . . . ________ %
4. Records and Accounting . . . . ________ %
5. Standards Association Activity . . . . ________ %
6. Warehousing . . . . ________ %
7. Sales and Service . . . . ________ %
8. Other . . . . ________ %

Total . . . . ± 100 %

h. If your company converted this product to metric measurement during a coordinated national program of metrication of 10-year duration based on voluntary participation, what would be the estimated total in-house net added cost of metrication for this product group over this 10-year period as a percent of the total value of your 1969 sales for this product group . . . . ________ %

i. Do you believe that significant tangible savings by your company would eventually result from a transition to the metric system of this product group? . . . . ☐ Yes ☐ No

If yes, how many years do you believe it would take these tangible savings to equal the net added cost that would be incurred by your company during your optimum transition period to the metric system for this product group? ________ yrs.

Reported by (Signature, name, address)

Person whom we should contact if needed:

Date of Report

Phone:

FORM NBS-510
(4-70)

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. METRIC STUDY
MANUFACTURING INDUSTRY QUESTIONNAIRE
PART B. – COST–SECTION 2

Far companies reporting on product groups that are standard ports ond/ar standard materials.

Bureau Budget No.
41-S70016
Approval Expires June 30, 1971

Company name:

a. Product group covered (4-digit SIC #)

b. Total value of sales of this SIC product group for the year 1969 (Check appropriate box)

☐ a. Up to $1 million
☐ b. Over $1m to 5m
☐ c. Over $5m to $10m
☐ d. Over $10m to $25m
☐ e. Over $25 to $50m
☐ f. Over $50m to $100m
☐ g. Over $100m to $250m
☐ h. Over $250m to $500m
☐ i. Over $500m to $1 billion
☐ j. Over $1 billion

c. Total value of materials (see definition) as a percent of your total value of sales for the year 1969 for this product group . . . . ________ %

d. Estimated total in-house net added cost for development of capability to supply standard parts and/or standard materials to both customary standards and metric standards as metric standards are developed expressed as percent of the total value of your 1969 sales for this product group . . . . ________ %

e. Estimated annual in-house net added cost for maintaining capability to supply standard parts and/or standard materials to both customary standards and metric standards expressed as percent of the total value of your 1969 sales for this product group . . . . ________ %

f. If you used a sample product for making this evaluation, what percent of the total value of sales indicated in b. did this sample represent? . . . . ________ %

g. Percent of items (d) and (e) attributed to the following (total = ± 100%)

		(d)	(e)
1.	Personnel Education	____%	____%
2.	Engineering and Research and Associated Documentation	____%	____%
3.	Manufacturing and Quality Control	____%	____%
4.	Records and Accounting	____%	____%
5.	Standards Association Activity	____%	____%
6.	Warehousing	____%	____%
7.	Sales and Service	____%	____%
8.	Other	____%	____%
	Total	± 100 %	± 100 %

h. Do you believe that significant tangible savings by your company would eventually result from a transition to the metric system of this product group? . . . . ☐ Yes ☐ No

If yes, how many years do you believe it would take these tangible savings to equal the net added cost that would be incurred by your company during your transition to the metric system for this product group? ________________ yrs.

Reported by (Signature, name, address)

Person whom we should contact if needed:

Date of Report | Phone:

Budget Bureau No. 41-S70044; Approval Expires December 31, 1970

Name and address of company *(Principal office) (Street, City, State and Zip Code)*

FORM BDSAF-871B
(7-7-70)

U.S. DEPARTMENT OF COMMERCE
BUSINESS AND DEFENSE SERVICES ADMINISTRATION

IMPACT OF METRICATION ON U.S. IMPORTS OF PRODUCT CLASS ____________

Return to: U.S. Department of Commerce
Washington, D.C. 20230
Attention: Business and Defense Services
Administration, OAAIA -510

RETURN NO LATER THAN SEPTEMBER 1, 1970

INSTRUCTIONS

General - Nearly all countries of the world have adopted the metric system of measurement. The United Kingdom in 1965 announced its intention of converting all manufacturing and other sectors of its economy to the metric system by 1975. In 1967, South Africa decided to follow.

In 1969, the New Zealand Government announced its intention of making the metric system its national system of weights and measures, and in 1970, both Australia and Canada announced the same intention.

Public Law 90-472, August 9, 1968, authorized the Secretary of Commerce to conduct a program of investigation, research, and survey to determine the impact of increasing worldwide use of the metric system on the United States.

As part of this study, BDSA has been asked to conduct a survey to evaluate the potential impact that metrication in the United States may have on U.S. foreign trade.

Mailing - Prepare and return one copy of this report to the Business and Defense Services Administration, U.S. Department of Commerce, Washington, D.C. 20230, **no later than September 1, 1970.**

Coverage - A complete report should be filed for your company for product class .
In all sections, except Section I, report data only for this product class. In Section I include all products shipped. Please complete all sections. If data are not available for any single item, report not available (NA). If your company does not maintain central records for all of your subsidiaries or divisions, you may elect to report for a single subsidiary or division. If you choose to report on this basis, select that subsidiary, department, or division whose products are most representative of the subject product class. Also indicate in the space below the name of the subsidiary, department or division

Estimates - If exact data are not available, reasonable estimates are acceptable. Report all value figures in terms of thousands of dollars, rounded to the nearest $1 thousand.

Confidentiality - The individual company information reported on this form is for statistical purposes only. The unauthorized publication or disclosure of individual company information by Government personnel is prohibited by law, and such personnel having access thereto are subject to fine and imprisonment for unauthorized disclosure.

Definitions

Value of Imports - The market value in the foreign country, excluding U.S. import duties, freight charges, and insurance, for goods coming into the U.S. customs area (the 50 States, the District of Columbia, and Puerto Rico) without regard to whether the importation involved a commercial transaction. This is the same value information required on import entries in accordance with Sections 402 and 402(A) of the Tariff Act of 1930, as amended.

Foreign Subsidiaries or Affiliates - Any foreign incorporated company in which the U.S. parent company holds 25 percent or more of the voting stock.

U.S. Customary System - The system of measurement units (yard, pound, second, degree Fahrenheit, and units derived from these) most commonly used in the United States. Synonyms: "English system," "U.S. system."

Metric System - The measurement system based generally on the meter as a unit of length, the kilogram as a unit of mass, the second as a unit of time, the degree Celsius as a unit of temperature and units derived from these. This system has evolved over the years and the modernized version today is identified as the "International System of Units" (SI).

Engineering Standards - A practice established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents prescribing screw thread dimensions, chemical composition and mechanical properties of steel, clothing sizes, performance standards, sizes and ratings, methods of testing for materials, and codes for highway signs. Engineering standards may be designated in terms of the level of coordination by which they were established (e.g., company standards, industry standards, national standards) in terms of the "language" or units upon which they are based (e.g., metric standards).

Metrication - Any act tending to increase the use of the metric system (SI), whether it be increased use of metric units or engineering standards that are based on such units.

Section I - 1969 TOTAL IMPORTS

Item	Value *($000)*
1. Total imports, all products.	

Section II - PRODUCT CLASS IMPORTS

Item	Value *($000)*		
	1967	1968	1969
1. Total imports of product class by supplier, total.			
a. From foreign affiliates.			
1. For further processing or assembly			
2. For resale without further manufacturing			
3. Other.			
b. From other foreign sources			
1. For further processing or assembly.			
2. For resale without further manufacturing.			
3. Other.			
2. Imports by system of measurement, total (estimates are acceptable).			
a. Value of imports designed, assembled, manufactured, and described in U.S. customary units and engineering standards			
b. Value of imports designed and manufactured in metric units and engineering standards but **described** in labels, packages, engineering drawings, or catalogues in U.S. customary units. Descriptions in dual dimensions would be included.			
c. Value of imports designed and manufactured in metric units and engineering standards but which have been substantially modified or changed to include standard parts, components, or subassemblies designed and manufactured in U.S. customary units and engineering standards.			
d. Value of imports designed, assembled, manufactured, and described in metric units and engineering standards.			

Section III - MAJOR FACTORS CURRENTLY INFLUENCING IMPORTS OF SUBJECT PRODUCT CLASS, BY FOREIGN SUPPLIER (COUNTRY) - The purpose of this section is to determine the most important factors affecting your current trade in the subject product class by major country, particularly the relative importance of the measurement system (U.S. customary or metric) to all other factors.

A. For those countries from which you are currently importing, rank by number (1, 2, 3, etc.) the five most favorable factors influencing your sales.

Factors promoting your imports	Canada	United Kingdom	West Germany	France	Italy	Netherlands	Lux-Belgium	Japan	Mexico
1. Superior technology of product.									
2. Prices are competitive									
3. Higher quality product.									
4. Reputation and reliability of product									
5. Growing U.S. market									
6. Vigorous company sales promotion program . .									
7. Low shipping costs									
8. Products designed and manufactured in metric units and/or engineering standards.									
9. Products are designed and manufactured in U.S. customary units and/or engineering standards.									
10. Lack of U.S. domestic competition									
11. Product maintenance and servicing is available									
12. Other *(Specify)*									
13.									

Section III -

B. For those countries listed below from which you are **not** now importing, rank by number (1, 2, 3, etc.) the five most important factors which are deterrents to your importing.

Factors deterring your imports	Canada	United Kingdom	West Germany	France	Italy	Netherlands	Lux-Belgium	Japan	Mexico
1. No technological advantage of products									
2. Prices are not competitive									
3. No quality advantage of product									
4. Stagnant U.S. market									
5. No company sales promotion program									
6. High shipping costs									
7. Products designed and manufactured in U.S. customary units and/or engineering standards									
8. High U.S. tariff duties									
9. Strong U.S. competition									
10. Products designed and manufactured in metric units and/or engineering standards									
11. Product maintenance and servicing not available									
12. Other *(Specify)*									
13.									
14.									

Section IV - IMPORT POTENTIAL AND METRICATION IMPACT

Report in Part A and B your company's estimated percentage change in imports of subject product class in 1975 as compared with 1970 under the following assumptions:
(1) The 8 percent annual growth rate in Free World international trade for the last six years will continue for the period 1970-75.
(2) United Kingdom, Canada, Australia, and New Zealand have substantially completed conversion to the metric measurement system by 1970.
(3) Base estimate on current 1970 dollars.

A. If the United States and your company continue to use current customary measurement units and/or engineering standards, by what percentage would your 1975 imports increase or decrease over 1970? (This assumes that among all major industrialized countries only the U.S. will not have converted.)

Increase ________ % No change ________ Decrease ________ %

B. If the United States and your company had converted to metric measurement units and engineering standards by 1970, by what percentage would your 1975 imports increase or decrease over 1970? (This assumes there would be no changes in U.S. manufactures cost of producing the subject product in metric units and/or standards.)

Increase ________ % No change ________ Decrease ________ %

C. Under the assumption as in Part B, would your imports of subject product class:

1. From your foreign affiliates, if any, ☐ increase, ☐ decrease, ☐ or remain at the current level
(Please check the appropriate box)

2. From other foreign suppliers (other than foreign affiliates) to the United States ☐ increase, ☐ decrease, ☐ or remain at the current level
(Please check the appropriate box)

3. a. And from what foreign suppliers (countries) if any, would your company expect your imports to increase?

________ ________ ________ ________ ________

b. And from what foreign suppliers (countries) if any, would your company expect your imports to decrease?

________ ________ ________ ________ ________

FORM BDSAF-871B (7-7-70) USCOMM-OC 37014-P71

Section V - **REMARKS.** Additional comments which would help us evaluate this report.	
Name of person who should be contacted if questions arise regarding this report	Area Code and Telephone No.
Reported by *(Signature, Name, and Address)*	Date reported

FORM BDSAF-871B (7-7-70) USCOMM-DC 37014-P71

Budget Bureau No. 41-S70044; Approval Expires December 31, 1970

Name and address of company *(Principal office) (Street, City, State and Zip Code)*

FORM BDSAF-871A
(7-7-70)

U.S. DEPARTMENT OF COMMERCE
BUSINESS AND DEFENSE SERVICES ADMINISTRATION

IMPACT OF METRICATION ON U.S. EXPORTS OF PRODUCT CLASS ____________

Return to: U.S. Department of Commerce
Washington, D.C. 20230
Attention: Business and Defense Services
Administration, OAAIA -510

RETURN NO LATER THAN SEPTEMBER 1, 1970

INSTRUCTIONS

General - Nearly all countries of the world have adopted the metric system of measurement. The United Kingdom in 1965 announced its intention of converting all manufacturing and other sectors of its economy to the metric system by 1975. In 1967, South Africa decided to follow.

In 1969, the New Zealand Government announced its intention of making the metric system its national system of weights and measures, and in 1970, both Australia and Canada announced the same intention.

Public Law 90-472, August 9, 1968, authorized the Secretary of Commerce to conduct a program of investigation, research, and surveys to determine the impact of increasing worldwide use of the metric system on the United States.

As part of this study, BDSA has been asked to conduct a survey to evaluate the potential impact that metrication in the United States may have on U.S. foreign trade.

Mailing - Prepare and return one copy of this report to the Business and Defense Services Administration, U.S. Department of Commerce, Washington, D.C. 20230, **no later than September 1, 1970.**

Coverage - A complete report should be filed for your company for product class . In all sections, except Section I, report data only for this product class. In Section I include all products shipped. Please complete all sections. If data are not available for any single item, report not available (NA). If your company does not maintain central records for all of your subsidiaries or divisions, you may elect to report for a single subsidiary or division. If you choose to report on this basis, select that subsidiary, department, or division whose products are most representative of the subject product class. Also indicate in the space below the name of the subsidiary, department, or division.

Estimates - If exact data are not available, reasonable estimates are acceptable. Report all value figures in terms of thousands of dollars, rounded to the nearest $1 thousand.

Confidentiality - The individual company information reported on this form is for statistical purposes only. The unauthorized publication or disclosure of individual company information by Government personnel is prohibited by law, and such personnel having access thereto are subject to fine and imprisonment for unauthorized disclosure.

Definitions

Value of Shipments - The received or receivable net selling values, f.o.b. plant (exclusive of freight and taxes), of products shipped, include installation where applicable. This is the same definition used by the Bureau of the Census.

Export Shipments - Value of shipments from the U.S. Customs area (including the 50 States, the District of Columbia and Puerto Rico) to foreign countries at the seaport, border point, or airport of exportation. It is based on the selling price (or cost if not sold) and includes inland freight, insurance and other charges to the port of exportation. This is the same definition used to prepare the Shipper's Export Declaration, Commerce Form 7525-V, which is filed with the U.S. Bureau of Customs.

Foreign Subsidiaries or Affiliates - Any foreign incorporated company in which the U.S. parent company holds 25 percent or more of the voting stock.

U.S. Customary System - The system of measurement units (yard, pound, second, degree Fahrenheit, and units derived from these) most commonly used in the United States. Synonyms: "English system," "U.S. system."

Metric System - The measurement system based generally on the meter as a unit of length, the kilogram as a unit of mass, the second as a unit of time, the degree Celsius as a unit of temperature and units derived from these. This system has evolved over the years and the modernized version today is identified as the "International System of Units" (SI).

Engineering Standards - A practice established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents prescribing screw thread dimensions, chemical composition and mechanical properties of steel, clothing sizes, performance standards, sizes and ratings, methods of testing for materials, and codes for highway signs. Engineering standards may be designated in terms of the level of coordination by which they were established (e.g., company standards, industry standards, national standards) or in terms of the "language" or units upon which they are based (e.g., metric standards).

Metrication - Any act tending to increase the use of the metric system (SI), whether it be increased use of metric units or engineering standards that are based on such units.

Section I - 1969 TOTAL SHIPMENTS - DOMESTIC AND FOR EXPORT	
Item	Value *($000)*
Total Shipments, all products	
1. Domestic shipments	
2. Export shipments	

Section II - PRODUCT CLASS SHIPMENTS - DOMESTIC AND FOR EXPORT			
Item	Value *($000)*		
	1967	1968	1969
Total shipments, product class			
1. Domestic shipments.			
2. Export shipments by customer, total			
a. To foreign affiliates			
1. For further processing or assembly			
2. For resale without further manufacturing			
3. Other			
b. To other foreign customers			
3. Export shipments by system of measurement, total (estimates are acceptable):			
a. Value of exports designed, assembled, manufactured, and described in U.S. customary units and engineering standards.			
b. Value of exports designed and manufactured in U.S. customary units and engineering standards but described in labels, packages, engineering drawings or catalogues in metric units. Descriptions in dual dimensions would be included.			
c. Value of exports designed and manufactured in U.S. customary units and engineering standards but which have been substantially modified or changed to include standard parts, components, or subassemblies designed and manufactured in metric units and engineering standards.			
d. Value of exports designed, assembled, manufactured, and described in metric units and engineering standards			

Section III - MAJOR FACTORS CURRENTLY INFLUENCING EXPORT SHIPMENTS OF SUBJECT PRODUCT CLASS, BY FOREIGN MARKET - The purpose of this section is to determine the most important factors affecting your current trade in the subject product class by major country, particularly the relative importance of the measurement system (U.S. customary or metric) to all other factors.

A. For those countries to which you are currently exporting, rank by number (1, 2, 3, etc.) the five most favorable factors influencing your sales.

Factors promoting your exports	Canada	United Kingdom	West Germany	France	Italy	Netherlands	Lux-Belgium	Japan	Mexico
1. Superior technology of your products.									
2. Prices are competitive.									
3. Higher quality products									
4. Reputation and reliability of product.									
5. Growing foreign market.									
6. Vigorous company export promotion program .									
7. Low shipping costs									
8. Products designed or manufactured in U.S. customary units and/or engineering standards									
9. Low tariff duties.									
10. Lack of non-tariff barriers.									
11. Lack of local and third country competition. .									
12. Products designed and manufactured in metric units and/or engineering standards									
13. Good financing and insurance.									
14. Product maintenance and servicing is available.									
15. Others *(Specify)*									
16.									
17.									

Section III -

B. For those countries listed below to which you are not now exporting, rank by number (1, 2, 3, etc.) the five most important factors which are deterrents to your exporting.

Factors deterring your exports	Canada	United Kingdom	West Germany	France	Italy	Netherlands	Lux-Belgium	Japan	Mexico
1. No technological advantage of products									
2. Prices are not competitive.									
3. No quality advantage of products									
4. Stagnant foreign market.									
5. No company export promotion program									
6. High shipping costs.									
7. Products designed and manufactured in U.S. customary units and/or engineering standards									
8. High tariff duties.									
9. Non-tariff barriers.									
10. Strong local and third country competition . .									
11. Products designed or manufactured in metric units and/or engineering standards									
12. Poor financing and insurance.									
13. Product maintenance and servicing difficult.									
14. Others *(Specify)*									
15.									
16.									
17.									

Section IV - EFFECT OF METRICATION ON EXPORT ACTIVITIES

1. Does your company design and manufacture the same products falling within the subject product class in both U.S. customary measurement units and/or engineering standards and metric units and/or engineering standards for export sales?

☐ Yes ☐ No *(If Yes, proceed to Question 2.)*

a. Has your company because it does not design or manufacture the subject product class in metric units and/or engineering standards found this a hindrance in exporting?

☐ Yes ☐ No

1. If so, please list those countries to which you are not able to export:

____________________ ____________________

____________________ ____________________

____________________ ____________________

2. Does your company or any of its domestic subsidiaries, divisions, or similar organizations of your company actively solicit export orders for subject product class specifying they be produced in substantially metric units and/or engineering standards?

☐ Yes ☐ No

3. In the last three years, has your company ever turned down an export order for any product falling within the subject product class solely because it could not meet the specifications that the goods be produced in metric units and/or engineering standards?

☐ Yes ☐ No

4. Because the United Kingdom is converting to the metric system, will this adversely affect your export sales if your company does not convert its production to metric units and/or engineering standards?

☐ Yes ☐ No ☐ Do not know

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Section V - EXPORT POTENTIAL AND METRICATION IMPACT

Report in Part A and B your company's estimated percentage change in export shipments of subject product class in 1975 as compared with 1970 under the following assumptions:
(1) The 8 percent annual growth rate in Free World international trade for the last six years will continue for the period 1970-75.
(2) United Kingdom, Canada, Australia, and New Zealand have substantially completed conversion to the metric measurement system by 1970.
(3) Base estimate on current 1970 dollars.

A. If the United States and your company continue to use current customary measurement units and/or engineering standards, by what percentage would your 1975 export shipments to all countries increase or decrease over 1970? (This assumes that among all major industrialized countries only the U.S. will not have converted.)

Increase ______________ % No change ________________ Decrease ______________ %

B. If the United States and your company had converted to the metric measurement units and/or engineering standards by 1970, by what percentage would your 1975 export shipments to all countries increase or decrease over 1970? (This also assumes there would be no changes in the cost of producing the subject product in metric units and/or engineering standards. Consideration should also be given to potential new markets where you may not be currently exporting because your products were not manufactured in metric measurements or engineering standards but which would open up, assuming your company had converted to the metric system.)

Increase ______________ % No change ________________ Decrease ______________ %

C. Under the assumption as in Part B, would your export shipments of subject product class:

1. From the United States to your foreign affiliates, if any, ☐ increase, ☐ decrease, or ☐ remain at the current level?
(Check the appropriate box)

2. From the United States to other foreign customers (other than foreign affiliates) ☐ increase, ☐ decrease, or ☐ remain at the current level?
(Check the appropriate box)

3. From your foreign affiliates, if any, to the United States ☐ increase, ☐ decrease, or ☐ remain the same?
(Check the appropriate box)

4. a. And in what foreign markets (countries) if any, would your company expect its exports from the United States to increase?

______________ ______________ ______________ ______________ ______________

b. And in what foreign markets (countries) if any, would your company expect its exports from the United States to decrease?

______________ ______________ ______________ ______________ ______________

Section VI - REMARKS: Additional comments which would help us evaluate this report. *(Use additional sheet if necessary)*

Name of person who should be contacted if questions arise regarding this report	Area Code and Telephone No.
Reported by *(Signature, Name, and Address)*	Date reported

FORM BDSAF-871A (7-7-70) USCOMM-DC 37015-P71

"FEDERAL GOVERNMENT SURVEY
Areas of National Responsibility"

This Questionnaire seeks Agency Head estimates of the effect of metrication on:

a. National areas* in which their agencies have responsibility (e.g., transportation, communications etc.)

b. Ability of federal agencies to perform their missions with respect to those areas of responsibility.

This Questionnaire should be completed and returned to the National Bureau of Standards at the same time as the Federal Government Survey (Internal Operations) Questionnaires.

The "Federal Government Survey: Internal Operations"** Questionnaire and the "Federal Government Survey: Area(s) of National Responsibility" Questionnaire should be reviewed in the preparation of your agency overall statement on the effects of increased worldwide and domestic usage of the metric system.

If more space is needed, please use additional sheets of paper.

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*By "areas of national responsibility" we mean a "complex" or "system" such as transportation, food and fibre and international affairs. This "system" is for the most part within the private sector of the U. S. economy. In this questionnaire, we seek estimates of the impact of metrication on the ability of the transportation system (for example) to function. We prefer that the opinions expressed be those of the Agency rather than those of the Agency's constituents. The U. S. Metric Study has other Surveys designed to obtain estimates from these constituents.

**The "Federal Survey: Internal Operations" questionnaire, which is being distributed to key personnel within your Agency, is concerned with metrication's effects on your Agency, itself. The two questionnaires complement each other.

Questionnaire for Agency Heads

"FEDERAL GOVERNMENT SURVEY:
Areas of National Responsibility"

Agency____

Respondent______________________________________

Name Title

Assisted by:____________________________________

Name Title

____

Name Title

____

Name Title

AREA OF NATIONAL RESPONSIBILITY:

1. To what extent is the metric system used in your area of responsibility (e.g., transportation system) in the United States?

   75 - 100% /_/

   26 - 74% /_/

   0 - 25% /_/

2. Do you discern any trends in metric usage in your area of responsibility?

   /_/Yes /_/No /_/DK

   2a. If yes, please explain.

   ____

   ____

   ____

   ____

3. What has been the impact on your area of responsibility of the increasing worldwide and domestic use of the metric system to the present time? Please estimate the impact according to the scale.*

   Negligible /_/ Substantial /_/

   Trivial /_/ Severe /_/

   Moderate /_/

*See attachment "Classification of Intensities of Impact"

3a. Please explain, as concretely as possible.

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4. What would be the likely effects on your area of responsibility (advantages, disadvantages, costs, benefits, practical difficulties) of the increasing worldwide and domestic use of the metric system, assuming no action by the federal government.

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______________________________.

5. Would adoption of metric measurement units (and/or standards) improve or impair your effectiveness within your area of responsibility in the U. S. (e.g., the transportation system).

Improve /_/

Impair /_/

DK /_/

6. If so, how, and to what extent?

____

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______________________________.

7. What would be the effects on your area of responsibility (advantages, disadvantages, costs, benefits, practical difficulties, etc.) of a nationally planned program to increase the use of the metric system?

The above question should be answered on the basis of two alternative schedules for metrication:

1. Ten year period

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______________________________.

2. Optimum period (not to exceed 20 years)

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______________________________.

8. Are there any numerical indicators which could be used as measures of the impact of metrication on your area of responsibility (e.g., balance of payments).

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______________________________.

9. What is the impact of increasing worldwide and domestic use of the metric system on the ability of your agency to perform its mission with respect to its area of responsibility?

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9a. Please estimate the impact according to the scale.

Negligible	/_/	Substantial	/_/
Trivial	/_/	Severe	/_/
Moderate	/_/		

10. From the standpoint of your agency, what action, if any should the United States take with respect to the increasing worldwide and domestic use of the metric system?

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COMMENTS:____________________________________

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Classification of Intensities of Impact

1. Negligible
   a. Need only to convert bulk produce quantities from pounds to kilograms, gallons to liters, etc.
   b. Already converted
   c. Need to do nothing - measured size of objects not important

2. Trivial
   a. Need to re-label, double label, or redescribe package goods and products.
   b. Need to make simple adjustments on machines or products to nominal metric sizes.
   c. Need to replace simple measuring devices such as rulers, thermometers.
   d. Need to change dials on scales and guages.
   e. Most problems can be solved by conversion charts.

3. Moderate
   a. Need to replace complex measuring devices.
   b. Need to maintain dual inventories.
   c. Changes in containers necessary.
   d. Parts of tools must be replaced such as rollers and dies.

4. Substantial
   a. Screw cutting and gear cutting machines must be modified.
   b. Major readjustments must be made in machines or products to convert to a metric system.
   c. Extensive changes in engineering drawings must be made.
   d. Stock sizes must be changed.
   e. Decisions must be made on fasteners.
   f. Complex and expensive metric measuring equipment will have to be acquired; less complex equipment will have to be provided at all work stations or machines, etc.

5. Severe
   a. Of such impact as to make change disastrous or inadvisable.
   b. Non-metric practice practically world-wide.

USCOMM–NBS–DC

FEDERAL GOVERNMENT SURVEY
(INTERNAL OPERATIONS)
U. S. Metric Study
Authorized by
PL 90-472, 9-8-68

INTRODUCTION

Background

Public Law 90-472, requires the Department of Commerce to study "the increasing worldwide use of the metric system" in order to determine what action, if any, should be taken in the United States Government regarding metrication to further "the best interests of the United States". This task has been delegated by the Secretary of Commerce to the National Bureau of Standards.

This Survey of Federal Government agencies is one of the major components of the Study. Its purpose is to determine:

1. Which federal agencies use the metric system* and to what extent.

2. Which federal agencies plan to increase metric usage voluntarily (i.e., without any nationally planned program to increase metric usage).

3. What might federal agencies do to hasten metrication** should there be a nationally planned program to increase metric usage.

4. Which federal agencies would be affected, and to what degree, by changes in metric usage external to the agency.

5. To what extent would such changes (i.e., both #3 and #4) improve or impair agency effectiveness.

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*The measurement system based on the meter as a unit of length, the kilogram as a unit of mass, the second as a unit of time, the degree Celsius as a unit of temperature, and units derived therefrom. The modernized version is known as "The International System of Units"(SI)
**Metrication is defined as any act tending to increase the use of the metric system.

Synopsis of Questionnaire

This Questionnaire is divided into two parts. Part I deals with the present and asks in what ways, if any, the subdivisions of your agency use the metric measurement units and metric engineering standards* for products, containers, components, materials, equipment or processes, etc.

Part II deals with the future and asks you (1) to state what changes in measurement units and engineering standards you would like to see with regard to your subdivision (Section IIA) and (2) to predict the effects on your subdivision that would probably occur under three different assumptions:

Assumption 1 No concerted national program to increase the use of the metric measurement units and/or metric engineering standards in a world of increasing metric usage (Section IIB).

Assumption 2 A nationally planned program to increase the use of SI metric measurement units (language only). After a ten year period of transition, SI metric measurement units will be used throughout the U.S. in all new and revised documents except for describing existing customary hardware, replacement parts therefor, and interfaces therewith. (Section IIC of Questionnaire)

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*Engineering standards differ from measurement units (metric measurement units are listed in the first footnote at bottom of page i). Engineering standards consist of practices established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents describing screw thread dimensions, chemical composition and mechanical properties of steel, method of test for sulphur in oil, and codes for highway signs. Engineering standards may be designated in various classes depending upon the level of coordination by which they were established; such as, company standards, industry standards, national standards, etc. The use of metric measurement units must normally accompany the use of metric engineering standards.

Assumption 3 A nationally planned program to increase the use of metric measurement units and metric engineering standards. Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a ten year period of transition. (Section IIC of Questionnaire)

Section IID asks whether you believe that there should be concerted action to bring about changes toward metrication.

Also worth noting is that in several of the sections you do not have to answer the remaining questions in the section if you answer "No" or "Don't Know" ("DK") to the first question.

Costs are to exclude all added or reduced procurement and contracting costs except "specialized hardware" which is designed to the buyer's specification and is not available off the shelf.

Costs are to be based on 1970 dollars and are to be net (e.g., added expenses minus savings).

Another inquiry, complementary to this, will be aimed at searching out the estimated effects of metrication on large scale national systems (e.g., transportation, communication) and on the ability of federal agencies to fulfill their responsibilities in regard to these systems.

INSTRUCTIONS

This questionnaire is designed to elicit your best estimates. Please submit any available data along with your estimates.

Please feel free to use separate sheets of paper on which to put additional information.

Each department (and independent agency) is asked to submit a consolidated response using information derived from the questionnaires which their constituent subdivisions have completed.

Responses should be returned to the department or agency liaison within thirty days from the date of receipt of this questionnaire.

Please look over the questionnaire carefully before beginning to answer the questions.

U. S. DEPARTMENT OF COMMERCE National Bureau of Standards Form NBS-511 (5-70) METRIC STUDY SURVEY FEDERAL AGENCIES	Questionnaire Number	Bureau of the Budget No. 41570015 Approval Expires June, 1971
Agency Name	Respondent Subdivision	
Date Questionnaire Received	Date Questionnaire Completed	

Please Give a Brief Description of Mission of Your Subdivision

Respondent's Name

PART I (Questions Relating to Existing Measurement Systems.)

1. Are metric measurement units and metric engineering standards used in any of your activities?

 - Metric measurement units ☐ Yes ☐ No ☐ Don't Know (DK)

 - Metric engineering standards* ☐ Yes ☐ No ☐ DK

 If both are No or DK, go to Section IIA. Otherwise, please answer questions below.

2. In which activities are your <u>now</u> using the metric system?

 Metric measurement units: ______________________________

 ____

 ____

 Metric engineering standards: ______________________________

 ____

 ____

3. Please check the advantages of your <u>present</u> use of metric instead of customary.

Advantages	Metric Units	Metric Engineering Standards
a. Cost Savings		
b. Operational Improvement		
c. Legal Requirements		
d. International Cooperation		
e. Scientific Activities Use SI		
f. Other (Please specify below)		

*Please again note that the use of metric measurement units must normally accompany the use of metric engineering standards.

4. Are there disadvantages to your agency in your present use of equipment, components, processes, etc. described in metric units and/or metric engineering standards?

- Metric measurement units ☐ Yes ☐ No ☐ DK

- Metric engineering standards ☐ Yes ☐ No ☐ DK

If both are No or DK, go to Section IIA. Otherwise, please answer questions below.

a. Please explain the disadvantages of your present use of the metric system.

Disadvantages of Present Use	Metric Units	Metric Engineering Standards
a. Increased Costs		
b. Lack of Familiarization		
c. Legal Requirements		
d. Operational Impairment		
e. Engineering and/or Industry Prefers Customary		
f. Other		

b. Do advantages of your present use of the metric system outweigh the disadvantages?

- Metric measurement units ☐ Yes ☐ No ☐ DK

- Metric engineering standards ☐ Yes ☐ No ☐ DK

COMMENTS:________________________________

PART II (Questions Relating to Future Measurement Systems.)

Section A

1. Are there any changes which your subdivision would like to see made in measurement units and/or engineering standards?

- Metric measurement units ☐ Yes ☐ No ☐ DK

- Metric engineering standards ☐ Yes ☐ No ☐ DK

If both are No or DK, go on to Section IIB. Otherwise, please answer questions below.

2. What changes would your subdivision like to see?

Metric measurement units:________________________________

Metric engineering standards:________________________________

3. Why would you like to see these changes in your subdivision?

Metric measurement units: ____

____

Metric engineering standards: _____________________________________

____

4. What problems or obstacles for your subdivision do you see in making these changes?

Metric measurement units: ____

____

Metric engineering standards: _____________________________________

____

COMMENTS:

SECTION IIB: ASSUMPTION 1

We would now like you to forecast or predict probable changes in measurement units and/or engineering standards for your agency, under the assumption that there is no concerted action to increase the use of the metric system in a world of increasing metric usage.

IIB. Under Assumption 1, please answer the following:

1. Do you anticipate that your agency will make changes toward metrication in measurement units and/or engineering standards?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

If both are No or DK, go directly to Question IIB2. Otherwise, please answer questions below.

a. Please describe the changes you foresee and the probable date of changes.

Metric Measurement Units	
Date	Change

Metric Engineering Standards	
Date	Change

b. Please check the reasons why you think these changes will occur.

☐ 1. To improve quality or performance
☐ 2. Suppliers may force the change
☐ 3. Increasing worldwide usage of the metric system
☐ 4. Increasing domestic usage of the metric system
☐ 5. Time and/or cost savings
☐ 6. Other (Please specify)

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____

c. What percentage change in your subdivision's annual internal costs* (either added costs or savings in 1970 dollars) might result from these changes? Please check the most likely percentage change.

Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Cost				
Savings				

*Costs are to exclude all added or reduced procurement and contracting costs except "specialized hardware" which is designed to the buyer's specification and is not available off the shelf.

Costs are to be based on 1970 dollars and are to be net (e.g., added expenses minus savings).

Part II Section B continued

d. Please explain why you expect these cost changes. ______________________

____

e. What legal problems (for example, changes in laws or codes) would you anticipate if your agency makes these changes?

____

____

f. If your agency makes changes, what difficulties do you foresee in addition to the costs and the legal problems?

____

____

g. What change in mission capability do you expect from these changes? Percentage change in your subdivision's mission capability.

Plus_____% Minus_____%

h. Please explain why you expect these changes in mission capability.

____

____

i. Would the advantages of such changes in mission capability outweigh the disadvantages?

☐ Yes ☐ No ☐ DK

j. If yes, please explain. ______________________

____

2. Under this assumption, if you do not anticipate that your agency will make changes in measurement units or engineering standards, please check the problem areas you foresee for your subdivision.

☐ a. Training
☐ b. Dual Dimensioning
☐ c. Waste
☐ d. Increased Inventory
☐ e. International Cooperation
☐ f. Increased Conversion
☐ g. Increased Interfacing
☐ h. Legal (changes in codes or laws, for example)
☐ i. Other (Please specify) ______________________

3. Should any customary engineering standards which you may now use be retained in your activities?

☐ Yes ☐ No ☐ DK

a. If yes, which ones? ______________________

____

b. Should any of these standards be promoted for international use?

☐ Yes ☐ No ☐ DK

c. Please explain. ______________________

____

COMMENTS:

SECTION IIC: ASSUMPTIONS 2 AND 3

Within Section IIC, both Assumptions 2 and 3 are considered for each of the ten questions.

Assumption 2 - Metric Measurement Units

Assume a nationally planned program to increase the use of metric measurement units (language only) in the United States. After a ten year period of transition -- July 1, 1972 to July 1, 1982 -- SI metric measurement units will be used throughout the U. S. in all new and revised documents except for describing existing customary hardware, replacement parts therefor, and interfaces therewith. Please assume change in language only; do not assume changes toward metric based engineering standards under the Assumption 2 part of Section IIC.

Assume that these language changes will be made on printed material (e.g., catalogues, deeds, labels) only as it is being revised unless there is a need or advantage to do so earlier.

Assume that industry will use the same period of transition so that by July 1, 1982, all products will be described in SI units.

Assume further that SI will be taught throughout the U. S. school system and that the general public will have gained familiarity with SI.

Assume that all countries except the U. S. and Canada will be metric at the outset of the transition period.

Assume that ample time will be available for planning changes.

Assumption 3 - Metric Engineering Standards

Assume a nationally planned program to increase the use of metric measurement units _and_ metric engineering standards.* Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a ten year period of transition -- July 1, 1972 to July 1, 1982. Implicit in this assumption are the following:

Only new or redesigned parts and products will be changed to comply to engineering standards based on the metric system, unless there are distinct advantages in changing existing items.

During the transition period the government, by and large, will use the optimum mix of metric and customary specifications for satisfactory performance and minimum price on initial purchases of new products and that optimum specifications will proceed at a uniform rate from virtually all customary standards in 1972 to virtually all metric standards in 1982.

Based on an orderly program of metrication, industry will be capable of supplying to the government replacement parts requirements in SI or customary standards until existing customary equipment has completed its useful life.

The level or numbers and types of systems and equipment as of FY 1970, will be constant for the purposes of the study, with metric systems and equipment replacing customary systems and equipment as the latter end their useful lives.

Metrication will not disturb the normal cycle of retirement, or modification of existing systems, equipment, and related software.

Assume that all countries except the U.S. and Canada will be metric at the outset of the transition period.

Assume that ample time will be available for planning changes.

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*The use of metric measurement units must normally accompany the use of metric engineering standards.

IIC Under these assumptions please answer the following:

1. Would there be any internal savings or added costs for your subdivision in 1970 dollars resulting from either of these two assumptions:

   - Metric units only (Assumption 2) ☐ Yes ☐ No ☐ DK

   - Metric engineering standards (Assumption 3) ☐ Yes ☐ No ☐ DK

   If both are No or DK, go directly to IIC5. Otherwise, please answer questions below.

2. What percentage change in your annual internal savings or added costs (in 1970 dollars) during the transition period (1972-1982) might result from this changeover? Please check the most likely percentage change.

Metric Measurement Units (Assumption 2)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

Metric Engineering Standards (Assumption 3)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

3. What percentage change in your annual internal savings or added costs (in 1970 dollars) during the post transition period (after 1982) might result from this changeover?

Metric Measurement Units (Assumption 2)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

Metric Engineering Standards (Assumption 3)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

4. What is your estimate in dollars for average annual savings or costs for your activities for the following periods?

Metric Measurement Units (Assumption 2)				
ACTIVITIES	Transition Period (1972-1982)		Post Transition Period (after 1982)	
	Savings	Costs	Savings	Costs
1)				
2)				
3)				
4)				
5)				
6)				
COMMENTS:				

Metric Engineering Standards (Assumption 3)				
ACTIVITIES	Transition Period (1972-1982)		Post Transition Period (after 1982)	
	Savings	Costs	Savings	Costs
1)				
2)				
3)				
4)				
5)				
6)				
COMMENTS:				

5. Following the transition period, please check the long term advantages and disadvantages you foresee for your subdivision.

Advantages/Disadvantages	Metric Measurement Units Only	Metric Engineering Standards
a. Cost Increase		
b. Cost Decrease		
c. Operational Improvement		
d. Operational Impairment		
e. Promotion of U.S. Standards Internationally		
f. International Communication Improved		
g. Other (Please specify)		

6. In your opinion, would the advantages of the changeover outweigh the disadvantages?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

Please explain:

Metric measurement units: ____________________

____

Metric engineering standards: ____________________

____

7. What would your agency have to do to implement the changeover?

Metric measurement units: ____________________

____

Metric engineering standards: ____________________

____

8. What legal problems (for example, changes in laws or codes) do you foresee for your agency as a result of the transition?

Metric measurement units: ____________________

____

Metric engineering standards: ____________________

____

9. During the assumed ten year transition period, do you foresee any problems for your subdivision in changing completely to the metric system (aside from cost or legal problems)?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

a. If yes, please check the problem areas.

Problem Area	Metric Measurement Units	Metric Engineering Standards
Operational		
Maintenance and Equipment		
Education and Training		
Other (Please specify)		

b. Please explain:

Metric measurement units:____

Metric engineering standards:______________________________________

10. Would a longer or shorter period than ten years be preferable (a more advantageous period in terms of minimum cost and disruption) to your subdivision for such a transition?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

a. Please explain:

Metric measurement units:____

Metric engineering standards:______________________________________

b. What would be a more appropriate transition period?

Metric measurement units: _____years

Metric engineering standards: ______years

c. To what extent would costs and disruption be minimized in your suggested transition period as compared to the ten year period?

Metric measurement units:____

Metric engineering standards:______________________________________

COMMENTS:

PART IID: CONCLUSION

1. Do you think there should be concerted action in the United States to bring about changes toward metrication in measurement units?

☐ Yes ☐ No ☐ DK

a. If yes, what concerted action should be taken?

____

____

2. Do you think there should also be concerted action in the United States to bring about changes toward metrication in engineering standards?

☐ Yes ☐ No ☐ DK

a. If yes, what concerted action should be taken?

____

____

GENERAL COMMENTS:

Thank you

USCOMM—NBS—DC

NONMANUFACTURING SURVEY

RESPONDENT NUMBER ___ ___ ___ ___

OMB NO. 41-S70034

INITIAL CONTACT INTERVIEW

CLASSIFICATION DATA

SIC 4-Digit Code: ____________ A 1-4 ___ ___ ___

Name of SIC Industrial Group: ________________________

(RECORD NAME AND NUMBER OF 4-DIGIT GROUP IN THE APPROPRIATE SPACE AT THE END OF SECTION I.)

Name of Respondent: ________________________________

Title of Respondent: ________________________________ A-5,6 ___ ___

Name of Organization: ______________________________

City, State, ZIP CODE: _____________________________ A-7,8 ___ ___

Telephone (Area Code & Number): ______________________

Date Initial Contact Interview Completed: ____________

Date Information Mailed: ________________

Date Second Interview Completed: ______________________

(DO NOT READ ANSWERS TO RESPONDENT, UNLESS SPECIFIED IN THE INSTRUCTIONS. THE RESPONSE CATEGORIES WHICH ARE SUPPLIED ARE ONLY FOR YOUR CONVENIENCE IN RECORDING. QUESTIONS WHICH ARE PRECEDED BY * SHOULD BE ASKED OF ALL RESPONDENTS.)

INTRODUCTION

This is ______________ of the firm of Bickert, Brown, and Coddington. We're conducting a survey for the National Bureau of Standards as part of the U.S. Metric Study. I believe you received a letter recently from the Department of Commerce explaining the study. The purpose of the survey is to try to determine how much the Metric System is being used by industry. We also need to know whether companies foresee any increased use of the Metric System in the future.

The information we collect from this official call is very important, since the survey results will be reported to the Secretary of Commerce and the Congress. Therefore, we need to talk to the highest ranking company spokesman who is available.

The interview will be conducted entirely by telephone and has two phases. The first phase, which I would like to complete today if possible, generally lasts 3 to 5 minutes. The second interview should take about 20 to 30 minutes, depending on the scope and nature of your company's activities. This second phase will take place during a separate phone call a week to 10 days from now.

I'd like to ask you the few questions of Phase 1 now, if I may.

SECTION I. ATTITUDES AND LEVEL OF KNOWLEDGE

*1. Maybe you've heard talk going around lately that the United States might adopt the metric system of measurement. Have you heard anything about this?

1. ___ Yes 2. ___ No 3. ___ Don't know A-9 ___

IF YES TO Q. 1:

2. What have you heard?

___ READ "SOMETHING"

___ HEARD "SOMETHING"

___ READ ABOUT IT IN BUSINESS PUBLICATIONS A-10,11 ___ ___

___ READ ABOUT IT IN NEWSPAPER

___ HEARD OR READ SOMETHING SPECIFIC (SPECIFY:) A-12,13 ___ ___

____

____

___ OTHER (SPECIFY:) ______________________________

____

*3. If one of your friends asked you what the metric system is, what would you tell him? A-14 ___

______________________________________ A-15,16 ___ ___

____ A-17,18 ___ ___

____

(IF RESPONDENT CAN GIVE NO ANSWER, OR ASKS FOR A DEFINITION, SAY:)

We will be sending you more information about the Metric System before my next call. Briefly, though, the Metric System is a measurement system based generally on the meter as the unit of length, the kilogram as the unit of mass, the second as the unit of time, the degree celsius as the unit of temperature, and units derived from these. It is the measurement system used in many parts of the world.

*4. Have you ever used the metric system yourself?

1. ___ Yes 2. ___ No 3. ___ Don't know — A-19 ___

IF YES TO Q. 4:

5. In what way did you use it?

1. ___ SCHOOL
2. ___ WORK — A-20 ___
3. ___ ARMED SERVICES
4. ___ FOREIGN TRAVEL — A-21 ___
5. ___ HOBBY
6. ___ OTHER: (SPECIFY) ________________

____

*6. Does the metric system have any advantages or disadvantages that you know of?

1. ___ Yes 2. ___ No 3. ___ Don't know — A-22 ___

IF YES TO Q. 6:

6a. What are they?

ADVANTAGES: ________________

________________ A-23,24 ___ ___

________________ A-25,26 ___ ___

____

DISADVANTAGES: ________________

________________ A-27,28 ___ ___

________________ A-29,30 ___ ___

____

(IF RESPONDENT ANSWERED "DON'T KNOW" WHEN ASKED TO DEFINE THE METRIC SYSTEM IN Q. 3, DO NOT ASK Q. 7.)

7. How do you think it would affect your company if the United States decided to adopt the metric system?

____

____

____

(ONLY A BRIEF, GENERAL ANSWER IS WANTED. IF RESPONDENT GIVES A LONG, DETAILED ANSWER, TACTFULLY INTERRUPT.)

1. ___ NOT AT ALL
2. ___ JUST WOULD TAKE TIME TO GET USED TO IT
3. ___ SOME SPECIFIC ADVERSE EFFECTS A-31 ___
4. ___ SOME SPECIFIC BENEFICIAL EFFECTS
5. ___ OTHER (SPECIFY:) __________________

   ____
9. ___ DON'T KNOW

That's all I really need to know today. In my next call, (Mr.) (Mrs.) __________, we will be particularly interested in some detailed information on metric usage in your company.

Am I correct in recording your primary standard industrial classification as:

NAME OF SIC CATEGORY: __________________________

4-DIGIT SIC NUMBER: __________________________

(IF CLASSIFICATION IS INCORRECT, DETERMINE RESPONDENT'S CORRECT PRIMARY SIC CLASSIFICATION AND RECORD IT ON THE FRONT OF THE QUESTIONNAIRE.)

Before I contact you again in a week or so, I will mail you some supplementary information about the metric system. The information is fairly brief, and it should help you to answer the second phase of questions. I would appreciate your reading through it before I call back.

When would be a convenient day and time for me to call you to conduct the second interview? If you'd prefer, it might be easier to conduct the next interview after business hours. I could call you at home some evening next week or even on Saturday, if that would be more convenient.

(IF HOME APPOINTMENT IS MADE:

HOME TELEPHONE NUMBER: ______________________)

DATE OF SECOND APPOINTMENT

DAY: ______________________

DATE: ______________________

TIME: ______________________

Thank you again, (Mr.) (Mrs.) ______________________. I'll plan on talking to you again on ______________ at __________ o'clock.

USCOMM-NBS-DC

OMB No. 41-S70034
Expiration Date 12/31/70

RESPONDENT NUMBER ___ ___ ___ ___

SECOND INTERVIEW

(II A)

(USE WITH THE FOLLOWING SIC CATEGORIES):

4-DIGIT NUMBER	SIC CATEGORY
0...	AGRICULTURE, FORESTRY, FISHERIES
10.. thru 14..	MINING
15.. thru 179.	CONSTRUCTION
49..	UTILITIES
50..	WHOLESALE
52.. thru 59..	RETAIL TRADE

INTRODUCTION

(Mr.) (Mrs.) __________? This is (INTERVIEWER) __________ of Bickert, Browne & Coddington and the U.S. Metric Study. I'm calling to complete the second phase of your interview. Have you had a chance to review the materials we sent you?

IF NO: Would it be possible to reschedule the second interview to give you more time to review that information?

When do you think that would be?

DATE: ____________________

TIME: ____________________

IF YES: Will you be able to complete the interview at this time?

(IF YES, CONTINUE WITH INTERVIEW)

(IF NO, RECORD NEW APPOINTMENT)

DATE: ____________________

TIME: ____________________

For this phase of questions, would you please answer the questions from your company's point of view, keeping in mind the principal industry group you are representing: (NAME OF 4-DIGIT SIC FROM PAGE 1 OF CONTACT INTERVIEW: __________. I'd like you to answer for your U.S. operations, unless foreign operations are specifically asked for in the question.

SECTION II. EXISTING MEASUREMENT SYSTEM: OUTPUT

*1. Could you please give me a brief run-down of your company's major activities?

____

______________________________ C-1,2 ___ ___

______________________________ C-3,4 ___ ___

______________________________ C-5,6 ___ ___

____

____

(PROBE FOR PRINCIPAL CLASS OF PRODUCTS)

*2. Do you quote any prices based on measurements such as length, area, or volume?

1. ___ Yes 2. ___ No 3. ___ Don't know C-7 ___

*3. How about quoting prices based on other measurements such as weight, temperature, or thermal content?

1. ___ Yes 2. ___ No 3. ___ Don't know C-8 ___

*4. I'm going to read some measurement dimensions. Could you tell me which measurement system - that is, U.S. or metric - you use to describe each dimension when your product(s) (is) (are) sold?

(READ DIMENSION TO RESPONDENT AND RECORD IN THE APPROPRIATE BOX BELOW. IF RESPONDENT ANSWERS "BOTH", ASK:

For what percent would you estimate the metric system is used to describe your product(s)?

DIMENSION	U.S.	METRIC	BOTH	PERCENT METRIC	
LENGTH OR AREA					C-9 ___
VOLUME					C-10 ___
WEIGHT					C-11 ___
TEMPERATURE					C-12 ___

*5. Are there any engineering or size standards which you use in selling your product(s)?

1. ___ Yes 2. ___ No 3. ___ Don't know — C-13 ___

IF YES TO Q. 5, ASK Q. 5a & 5b:

5a. Could you name those standards? ________________ — C-14,15 ___ ___

____ — C-16,17 ___ ___

____

5b. What measurement system (are those) (is that) standard(s) based on?

1. ___ U.S. 2. ___ Metric 3. ___ Other 4. ___ D.K. — C-18 ___

*6. Could you discuss for a moment the reasons why your company uses the measurement units or standards you just mentioned? (CHECK ONE OR MORE REASONS BELOW.)

___ TRADITION (ORIGIN UNKNOWN) ___ SUPPLIERS DETERMINE IT — C-19,20 ___ ___

___ CUSTOMERS DEMAND IT ___ LAW REQUIRES IT — C-21,22 ___ ___

___ INDUSTRY AGREEMENT ___ TO MEET DOMESTIC COMPETITION — C-23,24 ___ ___

___ TO MEET FOREIGN COMPETITION

___ TO IMPROVE QUALITY OR PERFORMANCE

___ OTHER (EXPLAIN) ________________________

___ OTHER (EXPLAIN) ________________________

___ DON'T KNOW

*7. Do you ever package any goods or products?

1. ___ Yes 2. ___ No 3. ___ Don't know — C-25 ___

IF YES TO Q. 7:

7a. What measurement units are used to describe the container or package? First of all, for length or area? And volume? And weight?

	U.S.	METRIC	DON'T KNOW	
LENGTH OR AREA				C-26 ___
VOLUME				C-27 ___
WEIGHT				C-28 ___

*8. Does your organization ever export any U.S. products to foreign countries?

1. ___ Yes 2. ___ No 3. ___ Don't know C-29 ___

IF YES TO Q. 8, ASK Q. 9 - 12.

IF NO TO Q. 8, SKIP TO Q. 13.

9. When you export products, do you describe those products with the same measurement units you use for U.S. sales?

1. ___ Yes 2. ___ No 3. ___ Sometimes 4. ___ D.K. C-30 ___

IF "NO" OR "SOMETIMES" TO Q. 9:

9a. Does this change present any problems?

____

_______________ C-31 ___

_______________ C-32 ___

____

10. How about engineering standards, are they the same as for U.S. sales?

1. ___ Yes 2. ___ No 3. ___ Sometimes 4. ___ D.K. C-33 ___

IF "NO" OR "SOMETIMES" TO Q. 10:

10a. Is there ever a problem for you? _______________

_______________ C-34 ___

_______________ C-35 ___

____

11. Do you feel that the volume of your export sales ever depends on the measurement units you use?

1. ___ Yes 2. ___ No 3. ___ Don't know C-36 ___

IF YES TO Q. 11:

11a. To what extent? ______________________

C-37 ___

______________________ C-38 ___

____

12. How about engineering standards, do you feel that the volume of your export sales ever depends on the engineering standards you use?

1. ___ Yes 2. ___ No 3. ___ Don't know C-39 ___

IF YES TO Q. 12:

12a. To what extent? ______________________

______________________ C-40 ___

______________________ C-41 ___

____

*13. Does your organization have any licensee or subsidiary operations in foreign countries?

1. ___ Yes 2. ___ No 3. ___ Don't know C-42 ___

IF YES TO Q. 13, ASK Q. 14 - 16.

IF NO TO Q. 13, SKIP TO Q. 17.

14. What measurement system is used in your foreign operations?

1. ___ U.S. 2. ___ Metric 3. ___ Both 4. ___ D.K. C-43 ___

15. Why is that system used? ______________________

______________________ C-44 ___

____

______________________ C-45 ___

16. Did measurement systems influence your decision to operate a foreign licensee or subsidiary?

1. ___ Yes 2. ___ No 3. ___ Don't know C-46 ___

IF YES TO Q. 16:

16a. How did measurement considerations influence your decision?

____

______________________ C-47 ___

______________________ C-48 ___

____

____

* 17. To your knowledge, are the products that you sell in the U.S. also imported to <u>this country</u> by foreign firms?

1. ___ Yes 2. ___ No 3. ___ Don't know C-49 ___

IF YES TO Q. 17:

17a. Are the measurement units or standards for these foreign products different from the ones used in <u>your</u> U.S. sales?

1. ___ Yes 2. ___ No 3. ___ Sometimes 4. ___ DK C-50 ___

*18. In general, do you think the measurement units or standards used for foreign goods have affected the sales of these goods in the U.S?

1. ___ Yes 2. ___ No 3. ___ Don't know C-51 ___

*19. Why is that? ____

____ C-52,53 ___ ___

____ C-54,55 ___ ___

____

RESPONDENT NUMBER ___ ___ ___ ___

SECOND INTERVIEW

(II B)

(USE WITH THE FOLLOWING SIC CATEGORIES):

4-DIGIT NUMBER	SIC CATEGORY
40.. thru 47..	TRANSPORTATION
48..	COMMUNICATIONS
60.. thru 62.. & 67..	FINANCE
7... thru 8...	SERVICES
63..	INSURANCE
64.. thru 66..	REAL ESTATE

INTRODUCTION

(Mr.) (Mrs.) ______________? This is (INTERVIEWER) of Bickert, Browne & Coddington and the U.S. Metric Study. I'm calling to complete the second phase of your interview. Have you had a chance to review the materials we sent you?

IF NO: Would it be possible to reschedule the second interview to give you more time to review that information?

When do you think that would be?

DATE: ______________________

TIME: ______________________

IF YES: Will you be able to complete the interview at this time?

(IF YES, CONTINUE WITH INTERVIEW)

(IF NO, RECORD NEW APPOINTMENT)

DATE: ______________________

TIME: ______________________

For this phase of questions, would you please answer the questions from your company's point of view, keeping in mind the principal industry group you are representing: (NAME OF 4-DIGIT SIC FROM PAGE 1 OF CONTACT INTERVIEW: ______________________. I'd like you to answer for your U.S. operations, unless foreign operations are specifically asked for in the question.

SECTION II. EXISTING MEASUREMENT SYSTEM: OUTPUT

*1. Could you please give me a brief run-down of your company's major activities?

____

____ B-1,2 __ __

____ B-3,4 __ __

____

____ B-5,6 __ __

____

*2. Do you quote any prices based on measurements such as length, area, or volume?

1. ___ Yes 2. ___ No 3. ___ Don't know B-7 ___

*3. How about quoting prices based on other measurements such as weight, temperature, or thermal content?

1. ___ Yes 2. ___ No 3. ___ Don't know B-8 ___

IF YES TO EITHER Q. 2 OR 3, ASK Q. 4-6.

IF NO TO BOTH Q. 2 & 3, SKIP TO Q. 7.

4. I'm going to read various measurement dimensions. Would you please tell me which measurement system - that is, U.S. or metric - you use to quote prices for each of these dimensions?

(READ DIMENSIONS TO RESPONDENT AND RECORD IN THE APPROPRIATE BOX BELOW. IF RESPONDENT ANSWERS "BOTH", ASK:

For what percent would you estimate the metric system is used in quoting prices?

DIMENSION	U.S.	METRIC	BOTH	PERCENT METRIC	
LENGTH OR AREA					B-9 ___
VOLUME					B-10 ___
WEIGHT					B-11 ___
TEMPERATURE					B-12 ___

5. Are there any engineering or size standards which you use in selling your services?

1. ___ Yes 2. ___ No 3. ___ Don't know — B-13 ___

IF YES TO Q. 5, ASK Q. 5a & 5b:

5a. Could you name those standards? ______________

______________________________ B-14,15 ___ ___

______________________________ B-16,17 ___ ___

5b. What measurement system (are those) (is that) standard(s) based on?

1. ___ U.S. 2. ___ Metric 3. ___ Other 4. ___ D.K. B-18 ___

6. Could you discuss for a moment the reasons why your company uses the measurement units or standards you just mentioned? (CHECK ONE OR MORE REASONS BELOW.)

___ TRADITION (ORIGIN UNKNOWN) ___ SUPPLIERS DETERMINE IT B-19,20 ___ ___

___ CUSTOMERS DEMAND IT ___ LAW REQUIRES IT B-21,22 ___ ___

___ INDUSTRY AGREEMENT ___ TO MEET DOMESTIC COMPETITION B-23,24 ___ ___

___ TO MEET FOREIGN COMPETITION

___ OTHER (EXPLAIN) ______________________________

___ OTHER (EXPLAIN) ______________________________

___ DON'T KNOW

*7. Do you ever package any goods or products?

1. ___ Yes 2. ___ No 3. ___ Don't know B-25 ___

IF YES TO Q. 7:

7a. What measurement units are used to describe the container or package? First of all, for length or area? And volume? And weight?

	U.S.	METRIC	DON'T KNOW	
LENGTH OR AREA				B-26 ___
VOLUME				B-27 ___
WEIGHT				B-28 ___

*8. Does your organization have any licensee or subsidiary operations in foreign countries?

1. ___ Yes 2. ___ No 3. ___ Don't know B-29 ___

IF YES TO Q. 8, ASK Q. 9 - 11.

IF NO TO Q. 8, SKIP TO Q. 12.

9. What measurement system is used in your foreign operations?

1. ___ U.S. 2. ___ Metric 3. ___ Both 4. ___ D.K. B-30 ___

10. Why is that system used? ______________________________

______________________________ B-31,32 ___ ___

______________________________ B-33,34 ___ ___

____

11. Did measurement considerations influence your decision to operate a foreign licensee or subsidiary?

1. ___Yes 2. ___No 3. ___Don't know B-35 ___

IF YES TO Q. 11:

11a. How did measurement considerations influence your decision?

______________________________ B-36,37 ___ ___

____

______________________________ B-38,39 ___ ___

____

*12. In general, do you think the measurement units or standards used for foreign goods have affected the sales of these goods in the U.S.?

1. ___ Yes 2. ___ No 3. ___ Don't know B-40 ___

*12a. Why is that? ______________________________

______________________________ B-41,42 ___ ___

____

______________________________ B-43,44 ___ ___

RESPONDENT NUMBER ___ ___ ___ ___ ___

SECTION III. EXISTING MEASUREMENT SYSTEM: INPUT

*1. Does your organization make any significant use of equipment, supplies, components or tools which are described in metric units?

1. ___ Yes 2. ___ No 3. ___ Don't know D-1 ___

IF YES, ASK Q. 1a - 1d:

1a. Can you list for me those articles which are described in metric units?

(RECORD EACH GENERAL CATEGORY OF METRIC ARTICLE IN COLUMN A BELOW.)

	A. METRIC ARTICLES	B. % METRIC	C. DUAL			
1.				D-2,3 ___	D4 ___	D5 ___
2.				6,7 ___	8 ___	9 ___
3.				10,11 ___	12 ___	13 ___
4.				14,15 ___	16 ___	17 ___
5.				18,19 ___	20 ___	21 ___
6.				22,23 ___	24 ___	25 ___

(FOR EACH GENERAL CATEGORY OF "METRIC ARTICLE" RECORDED IN Q. 1a, ASK Q. 1b - 1d.)

1b. About what perecnt of your total (METRIC ARTICLES) are described in metric units?

(RECORD IN COLUMN B ABOVE.)

1c. Are those (supplies) (components) (equipment) (tools) you mentioned described in metric units only, or is there dual dimensioning?

1. ___ Metric only 2. ___ Dual 3. ___ Don't know

1d. Which of them have dual dimensioning?

(RECORD IN COLUMN C OF CHART ABOVE)

*2. Now I'd like to ask about engineering standards. Does your organization make any significant use of equipment, supplies, components or tools which are designed to metric engineering standards?

1. ___ Yes 2. ___ No 3. ___ Don't know — D-26 ___

IF YES TO Q. 2, ASK Q. 2a - 2d:

2a. Which articles are designed to metric engineering standards?

(RECORD EACH GENERAL CATEGORY OF ARTICLE IN COLUMN A BELOW.)

	A. METRIC ARTICLES	B. % METRIC	C. DUAL	
1.				D-27,28 ___ 29 ___ 30___
2.				31,32 ___ 33 ___ 34___
3.				35,36 ___ 37 ___ 38___
4.				39,40 ___ 41 ___ 42___
5.				43,44 ___ 45 ___ 46___
6.				47,48 ___ 49 ___ 50___

(FOR EACH GENERAL CATEGORY OF "METRIC ARTICLE" RECORDED IN Q. 2a, ASK Q. 2b - 2d.)

2b. About what percent of your total (METRIC ARTICLE) are designed to metric standards?

(RECORD IN COLUMN B ABOVE.)

2c. Are those (supplies) (components) (equipment) (tools) which you mentioned designed to strictly metric standards, or is there dual dimensioning?

1. ___ Metric only 2. ___ Dual 3. ___ Don't know

2d. Which of them has dual dimensioning?

(RECORD IN COLUMN C OF CHART ABOVE.)

IF "YES" TO EITHER Q. 1 OR 2, ASK Q. 3 - 5.

IF "NO" TO BOTH Q. AND 2, SKIP TO Q. 6.

3. Were the metric articles you mentioned manufactured in the U.S. or in a foreign country?

1. ___ U.S. 2. ___ Foreign 3. ___ Both 4. ___ D.K. D-51 ___

IF "BOTH" TO Q. 3:

3a. Could you please estimate what percent were manufactured in a foreign country?

PERCENT FOREIGN MADE: _______ D-52 ____

4. Has your company found any particular advantages in using metric goods or equipment?

ADVANTAGES: ________________________________

D-53,54 ___ ___

________________________________ D-55,56 ___ ___

________________________________ D-57,58 ___ ___

____

____

5. How about any disadvantages or problems associated with such metric goods or equipment?

DISADVANTAGES: ________________________________

D-59,60 ___ ___

________________________________ D-61,62 ___ ___

________________________________ D-63,64 ___ ___

____

____

*6. Which of the following phrases best describes how important measurements and measurement calculations are to your overall company operations? (READ CHOICES TO RESPONDENT.)

1. ___ VERY IMPORTANT
2. ___ MODERATELY IMPORTANT
3. ___ RELATIVELY UNIMPORTANT
4. ___ NOT AT ALL IMPORTANT

D-65 ___

*7. If you think of the total man-hours in your organization that are devoted to making measurements or measurement calculations, about what percent of this total would you estimate is spent using the metric measurement system?

PERCENT METRIC ___________ D-66 ___

RESPONDENT NUMBER ___ ___ ___ ___

SECTION IV. FUTURE MEASUREMENT

In the next group of questions I'd like your opinions about your possible future use of the metric system in this country. Some of the questions will ask for predictions, and I realize that some of your answers can only be rough estimates. But please try to estimate as accurately as you can. Again, I'd like you to answer for your company in the United States, unless foreign operations are specifically mentioned.

In the first set of questions, consider only the trends in your (company's) (organization's) operations as they now exist. We want to know what you think will happen to the use of measurement systems in this country, if the existing trends are allowed to follow their natural course. In other words, what will happen if there is no national program to adopt the metric system, and each company is allowed to use whichever measurement system is best for its purposes.

*1. Do you think that your organization will ever use or increase its use of metric measurements on its own?

1. __ Yes 2. __ No 3. __ Not unless whole U.S. does 4. __ DK E-1 ___

*1a. Why is that? (CHECK ONE OR MORE RESPONSES BELOW.)

(IF "YES")

___ TO FACILITATE INTERNATIONAL COMMERCE

___ TO IMPROVE QUALITY OR PERFORMANCE

___ INDUSTRY AGREEMENT

___ TO MEET FOREIGN COMPETITION

___ OTHER: ______________

___ OTHER: ______________

___ DON'T KNOW

(IF "NO" OR CONDITIONAL)

___ NO NEED

___ TOO EXPENSIVE E-2,3 ___ ___

___ INDUSTRY AGREEMENT E-4,5 ___ ___

___ NO CUSTOMER DEMAND E-6,7 ___ ___

___ NO FOREIGN COMMERCE

___ SUPPLIERS DETERMINE IT

___ LAW REQUIRES U.S. SYSTEM

___ INTEGRATED; CANNOT CHANGE ALONE

___ OTHER: ______________

___ DON'T KNOW

IF YES TO Q. 1, ASK Q. 2 - 4:

IF NO TO Q. 1, SKIP TO Q. 5.

2. When do you think you might begin to make changes in your present measurement system on your own?

NUMBER OF YEARS: _______ DON'T KNOW ____ E-8 ____

3. What do you suppose will be some of the advantages of increasing metric usage? ____________________

____________________ E-9 ____

____________________ E-10 ____

____

4. How about disadvantages? ____________________

____________________ E-11 ____

____________________ E-12 ____

____

*5. Let's suppose that the firms from which you buy supplies, equipment, tools, or components increased their use of metric measures or standards on their own. What effect would that have on your (company) (organization)? ____________________

____________________ E-13 ____

____________________ E-14 ____

____

*6. Do you think your company would face any inventory problems if some industries went metric on their own while others continued to use the U.S. system?

1. ___ Yes 2. ___ No 3. ___ Don't know E-15 ___

IF YES TO Q. 6:

6a. What would be the nature and extent of those inventory problems?

____

____ E-16 ___

____ E-17 ___

____ E-18 ___

*7. Do you think that the government should take any action to bring about changes in the use of metric units or standards in this country?

1. ___ Yes 2. ___ No 3. ___ Don't know E-19 ___

IF YES TO Q. 7:

7a. What sort of action should be taken to bring about these changes?

___ A COORDINATED, VOLUNTARY NATIONAL PROGRAM

___ A COORDINATED NATIONAL PROGRAM WITH CERTAIN CHANGES MANDATORY

___ A NATIONAL EDUCATIONAL PROGRAM E-20 ___

___ OTHER (SPECIFY): ____________________ E-21 ___

____

___ OTHER (SPECIFY): ____________________

____

___ DON'T KNOW

While you are answering the next questions I'd like you to think in terms of a nationally planned program to increase the use of the metric system in this country. We've set up a list of hypothetical characteristics of such a national program, so that each respondent can answer in terms of the same plan.

Since our last conversation, you've received some materials from us which include a list of those hypothetical program characteristics. I'd like to review those characteristics with you now. Do you have that list handy.

(READ ALL EIGHT CHARACTERISTICS TO THE RESPONDENT, EVEN IF HE STATES THAT HE HAS READ THE LIST.)

CHARACTERISTICS

1. All major countries except the U.S. are now metric.

2. There would be a nationally planned program in the United States to increase the use of the metric measurement system in this country.

3. The changeover to the metric system would be completed by the end of a designated time period.

4. Within the designated time period, all changes to metric language for printed materials such as signs, catalogues, deeds, and labels would be made only when such materials needed to be revised; and all changes to metric sizes or engineering standards would be made only for new or redesigned parts or products.

5. Existing equipment would be used until the end of its normal life cycle; the only changes to metric units would be in dials, gauges, and indicating devices.

6. You could establish your own schedule for conversion to metric language or standards, as long as these changes were accomplished within the designated time period.

7. All goods and services normally used by your organization would be available in metric terms as needed and at no extra cost to you.

8. The metric system would be taught in all U.S. schools during the transition period and the general public would be gaining familiarity with the metric measurement system at the same time.

We've adopted those characteristics to find out how a nationally planned program might affect you. Let me emphasize that no program of this type actually exists. It's purely hypothetical.

Before we continue, do you have any questions about the characteristics?

*8. Suppose that you were going to help develop a national plan for adopting the metric system in this country. What kind of time period do you think would be reasonable for making the changeover?

___ NEVER

___ IMMEDIATELY E-22 ___

___ NUMBER OF YEARS

___ DON'T KNOW

(KEEP THIS NUMBER OF YEARS IN MIND IN OBTAINING ANSWERS TO Q. 10 - 12a.)

*9. How about a plan for a changeover for your own industry; what time period do you think would be reasonable?

___ NEVER

___ IMMEDIATELY E-23 ___

___ NUMBER OF YEARS

___ DON'T KNOW

*10. Suppose a national plan were developed so that the whole United States would be metric by the end of a (NO. OF YEARS IN Q. 8) year time period. What would be the biggest advantage to your organization of this planned (NO. OF YEARS) - year changeover?

____ E-24 ___

____ E-25 ___

____ E-26 ___

____

*11. What would be the biggest disadvantages? ________________ E-27 ___

____ E-28 ___

____ E-29 ___

____

*12. How about your competition? Would this planned (NO. OF YEARS)-year metric changeover have any effect on your competitive position among your chief U.S. competitors?

1. ___ Yes 2. ___ No 3. ___ Don't know E-30 ___

IF YES TO Q. 12:

12a. What effect would it have? ________________

____ E-31 ___

____ E-32 ___

____

(IF TIME PERIOD MENTIONED IN Q. 8 WAS EXACTLY TEN YEARS, SKIP TO Q. 17.)

13. What if the national plan for changeover were a 10-year period? If you use the same characteristics on your list, would it change any of the answers you gave to the (NO. OF YEARS GIVEN TO Q. 8) - year period?

1. ___ Yes 2. ___ No (PROBE)

IF YES TO Q. 13, ASK Q. 14 - 16.

IF NO TO Q. 13, SKIP TO Q. 17.

14. What would be the biggest advantage to your organization of this 10-year planned changeover?

______________________________ E-33 ___

______________________________ E-34 ___

____

____

15. And what would be the biggest disadvantages?

______________________________ E-35 ___

______________________________ E-36 ___

____

____

16. Would this 10-year planned metric changeover have any effect on your competitive position with your chief U.S. competitors?

1. ___ Yes 2. ___ No 3. ___ Don't know E-37 ___

IF YES TO Q. 16:

16a. What effect would it have? ______________

______________________________ E-38 ___

______________________________ E-39 ___

____

____

*17. Keeping in mind the eight program characteristics, do you think that a national 10-year planned changeover would influence your annual dollar sales?

1. ___ Yes 2. ___ No 3. ___ Don't know E-40 ___

IF YES TO Q. 17, ASK Q. 17a & 17b:

IF NO TO Q. 18, SKIP TO Q. 18.

17a. What do you think the percent change in your annual U.S. dollar sales might be?

(BE SURE THAT THE RESPONDENT INDICATES THE DIRECTION OF CHANGE; i.e., POSITIVE OR NEGATIVE.)

1. ___ + % 2. ___ - % 3. ___ Don't know E-41 ___

17b. How about the percent change in your annual dollar export sales?

1. ___ + % 2. ___ - % 3. ___ Don't know E-42 ___

*18. Let's talk about costs now. Do you think a nationally planned 10-year changeover would have any effect on your annual dollar costs?

1. ___ Yes 2. ___ No 3. ___ Don't know E-43 ___

IF YES TO Q. 18, ASK Q. 18a - 18c.

IF NO TO Q. 18, SKIP TO Q. 19.

18a. Could you estimate the percent change in terms of your annual costs?

1. ___ + % 2. ___ - % 3. ___ Don't know E-44 ___

18b. About how long would you expect this change in costs to affect your operation?

___ YEARS ___ MONTHS ___ DON'T KNOW E-45 ___

18c. Which of the following would you estimate to be the most important factor in your (increase) (decrease) in costs?

(READ CHOICES TO RESPONDENT.)

___ LABOR

___ EQUIPMENT

___ COMPONENTS

___ INVENTORY E-46 ___

___ OTHER (ASK FOR EXPLANATION) ________________

____

____

___ DON'T KNOW

*19. Would such a changeover affect your selling price?

1. ___ Yes 2. ___ No 3. ___ Don't know E-47 ___

(IF RESPONDENT ASKS OR EXPRESSES CONFUSION, EXPLAIN:

What we need to know here are changes in the actual costs to your customers, not simple changes in cost because an article is sold in larger or smaller units.)

IF YES TO Q. 19:

19a. About what percent increase or decrease in unit price might you expect?

1. ___ + % 2. ___ - % 3. ___ Don't know E-48 ___

*20. Would any of your employees have to be retrained if the United States were to go metric?

1. ___ Yes 2. ___ No 3. ___ Don't know E-49 ___

IF YES TO Q. 20, ASK Q. 21 - 23a.

IF NO TO Q. 20, SKIP TO Q. 24.

21. About what percent would have to be retrained?

_____% ___ Don't know E-50 ___

22. What do you think it might cost your company on the average to retrain an employee?

$__________ ___ Don't know E-51 ___

23. How does this compare with the costs for originally training an employee?

____

____________________ E-52 ___

(TRY TO OBTAIN APPROXIMATE COSTS FOR ORIGINAL TRAINING.) E-53 ___

IF THE ANSWERS TO Q. 22 & 23 ARE OF EQUAL SIZE:

23a. Then you think that it would require just as long to retrain your personnel in the new system of measurement as it took to teach them their job skills in the beginning?

1. ___ Yes 2. ___ No 3. ___ Don't know E-54 ___

We need to know the answers to the next two questions, so that we may get the most up-to-date information about the size of your organization. This information will be kept completely confidential.

*24. How many persons are employed in your organization on the average?

01 ___ Less than 10	06 ___ 250 to 499			
02 ___ 10 to 19	07 ___ 500 to 999	E-55,56 ___ ___		
03 ___ 20 to 49	08 ___ 1,000 to 2,499			
04 ___ 50 to 99	09 ___ 2,500 to 10,000			
05 ___ 100 to 249	10 ___ Over 10,000			

*25. What were your approximate gross sales or gross dollar volume for the 1969 business year?

$____________

(IF RESPONDENT HESITATES, READ THE EXAMPLES OF DOLLAR RANGES LISTED BELOW WHICH YOU FEEL ARE NEAR TO HIS ACTUAL DOLLAR RANGE.)

01 ___ Up to $50 thousand	08 ___ Over $25M to $50M	
02 ___ Over $50T to $100T	09 ___ Over $50M to $100M	E-57,58 ___ ___
03 ___ Over $100T to $500T	10 ___ Over $100M to $250M	
04 ___ Over $500T to $1 M	11 ___ Over $250M to $500M	
05 ___ Over $1M to $5M	12 ___ Over $500M to $1B	
06 ___ Over $5M to $10M	13 ___ Over $1 billion	
07 ___ Over $10M to $25M		

Finally, I'd like to ask just three more broad questions about your company's overall feeling regarding the use of the metric system in this country. They may appear to be repetitive, but we need your candid opinion.

*26. Which of the following choices most closely indicates the current attitude of <u>your company</u> toward increased metric usage in your operations?

(READ CHOICES TO RESPONDENT.)

1. ___ STRONGLY FOR
2. ___ MILDLY FOR
3. ___ NEUTRAL — E-59 ___
4. ___ MILDLY AGAINST
5. ___ STRONGLY AGAINST

*27. Do you believe that increased metric usage is in the best interests of the United States?

1. ___ Yes 2. ___ No 3. ___ Don't know — E-60 ___

*28. If it is found that metric usage is in the best interests of the United States, which of the following courses of action, in your opinion, is preferable?

(READ CHOICES TO RESPONDENT.)

1. ___ A MANDATORY PROGRAM BASED ON LEGISLATION
2. ___ A COORDINATED NATIONAL PROGRAM BASED ON VOLUNTARY PARTICIPATION — E-61 ___
3. ___ NO NATIONAL PLANNED PROGRAM; PARTICIPATION WOULD BE TOTALLY VOLUNTARY
4. ___ DON'T KNOW

Thank you very much. We appreciate the time you have given in helping us with this study.

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