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MARINE INDUSTRY STANDARDS
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MARINE INDUSTRY STANDARDS OF THE U.S. AND THE WORLD

Presented at

The National Shipbuilding Research Program

Annual Technical Symposium

By

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ABSTRACT

This paper provides an overview of standards developed or invoked by national and international organizations for the marine industry. Data on standards promulgated by U.S. voluntary and government organizations are presented and compared with those standards available to shipbuilders in other nations. The sources of international and national mandatory standards are reviewed and the U.S. standards system is compared with other nations. A critical deficiency in the U.S. is the relatively small number of fully definitive voluntary standards that can be used for competitive procurement. Recommended action by the marine industry and the standardization community is presented, focusing on the need to effectively apply the limited resources that are available.

MARINE INDUSTRY STANDARDS OF THE U.S. AND THE WORLD

INTRODUCTION

This paper was developed at the invitation of the SNAME SP-6 Secretary to assist the Panel in its long-range planning. The aim is to provide benchmarks from which U.S. marine standards can be developed and some definition of the scope of the task. Data has been developed from a number of sources and related projects including

- preparation of the National Bureau of Standards Directory of Standards Activities of Organizations in the United States, SP 681;

  a comprehensive assessment of the Department of Defense Specifications and Standards Program;

  consultation sponsored by the United Nations Industrial Development Organization at the Rio de Janeiro shipyard of EMAQ-Engenhario E Maquinas S.A.;

  research for tune chairman of the National Science Board's Committee on Maritime Standardization;

  nine years service on the mechanical systems and electrical systems committees of the American Boat and yacht Council; and

  the online database of standards and specifications, TechData developed and maintained by Information Handling Services, Inc.

More than fifty years ago, in 1933, the U.S. had about 5000 standards in use nationally. About half of these were Government documents. In the Commerce Department's Standards Yearbook of 1933 four of the 350 standards developing organizations are identified as "...making standardization the major feature of their activities:

American Standards Association
American Society for Testing Materials
Central Committe on Lumber Standards
American Marine Standards Committee"

The American Standards Association (ASA) was one of the earlier names of the American National Standards Institute (ANSI). ASTM designates itself today as the American Society for Testing and Materials. The other two organizations became defunct as the Depression took its toll of American industry and commerce.

In 1933 these four organizations published nearly half of this country's private sector standards. As shown in Table 1 there were 256 standards specifically prepared for maritime applications.

Table l-Quantity of Standards Available in 1933 from Major Standards Developers

ASA	211	
ASTM	441	released
	224	tentative
CCLS	23	
American Marine Standards		
	96	hull
	36	machinery
	27	ship operations
	7	port facilities
	1	special
Total	256	

SOME BASIC DATA

Today, the U.S. has more than 81,000 standards (See Table 2). Compare this to 20 years ago when there were 39,500 government standards and less than 14,000 private sector standards (See Figure 1). Growth has been primarily in the private sector, and is increasing at an average rate of 3.5 percent per year. In other developed countries the growth rate is approximately five percent per year. The number of International Organization for Standardization (ISO) standards has increased in the last ten years at a rate of nearly 12 percent per year. As shown in Table 3 the U.S. has one of the largest standardization resources in the world.

Forty percent of U.S. standards have been developed within the private sector by about 400 organizations. About 270 of these have ongoing standards development programs, the remainder have one or two standards but are not in the mainstream of U.S. standardization activities. Figure 2 is a breakdown of the standards developing organizations. Twenty of them are responsible for nearly 80 percent of the standards. Fourteen of these develop standards for industry and these are listed in Table 4. Note that ground and air transportation are major developers of standards for their own use.

TABLE 2-Current U.S. Standards

Government	
Defense	38,000
Federal	6,000
Other	5,000
(60%)	49,000
Private Sector	
Scientific & Professional	12,600
Trade Association	11,200
Standards Writing	8,700
(40%)	32,500
Total	81,500

TABLE 3—World Standards Development

USSR	83,000
USA	81,500
F. R. Germany	24,000
P. R. China	14,000
India	12,000
France	11,000
U.K.	9,600
Japan	8,300
Italy	8,000
Sweden	6,000
Canada	5,500
Spain	5,500

TABLE 4—Developers of Industrial Standards

	No. of Standards
ASTM	7,500
Society of Automotive Engineers	4,200
Aerospace Industries Assn.	2,800
Association of American Railways	1,350
American National Standards Institute	1,200*
Factory Mutual	600
American Society of Mechanical Engineers	550
Electronic Industries Assn.	480
Institute of Electrical & Electronics Engineers	500
Underwriters Labs.	465
American Railway Engineers Assn.	400
American Petroleum Institute	350
Technical Association of the Pulp & Paper Industry	270
National Fire Protection Assn.	260

*Copyright assigned to the American National Standards Institute.

TABLE 5 -Categories of Military Specifications and Standards

Military Products & Equipment	9,000	25%
General Engineering	1,300	3%
Materials	4,700	12%
Parts	11,500	30%
Industrial Equipment	9,000	24%
Consumables	2,500	6%
Total	38,000	

FIGURE 1 U.S. STANDARDS GROWTH 1964 - 1984

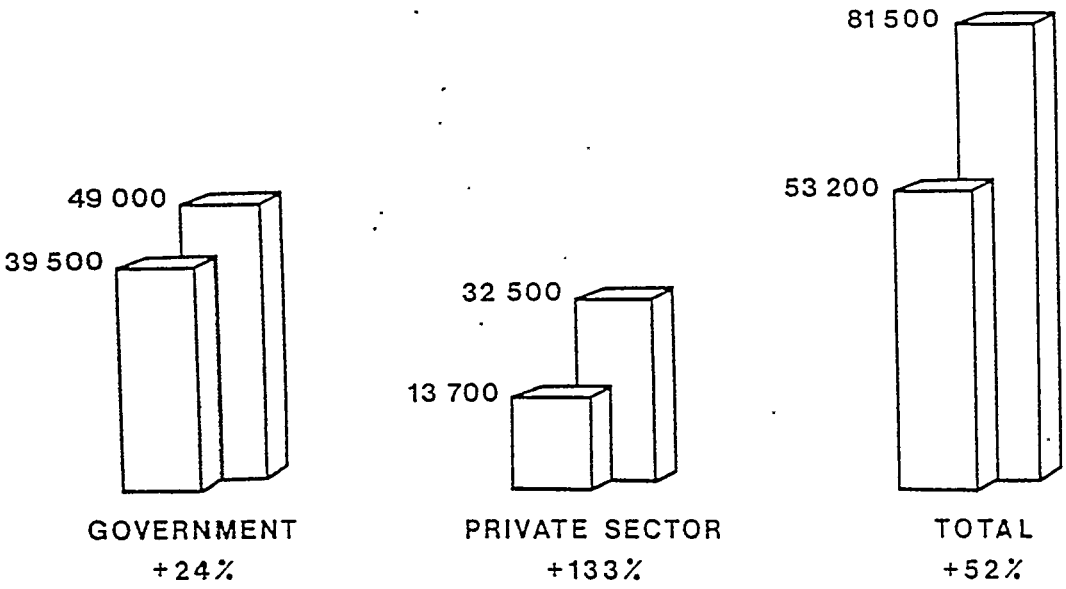
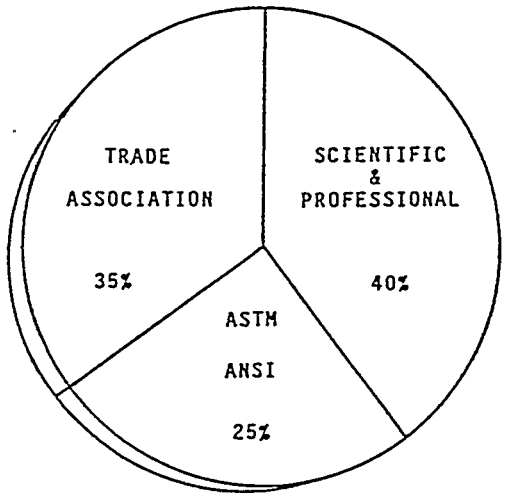


FIGURE 2

CLASSIFICATION OF STANDARDS DEVELOPERS



These private sector standards are widely used by government agencies. DoD has formally adopted more than 3,600 industry standards and references thousands more in its own standards.

The largest body of standards in the free world have been developed by the Department of Defense. As shown in Table 5 only about one quarter of the 38,000 active standards are for munitions and war materiel. The remainder provide very complete documentation for everything from microelectronics to bulldozers. Many industries make extensive use of military specifications and standards in their commercial products.

The rate of standards development by DoD has slowed to the point where as many standards are being canceled as are created. In the past four years, DoD canceled 3,630 of its specifications and standards, created 2,962 new ones, and adopted 1,182 standards industry standards.

STANDARDS FOR THE MARINE INDUSTRY

Table 6 lists the quantities of military specifications and standards for the Federal Supply Classes (FSC's) of special interest to the marine industry.

Table 6-Marine Related Military Specifications and Standards

FSC	CLASS	QUANTITY
19--	Ships, small craft; docks	75
2010	Propulsion components	5
2020	Rigging	2
2030	Deck machinery	12
2040	Marine hardware & hull items	67
2090	Miscellaneous equipment	26
2825	Steam turbines	5
4220	Marine lifesaving & diving	107
4410	Boilers	18
4420	Heat exchangers & condensers	15
4620	Water distillation	9
4810	Powered valves	10
5830	Intercoms & pa systems	45
6320	Shipboard alarms & signals	11
		407

Ships, of course, make use of a wide variety of components and equipment that are not exclusive to the marine industry. Table 7 summarizes the standards that constitute the database of government and industry standards that are pertinent to the marine-industry.

Table 7-U.S. Database of Marine Industry Standards

Government		Industry	
Mil (Navy)	400	Marine	100
Mil (Other)	2500 est.	Other	2500 est.
Federal	700 est.		
Navy Dwgs	3500		
	7100		2600

The 3,500 Navy standard drawings may be considered by some to be too specialized for general application but a careful review will indicate that the majority cover equipment and installations that are applicable to non-combatants. The majority of the marine standards developed by industry have been prepared by the American Boat and Yacht Council and while most are not applicable to ships, they are excellent documents for captain’s gigs and similar auxiliaries.

Table 8 demonstrates that the body of marine standards developed by other nations is relatively modest. Many less developed nations make extensive use of the standards of other countries.

Table 8-Marine Industry Standards of Some Other Nations

Japan	860
Germany	450
France	280
P R China	140
United Kingdom	130

PRODUCT STANDARDS FOR PROCUREMENT

A widely held belief is that all government standards are excessively restrictive or "gold-plated" resulting in the purchase of products that are not cost-effective. While there are certainly examples where this is the case, the majority of Federal and Military Specifications are well developed documents that enable materials and components to be purchased competitively from the lowest bidder; assess the quality of the product and, if warranted, reject it. State purchasing agencies make extensive use of government specifications and standards. Many industries use government specification in their commercial products. In such areas as semiconductors and integrated circuits, wire and electrical connectors; lubricants and finishes, many manufacturers of commercial products rely on government documents. They would not do so if they were not cost effective.

A major deficiency of our inventory of private sector standards is the small number that define a product with sufficient specificity to enable competitive procurement. While about 25,000 government standards fully define product requirements, only six to eight thousand from the private sector are product standards. Most of these are for fasteners and materials primarily for application in aircraft and railways. Private sector standards are most commonly used by government and industry as second tier reference documents. These define individual test methods; dimensional tolerances, color codes and similar individual parameters and characteristics which, when selectively applied, together define the end product. For example, there are more than 100 industry standards on the constituents of paints; sampling, analysis and test methods for paints; and recommended practices for preparing surfaces prior to painting, but there are hardly any private sector standards for the various types or grades of paints. As a result, the large retailers, government agencies, ship owners and other major users of paint have prepared their own specifications that define performance requirements or proven formulations.

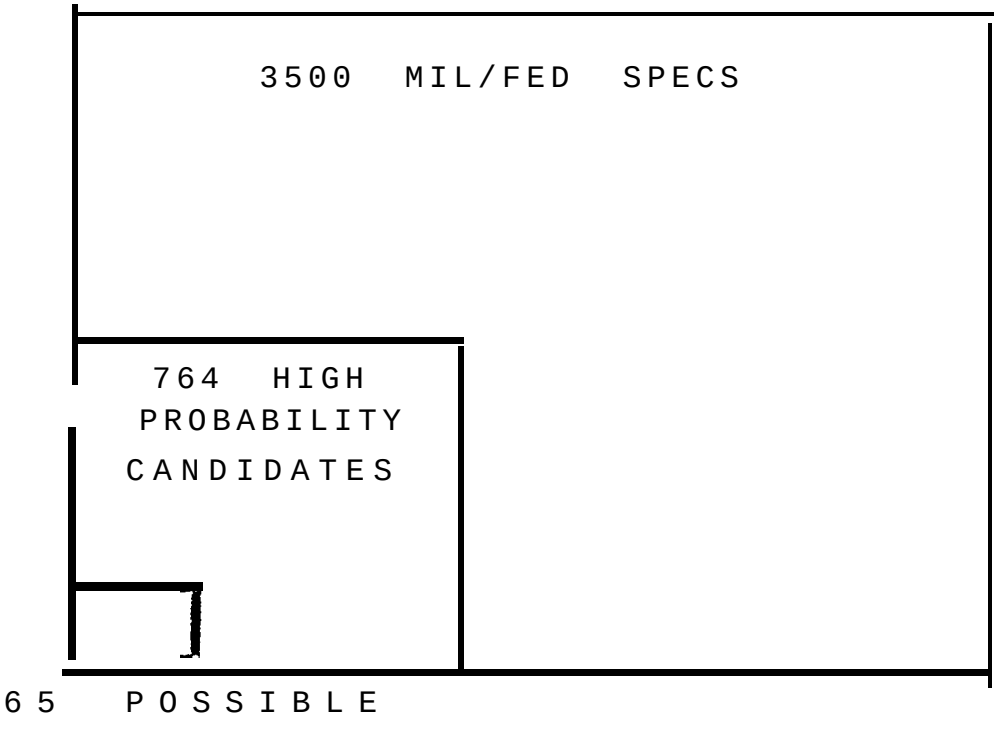
In March 1983 the Maritime Administration, U.S. Department of Transportation, completed a study of 764 military specifications for a wide variety of commodities used on board commercial and navel ships. These were selected from a base of about 3,500 specifications that are applied by the Navy. It was believed that there was good probability that these 764 could be replaced by commercial industry standards with an adequate (not necessarily combat rated) level of commercial performance and quality. The commodities ranged from switches and

valves to bearings and hand tools, padlocks to awnings. The analysis identified only 65 possible substitute industry standards (8.5%). See Figure 3. Even many of these are not product standards that can be used for procurement. While the Underwriters Laboratories standard on locks is useful as a reference document to define pick resistance many other parameters need to be provided including basic dimensions, corrosion resistance, and type of keying before a lock supplier could respond to a purchase order for a UL 437 lock.

FIGURE 3

MARAD STUDY TO IDENTIFY

COMMERCIAL STANDARD SUBSTITUTES



MANDATORY AND VOLUNTARY INTERNATIONAL STANDARDS

In recent years international standards have started to have a significant effect on standards development in the U.S. and have influenced standards development in other countries for a much longer period. Shrinking domestic markets have forced U.S. and foreign suppliers to compete fiercely for third world markets where international standards are preferred. In response to their constituencies most U.S. standards developers are bringing their standards in consonance with international standards. In addition, foreign built or foreign designed equipment has a significant share of the market in many industries and this equipment, more often than not, reflects requirements and ratings set by international standards.

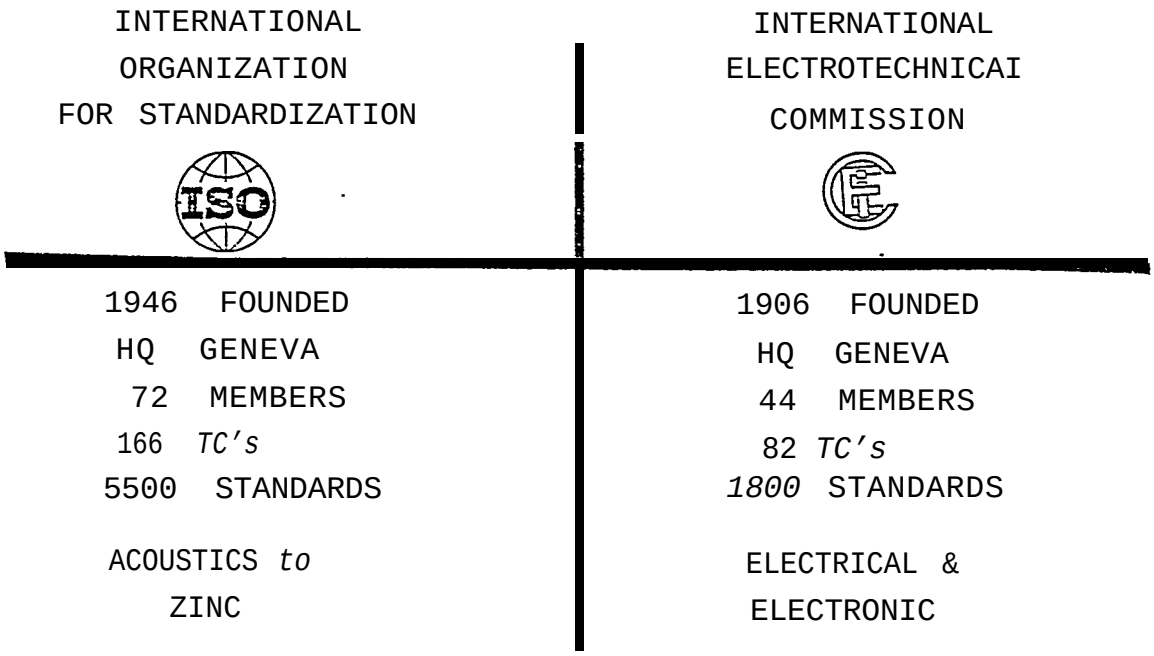
The most influential international standards are those developed by treaty organizations. It is usually mandatory that their standards be adopted by nations which are signators to the treaty. There are about seventy-five treaty organizations that establish standards. Those that most directly affect marine interests are the International Maritime Organization (IMO) and the World Health Organization (WHO). IMO has developed dozens of codes affecting the design and operation of ships ranging from safety of life and pollution prevention to the construction of ships carrying dangerous chemicals and minimum requirements for containers. The WHO Guide to Ship Sanitation is the basis for most national regulations and standards in this field.

Another 125 international organizations develop voluntary standards. As shown in Table 9 the International Organization for Standardization (ISO) and the International Electrotechnical Commission have developed the majority of the world's international standards. Figure 4 summarizes the effort of these two organizations. No more than twenty-five of their standards are true product standards. Technical Committee 8 (TC 8), Shipbuilding, is one of ISO's oldest committee and has prepared more than 120 standards. It is organized around twelve subcommittees ranging from Ships Scuttles and Windows, to Shipborne Barges, and RO/RO Ship to Shore Installations. The U.S. participates - and that to a limited extent - on four of the twelve subcommittees: SC5 Machinery and Piping, SC 10 Deck Machinery, SC 14 Yachts, and SC 15 Computer Applications in Shipbuilding. Yachts may soon be spun-off as a separate Technical Committee.

Most of the IEC work of interest to ship builders centers on Technical Committee 18, Electrical Installations in Ships. A series of standards have been developed that constitute an international shipboard electrical code. These standards include requirements for system design; all types of equipment including generators, motors, and switchgear; batteries; lighting, cooking appliances; and cables and their installation ranging from low voltage to coaxial. IEC Technical Committee 80 was recently organized to develop standards for Advanced Electronic Navigational Instruments.

TABLE 9—INTERNATIONAL STANDARDS	
ISO	5500
I EC	1 800
22 OTHERS	1 500
180 MORE	1 500
TOTAL	10 300

FIGURE 4



Outside of the United States, then, there are about 200 international standards directly applicable to the marine industry and more than 5000 national standards.

APPLYING THE WORLD'S STANDARDS

EMAQ, a major Brazilian shipbuilder, makes effective use of standards from throughout the world. Figure 5 presents the results of a study of the application of standards on a 37,800 ton bulk carrier designed and built by EMAQ. More than 46 percent of the materials and products used to build this ship are defined by company or national standards. These standard materials and products constitute nearly 22 percent of the total cost of purchased items for this ship.

EMAQ maintains a computerized database of marine standards from the major shipbuilding countries of the world. An excerpt is presented in Figure 6. (SIS, DIN, JIS, GOST, and AFNOR, are the national standards bodies of Sweden, Germany, Japan, Russia, and France). When creating a new company standard EMAQ's standards specialists review pertinent foreign and international standards and incorporate the best features in their company standard.

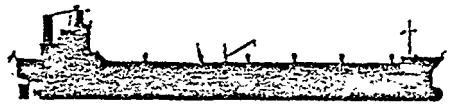
Like many developing countries Brazil needs to conserve its supply of "hard currency". For lack of indigenous suppliers Brazilian shipbuilders had to import many kinds of marine equipment at considerable expense to the builders and the nation. Under the auspices of the Brazilian Society of Naval Architects and Marine Engineers, national standards have been established which define products used by all Brazilian yards. Sufficient market has thus been established to make it worthwhile for suppliers to tool-up. As an example, to encourage Brazilian suppliers to produce portlights and windows, Brazil's counterpart to SNAME SP-6 developed a product standard based on ISO envelope dimensions and materials and hardware from the Marine Series of the British Standards Institution. Consensus was then established through the Brazilian standardization institute, ABNT. Not only did this expedite preparation of a Brazilian standard but it assured acceptance by the classification societies.

FIGURE 5

EMAQ - ENGENHARIA E MAQUINAS S.A.

Hull No. 340

Bulk Carrier



MATERIAL GROUPS	NO. OF STD. ITEMS	% (*)	COST OF STD. ITEMS	% (**)
Welding		0.6	$215,906	3.87
Non-Ferrous	24	0.7	2,183	0.03
Others	29	0.8	3,647	0.06
Ropes and Accessories	34	1.0	1,615	0.02
Packing Material	36	1.1	1,591	0.02
Steel Profiles	36	1.1	131,741	2.35
Other SteeI Materials	50	1.5	12,449	0.22
Hull Fittings	52		63,426	1.15
8uilding Material	80	2.5	7,724	0.13
Steel Plates			507,629	9.05
Electricity	134	4.2	61,103	1.08
Fasteners	360	11.1	16,354	0.29
Piping and Accessories	554	17.1	198,142	3.52
Total	1,501	46.2	$1,223,510	21.73

(*) Related to the total number of items used on hull 340 (3,249 items)

(**) Related to the total cost of materials of hull 340 ($5,615,000)

February 1983

FIGURE 6

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                                   RELATORIO DE REC. BIBLIOGRAFICA                                  6-JAN-83
                                          MANCAL,BEARING                                             PAGE 43

                        TIPO
 REG          CONOR     EDICAO  NUMEDI  NUMDOC  VOLU  MES  ANO  NPAG  ASS1  ASS2  ASS3  ASS4  ASS5        ASNTAB

 024187  SS-782031        N                            02   82
SHIPBUILDING-RUDDERS-KEYSTRIP FOR BEARING STAVES

  SIS
   THIS STANDARD SPECIFIES THE DIMENSIONS AND MATERIAL OF KEYSTRIP FOR STAVES OF RUDDER BEARINGS IN SHIPS-CONSTRUC
    AO NAVAL/LEME/CHAPA FURADA/LEME
       25-000-000
===============================================================================================================

 011302  DIN-00620/4      N                            10   68         490                      TOLERANCIA/ISOLAMENTO
TOLERANCES OF BALL AND ROLLER BEARINGS RADIAL INTERNAL CLEARANCE

  DIN
   THIS STANDARD APPLIES ONLY TO THE TYPES OF BALL AND ROLLER BEARING AND THE NOMINAL DIMENSION RANGES INDICATED I
    N SECTIONS 3 TO 5.
===============================================================================================================
 011303  DIN-00625/1      N                            09   59         490                      ROLAMENTO
DEEP GROOVE BALL BEARINGS SINGLE-ROW WITHOUT FILLING NOTCH

  DIN
   THE OUTSIDE DIMENSIONS OF THE DEEP GROOVE BALL BEARINGS DETAILED HEREIN AGREE WITH ISO RECOMMENDATION R 15

===============================================================================================================
 019471  H-1509           N                                 66         490                      ANEL/MANCAL/ROLAMENTO
LOCATING SNAP RINGS FOR ROLLING BEARINGS

  JIS
   DESCRICAO FORMATO DIMENSOES E CARACTERISTICAS GERAIS DO FECHO DE ARRUELA   PARA MANCAIS DE ROLAMENTO

===============================================================================================================
 021890  GOST-0333        N                            07   59         490                      ROLAMENTO
TAPERED SINGLE-ROW ROLLER BEARINGS

  GOST
   THE PRESENT STANDARD COVERS TAPERED SINGLE-ROW ROLLER BEARINGS,INTENDED TO TAKE SIMULTANEOUS RADIAL AND AXIAL S
    TRESS
===============================================================================================================
 021741  GOST-0800        N                            01   55         490                      TUBO/MECANICO/ROLAMENTO
BEARING TUBES OF WX15 STEEL

  GOST
   THIS STANDARD COVERS HOT-ROLLED(WITH TURNED OUTSIDE SURFACE) AND COLD.ROLLED(UNTURNED) SEAMLESS TUBES MADE OF W
    X15 STEEL INTENDED FOR MANUFACTURING OF RACES FOR BALL BEARINGS AND ROLLER BEARINGS.
===============================================================================================================

 022501  NF-F01-018       N                            09   71         350                      RODA/MANCAL
WHEELS AND BEARINGS LOCKING DEVICES

  AFNOR
   FIXE.POUR LENTRETIEN DES ESSIEUX NON FORES,A BOUTS FILETES RAINURES,SUIVANT LA FEVILLE DE DOCUMENTATION NF-F01-
    015.LES CARACTERISTIQUES DES DISPOSITIFS DE BLOCAGE DES ROVES A PORTEE DE CALAGE CONIQUE OU DES ROULEMENTS ...
===============================================================================================================
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Typical citations for bearings selected at random from EMAQ standards database

RESPONDING TO U.S. NEEDS FOR MARINE INDUSTRY STANDARDS

There has been considerable discussion within the U.S. marine industry and standards circles on the need for a comprehensive set of up-to-date industry standards. The limited resources available for this effort must be used judiciously so that not only are basic standards prepared but important standards for new technology are developed. Timely standardization action is often the catalyst for introduction of cost-effective new technology. We could very well emulate the approach of some of the developing nations and adapt or adopt up-to-date existing standards. National standards for basic products could then be prepared with considerably less effort than "starting from scratch" or trying to update an obsolete standard. Manpower thus saved could be applied to newer technology.

A few years ago, some Japanese national standards for deck fittings were reviewed with this objective in mind. For various reasons these standards were not considered appropriate for American manufacturing practices and usage. While these Japanese standards may have been inappropriate, those prepared by other countries may be exactly what we need. SNAME SP-6 should consider <u>adapting</u> U.S. Navy, foreign and international standards by

- cutting and pasting into U.S. format, and/or
- copying tine standards with U.S. conventions for measurement and language and applicable second tier reference documents.

Where appropriate, <u>adopt</u> existing standards:

- Use a cover sheet indicating that; through the consensus process, a particular standard is adopted by the marine industry. If necessary, exceptions or substitutions can be noted on tine cover sheet. This is the process by which more than 3;600 industry standards have been adopted by the Department of Defense.
- Similarly, ISO and IEC standards can be adopted as national standards. American National Standards Institute procedures, based on ISO/IEC Guide 3; provide for designation of adoption by applying the ANSI prefix, e.g. AINSI/ISO 334-1979. While this practice is just taking hold in the U.S. it is widely used by the rest of the world. In Germany more than 5,000 ISO and IEC standards are designated DIN ISO ---- and DIN IEC ----- Sixteen percent of Britain's standards and 43 percent of Denmark's are adopted ISO and IEC standards. .

- Prepare lists of standards preferred by the marine industry. By doing so SNAME SP-6 would:

    (1) define the universe and focus on those areas that urgently need new or updated standards;

    (2) provide a useful tool to yards and design agencies, most of which do not have standardization activities to perform this basic task; and

    (3) assist suppliers and distributors to identify those types of products that should be in inventory.

The techniques outlined are widely used and proven and make effective use of available standardization resources. All are compatible with the consensus process of standards development. The circulation of Lists of Preferred Standards is particularly effective in demonstrating to management that standards impact all areas of the design, production; and operation cycle.

A necessary tool for this effort is a bibliographic database of those standards that could be of use to the marine industry. Such a database can be quickly and economically prepared using existing data sources and readily available inexpensive software. If sufficient use can be demonstrated, such a database could be made accessible to every yard and design agency having a simple, PC type, computer terminal. Additional opportunities and applications would be identified as the database is used. The potential for improving the application of standards in U.S. yards and the opportunity to expedite the development of new standard's through these proposals warrants serious consideration by SNAME and SP-6.