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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

World Class U.S. Shipbuilding Standards

Task 2: The Management Plan

Part 4: The Plan - Processes, Phases and Criteria

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
National Steel and Shipbuilding Company
San Diego, California

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**WORLD CLASS U.S. SHIPBUILDING
STANDARDS**

**NSRP 6-94-1
Task 2**

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A listing of all participating shipyard personnel is provided in Appendix D.

FOREWORD

The National Shipbuilding Research Program (NSRP), in an effort to revitalize commercial shipbuilding in United States, is funding research projects designed to provide better tools and insight to world class commercial shipbuilding practices. The need for a complete set of comprehensive US National Commercial Shipbuilding Standards was the basis for this project. It entailed visits to several world class shipyards, by a team of experienced shipbuilders, to look at their standards and standards producing organizations.

The objective of this task was to establish a management plan (process) for the identification, evaluation, development and maintenance of an effective, internationally recognized set of commercial standards applicable to the US shipbuilding and repair industry.

This report will provide a summary level analysis of the project findings along with the management plan. The plan will identify: where to start, national vs. Shipyard standards, partnerships (with nationally recognized standards organizations) and typical methods/organizations to be implemented for the establishment and maintenance of national and shipyard standards programs.

The findings and recommended actions reflected in the report constitute input from the total Project 6-94-1 task 2, Team: Philip R. J. Lloyd,, NASSCO, Walter F. Devine, NASSCO, Bobby J. Griffin, Avondale Shipyard, Laddie Matherne, McDermott Shipyards, Devens D. Arnett, CDI Maine Company and Raphael Cronin, Newport News Shipyard.

This report culminates the task efforts and lays the groundwork for achievable, constructive and effective follow on actions to reach the end goal. It was co-authored by Devens Arnett, Philip Lloyd and Walter Devine; and compiled by CDI Marine Company.

3.0 EXECUTIVE SUMMARY

You're on a business trip and in a local store, you see a lamp that will look great in your den. You buy the lamp - but not the light bulb since you have many at home. On returning home, you screw a 40W bulb into the lamp, plug the lamp into the wall and turn it on. It works perfectly; you are indebted to National Standards.

Standards, of course, exist in the US shipbuilding industry. For example, the US designer can select a gate valve and mating flanges, and not worry about the buyer getting a valve that has different dimensions. The fitter does not worry about not being able to do a good brazing job because of improper dimensions between the flange and the pipe; the components selected are of the correct material; the bolt holes accommodate the bolts, etc. The designer can apply a single standard, confident that the fitter need not worry about customization. The purchasing department can choose one of several vendors on a competitive basis and know the valve will both perform and fit, and the owner will have confidence in the material selection.

Although direct comparisons between the US and other countries are difficult, engineers at world class shipyards do have comprehensive National Standards available, providing for an easy selection of components and processes. On the other hand, their US engineer counterparts do not. As a matter of fact, the US does not have an established and recognized set of US National Standards for commercial shipbuilding.

We remain at a competitive disadvantage as compared to world class commercial shipbuilding countries such as Japan, Denmark, Korea, and other Western European countries, who have established sets of world class National Standards. In these countries, shipyard proprietary standards also exist and follow the National Standards suit as providing state-of-the-art world class shipbuilding standards. While the rest of the world has advanced in the development and refinement of world class shipbuilding standards, the US shipbuilding industry has fallen behind. Our focus has been on the design and construction of naval combatants and support vessels - utilizing the complex and costly Mil-Specs as the "foundation" for design, material procurement, construction quality control, testing, and other process related systems specifications.

We do not wish to imply that the US is without any supporting Shipbuilding standards. Quite the contrary! We have an abundance of high quality standards in all categories, the product of nationally and internationally recognized US standards producing organizations - too numerous to mention. These standards are well integrated in our current shipbuilding processes. Furthermore, areas identified as not covered by a US standard are most likely covered by another country's national standard or even possibly by an international standards organization. The important point is that the task of establishing a set of US World Class Shipbuilding Standards is one of an "Adopt, Adapt" process vs. that of a "Develop" process. This project's objective is to create a "just as easy" selection of shipbuilding components and processes as the competing countries currently enjoy.

Consider also the military side of the shipbuilding business. The Department of Defense recognizes the need to shift away from the requirement to use Mil-Specs and now champions utilization for commercial off the shelf, (COTS), acquisition for new construction and conversion work. This shift away from Mil-Specs into the commercial specification arena has caught the US Shipbuilder by surprise. Are we ready for the transition? Are there sufficiently developed standards to take the place of the more restrictive and often cost prohibitive Mil-Specs? Do we have sufficient products and equipment available from multiple manufacturers that were built to a commercial specification accepted by ABS, Lloyds, USCG and so forth? The questions go on.

This report provides a basic description of standards organizations and cultures in the visited World Class shipyards. It also defines a process that leads us to take the first crucial step and begin to bring the US shipbuilding community and support industries on line to attain World Class Shipbuilding status.

The report Plan embodies seven principal segments:

- Selection of Phase 1 Standards
- Establish SP6 Standards Technical Point of Contact (TPOC) and Supporting Coalition
- Shipyard Approval/Prioritization of Phase 1 Standards
- Standards Acquisition and Distribution to Shipyards
- Coordination of "Adopt, Adapt, Develop" Review Process
- Collect, Coordinate Processing with Standards Agencies
- Publish Listing of US National Shipbuilding Standards

We realize there may be alternative approaches to accomplish the ultimate goal; however, many well respected shipbuilders have previously discussed and studied this subject at great lengths - since 1980 and probably before - and yet no major progress has been made. Refer to IHI/BIW and CDI Marine Company reports, references [1] and [2].

In closing, the report concurs in principal with the earlier reports, referenced herein, and will quote and/or utilize some of their findings. Their conclusions were not much different from the plan recommended in this report. We have chosen to provide a more simplistic phased approach that will let us begin the process. There will be "adjustments" to the plan as we transition to World Class Standards. However, we need to get "off top dead center" and start with a feasible approach. We believe what is offered herein is just that. The time to end the discussion and begin the job is here.

4.0 BACKGROUND

4.1 PROJECT OBJECTIVES

The NSRP 6-94-2, Task 2, Project objectives were to conduct a study of selected World Class Shipbuilders and evaluate their standards organizations and methodologies used in the development and maintenance of standards. Each visit was to be documented in a formal trip report. A final report including a Management Plan for the identification, acceptance and/or development of US World Class Shipbuilding Standards, was also required. This final report concludes accomplishment of these objectives.

4.2 CATEGORIZATION OF SHIPBUILDING STANDARDS

Shipbuilding standards, to facilitate understanding of this report, need to be segregated into two categories (families), which will be further defined in several smaller increments. The first category is the National Standards which deals with Federal agency standards or specifications of voluntary standards organizations. Included may also be standards adopted from international standards organizations. The second category is the Shipyard Proprietary Standards. These standards are unique to individual companies and are developed and controlled by the company.

National Standards are not to be confused with regulatory agencies' mandated requirements - such as USCG, USPH, FCC, etc., who issue Federal Rules and Regulations or any requirements of international organizations, such as IMCO, SOLAS, MARPOL, etc. It is anticipated that the creation of US Shipbuilding National Standards will principally be from an identification, acceptance and/or development processes in conjunction with US standards agencies', such as ASTM, ANSI, ASME, IEEE, etc. All standards need wide approval from the key stake-holders of the industry.

The responsibility for the final collection, compilation, publication and distribution of a listing/index of US Shipbuilding National Standards remains to be determined. It is recommended that an agency of the Federal Government, such as MARAD or DOT, accept the responsibility for this important undertaking.

Appendix A has been developed to provide examples of a basic listing and breakdown of typical categories for each of the two families discussed. Further, Appendix B also shows the standards selected for the Phase 1 listing of standards recommended for review/ratification as US Shipbuilding National Standards.

4.3 ESTABLISH A SET OF CATEGORIES OF STANDARDS FOR STUDY

The initial action of the team was to identify the criteria to be applied to the selection of standards categories for the purpose of this study. This was initiated by the shipyard representatives on the team and verified/confirmed by the shipyards involved. The consensus of the team was that the

standards' categories must be for standards that are high volume, labor intensive and of a national standard level. The Team selected pipe hangers, vent fittings, hangers, wireways and ladders, as our basic study group.

Concurrent with the standards categories selection process, a series of related questions was developed and finalized. These questions were forwarded to all the World Class shipyards scheduled to be visited. Each yard accepted the action to review and have answers to the questions prior to the visit. Upon it's arrival, the Team was afforded the best of hospitable spirit and candid response to all questions. Each shipyard genuinely wanted to see progress in the US towards the establishment of modern World Class Standards. They recalled the time when the situation was reversed and the US was a leader in the construction of world class merchant vessels and they were visiting our shipyards for help in standardization and processes.

Trips were arranged and the team traveled to Odense Steel Shipyard Ltd., Denmark, Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) Shipbuilding Division, Japan and Sumitomo-Heavy Industries (SHI), Ltd., Japan. Trip reports, references [3] through [5], apply.

There were other related tasks under Project 6-94-1 that contributed to the analysis, by compiling a report for the above category standards - including brief abstracts of the standards identified. The report also provides a matrix identifying specific existing World Class Standards related to specific selected categories. This report is titled NSRP 6-94-1, Task 3, World Class Shipbuilding Standards. Reference [6] applies.

4.4 THE FITNESS TEST

There are numerous goals that drive a World Class shipyard to success. However, all yards visited voiced three in particular - The Fitness Test - as being key performance factors:

- Complete Ship Design In 10 Months
- Complete Ship Construction In 18 Months
- Realize Net Profit On Completion

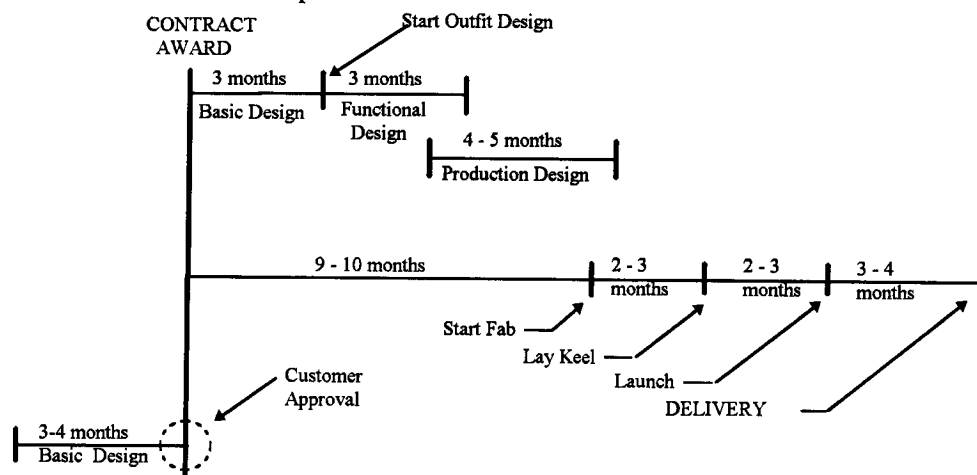


Figure 1
Typical World Class Ship Design and Construction Schedule
(Typical for Tanker or Container Ship)

Each of the shipyards visited enjoyed the ability to consistently meet the Figure 1 milestones. This ability was principally attributed to an established set of either national or association (Denmark) standards supplemented with shipyard proprietary standards.

4.5 STANDARDS ORGANIZATIONS AND MANAGEMENT

"Standards" to the US shipbuilder often represents thoughts of a part of a process, a committee, a book, or perhaps an individual at a shipyard whose job is "standards".

To the commercial World Class shipbuilder, "standards" are the working environment. It is the language that is used to reach agreement on product and price with the owner, to order equipment, create product models in CAD, instruct production workers and CAM systems, develop processes, and to converse with industry at large. Standards are the culture and lifeblood of the foreign shipbuilding community, pictorially represented below in Figure 2.

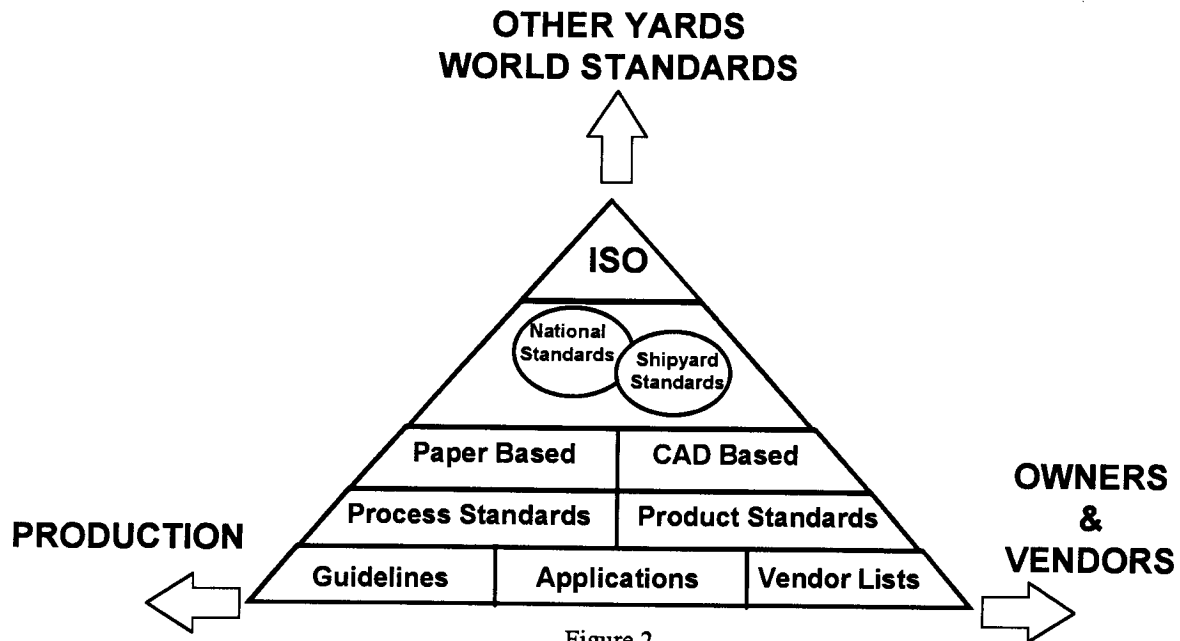


Figure 2

The World Class Shipbuilders approach for standards development, maintenance and approval is to broadly distribute the responsibility across the many disciplines of the shipyard - Engineering and Design, Quality Control, Test and Activation, etc.. It is within these areas that effective and practical standards can be controlled - by the end user individual or group - who use the standard and have responsibility for the product or specification. It is incumbent on these cognizant people to coordinate the development of new standards or the revision of existing standards with all other involved parties - whether exclusively with shipyard production, industrial suppliers, owners or regulatory agencies or a combination thereof. All levels of management are involved in the process. Assignments are considered to be an integral part of the technical persons work - not

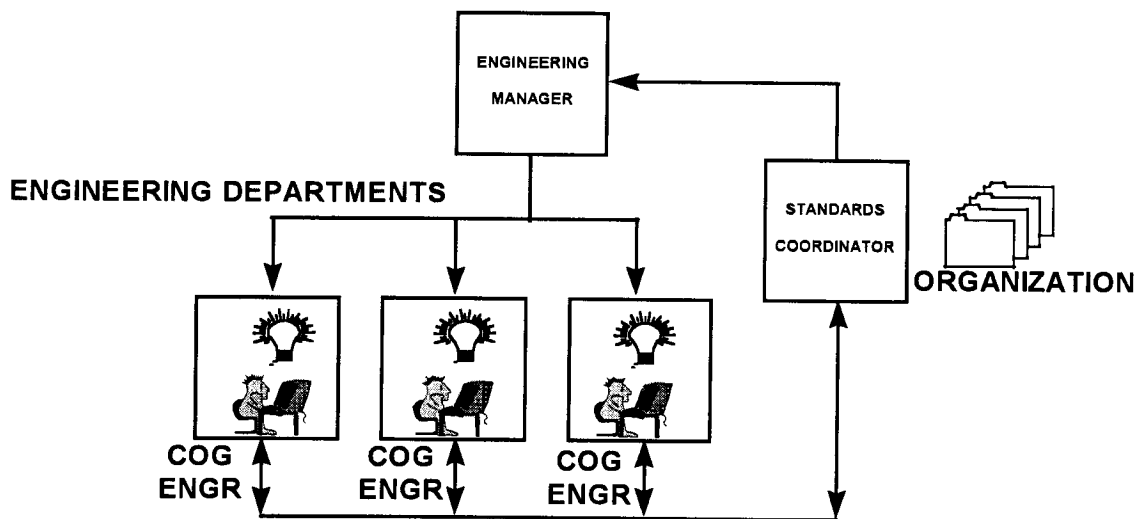
Feedback and input to the cognizant technical department is routinely accomplished. One yard provided desks for all shipyard workers at which to eat lunch and to think about standards and process improvements!

The numbers of standards maintained at the visited shipyards was significantly varied - from 500 to 10,000. Odense Steel Shipyard was an advocate of maximum use of their Association's Standards while SHI relied on many internal shipyard standards. All standards have been in place for many years and are integral with the culture of the shipyards. Approval authority for all standards is maintained at the senior management level in each discipline at the Japan shipyards. Odense managers submitted each new and revised standard to their Chairman of the Board, Maersk M. Moller, for final approval, up to his retirement.

At Odense Steel Shipyard, it would not be unusual for a designer to complete the installation drawing and then go to Production to fabricate and install the design. Design/installation problems would be his problem to resolve, including returning to the Design area to fix the drawings. What a powerful learning process.

Some shipyards had their proprietary standards in electronic format while others had paper based, manually produced standards. It is this high level of recognition of importance and support that is the key ingredient of any successful standards organization. This is where we need to go.

A typical shipyard standards organization indicative of those established in World Class foreign construction shipyards would look similar to that shown in Section 6.0, Figures 6.2a and 6.2b or Figure 2, below.



4.6 STANDARDS PROCUREMENT

Figure 2
Typical Standards Organization of a World Class Shipyard

An original objective of the task was to investigate the purchase of complete standard sets from a selected foreign shipyard or country. As the project progressed, the team realized that complete sets of shipyard standards would be of little use to other shipyards as they are tailored to the originating shipyard's preferred and/or proprietary processes. Also, the methodology of shipyards' standard development would be invisible, which became more apparent as the real need. Further, neither shipyard or National Standards would likely be available in English.

Many quality National standards are available for a fee, and are recommended later as source material for the development of our own US National Shipbuilding Standards.

5.0 THE PLAN - PROCESS PHASES AND CRITERIA

5.1 OVERVIEW

This section describes the components of a recommended Management Plan, designed to accomplish our objective - the establishment of US World Class Shipbuilding Standards. SP-6 has progressed through the initial phases of the plan and are poised for constructive action. Foldout 6-1, section 6.0, provides a high level view of the total process, its phases and criteria. It is recommended that the reader review this before delving into the detailed description in this section - to gain an overview and keep things in perspective.

The section 4.0, Background, described the steps of the plan that have already been accomplished. The trip reports are quite informative and are recommended reading - references [3] through [5] apply.

The Management Plan is for the identification and acceptance of standards to a National Standards level. It will not focus on shipyard standards, as they are the sole responsibility of each individual shipyard. It is hoped that the successful establishment of a comprehensive set of National Standards will eliminate the need for shipyards to maintain many standards that they currently have or would have to develop to satisfy perspective customer.

The report Plan embodies seven principal segments:

- Selection of Phase 1 Standards
- Establish SP6 Standards Technical Point of Contact (TPOC) and Supporting Coalition
- Shipyard Approval/Prioritization of Phase 1 Standards
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- Coordination of "Adopt, Adapt, Develop" Review Process
- Collect, Coordinate Processing with Standards Agencies
- Publish Listing of US National Shipbuilding Standards

5.2 SELECTION OF PHASE 1 STANDARDS

The criteria that was applied in the selection of Phase 1 standards was that specified in the original listing from the IHI report, reference [1] - as follows:

1. Improve communications, (smoother negotiations, minimize conflicts)
2. Improve approval process, (simplify plan approval, shorten approval time)
3. Improve inspection process, (simplify/eliminate inspection, shorten inspection time, eliminate duplication)
4. Improve design/engineering process, (reduce engineering man-hours, minimize design changes, improve accuracy of drawings)
5. Improve purchasing process, (simplify ordering, minimize estimation work)
6. Improve production, (improve productivity, reduce man-hours)

7. Stabilize or improve technology level (stabilize or improve engineering and production technology, eliminate inconsistency in design or specifications)
8. Maintain or improve quality (maintain quality, improve reliability)
9. Reduce cost (avoid over design, reduce tailor made products)
10. Shorten delivery time (reduce purchasing time)

The Standards categories and description for Phase 1, are listed in Table 1, below. The listing identifies standards that are closely related to the original categories selected for this study. The selected standards for these categories are listed in Appendix B. No attempt was made to list all the standards for each category, as it is desired to verify the process first and then to proceed with a larger more aggressive quantity. The standards for Phase 1 were selected from earlier NSRP project studies, specifically, CDI Marine Co's 6-94-1, Task 3 Report, UMTRI's Compendium of Standards and ASTM Volume 01.07 of Shipbuilding Standards - references [6] through [8], respectively. The order of standards selection for "adoption, adaptation or development" listed in Appendix B, was:

1. US National Standards Organization
2. International Standards Organization
3. Foreign World Class Shipbuilder's National or Association Standard
4. Other?

#	STANDARD CATEGORY	STANDARD	STD ORG (typical)	STD # (typical)
1	Piping	Pipe Hangers and Supports - Materials, Design and Manufacture	MSS	SP-58-83
2		Pipe Hanger and Supports - Selection and Application	MSS	SP-69-83
3	Vent Fittings	UL Standard for Safety Marine Rigid and Flexible Air Ducting	ANSI	1136
4		Air Conditioning, Heating, and Ventilation, General	MASS	12.1
5	Wireways	Electrical Cable, Hangers and Saddles for Marine Use	CNS	F5047
6		Recommended Practice For Electrical Installations Shipboard.	ANSI/IEEE	45
7		Electric Cable Clips for Marine Use	CNS	F5046
8	Ladders	Ladders, Fixed Vertical	ASTM	F840
9		Ladder, Stairway	MASS	5.03
10		Ladder, Grating, Floorplate	MASSD	79.01
11		Shipbuilding; Steel Dog - Step Ladders	ISO	5485
12		Shipbuilding; Embarkation Ladders	ISO	5488
13		Shipbuilding; Vertical Steel Ladders	ISO	3797
14		Shipbuilding; Inland Vessels; Fixed Steel Deck Stairs	ISO	5485

Note: Refer to Appendix B for a complete listing of selected Phase 1 standards.

Table 1
Standards Selected for Phase 1

5.3 ESTABLISH SP6 STANDARDS TPOC AND SUPPORTING COALITION

In order for the Management Plan process to be accomplished effectively, a strong leadership coalition must be established. It is recommended that SP6 appoint a Technical Point of Contact (TPOC) to act as the overall facilitator/champion for the process. The membership of the coalition must include senior shipbuilders, designers, engineers, quality control personnel, purchasing agents and etc. The details of the structure of the coalition is left to the decisions and recommendations of the SP6 panel and its designated TPOC. The establishment of US National Shipbuilding Standards is not likely to occur through voluntary efforts alone. The linking of the Management Plan initiative to a funded NSRP Project or Super Project is recommended. The establishment of a project approach as a funded task to private industry will ensure consistency of approach and a dedicated and accountable TPOC.

The 6-94-1 Management Plan addresses a very small portion of the overall standards task. Nevertheless, its value to provide a constructive learning experience for a subsequent and much larger effort would be immeasurable.

5.4 SHIPYARD APPROVAL/PRIORITIZATION OF PHASE 1 STANDARDS

The most fundamental and important issue in the implementation of each phase of the Management Plan is the need to remember who the end user and ultimate customers are. It is their priorities and processes that this plan must serve. The end user is the shipbuilder and the ultimate customer is the ship owner. If this program supports their criteria for the selection and ratification of a necessary standard - then it will be successful.

Following SP6 review and comment of the Phase 1 standards, the list will be forwarded to all participating shipyards for their approval and prioritization. This will be an iterative process and more than likely, require adjustments to the original list.

Once the Phase 1 list of standards is finalized, the next step will be to obtain copies of each of the standards for submittal to the shipyards for meaningful evaluation.

5.5 STANDARDS ACQUISITION AND DISTRIBUTION TO SHIPYARDS

The acquisition of standards will be a challenge in itself. Standards are available at the: University of Michigan Transportation Research Institute (UMTRI), Gulf Coast Regional Maritime Technology Center (GCRMTC), MARAD, and when all else fails, from the individual standards originating organizations. All standards obtained will be for evaluation use only and accordingly, should be at a minimal cost. Some standards organizations may not agree with the distribution of their standards without being purchased, even for evaluation. Hopefully, if this is the case, we would be able to purchase one copy for wide distribution - with the explicit understanding that the standard is for the review process only. This area will need to be

thoroughly understood to prevent any conflict with proprietary rights of the applicable standards producing organization. It needs to be addressed as a first order of business.

Having resolved the first hurdle satisfactorily, the Phase 1 selected standards are to be obtained by the SP6 TPOC, or his/her designate, and submitted to all participating shipyards, for their “adopt, adapt, develop” review and input.

5.6 COORDINATION OF ADOPT, ADAPT, DEVELOP REVIEW PROCESS

The coordination for review of each standard between all participating members is critical to the timely accomplishment of the plan. (It is recommended that SP6 coordinate the initial Phase 1 distribution of standards and coordination of the process of obtaining shipyard concurrence for each selected standard - with the assistance of a small coalition of interested and proactive shipbuilding experts.)

The completion of the each standard’s review process by participating shipyards, should provide one of the following conclusions:

- Adopt - the standard is acceptable as written to become a National Shipbuilding Standard
- Adapt - the standard needs to be modified to meet US Shipbuilders requirements
- Develop - a new standard will have to be developed to be acceptable to the US Shipbuilder

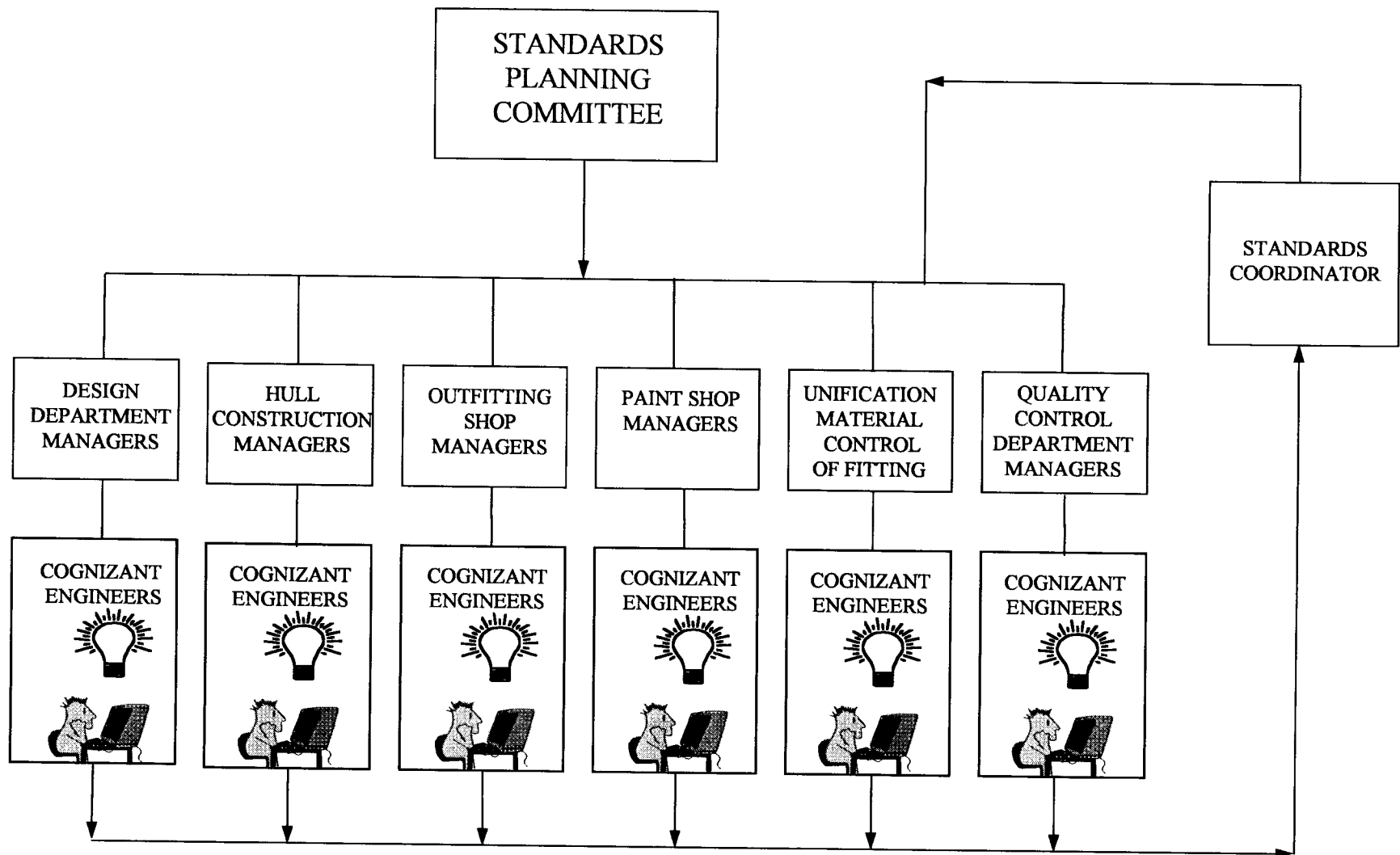
5.7 COLLECT, COORDINATE PROCESSING WITH STANDARDS AGENCIES

Existing standards that are satisfactory to the majority of shipbuilders will be documented and processed as an agreed to US National Shipbuilding Standard. As each standard is processed through the review cycle to completion, the results will be published to the participating shipyards, standards agencies and other participants, including vendors. This publication of results will be accomplished by the SP6 TPOC and coalition. At this point, in conjunction and in compliance with each standard source agency’s rules and procedures, the standard will be submitted to a designated agency as a US National Shipbuilding Standard. This may, depending on the conditions of acceptance of the standard by the shipbuilders, require the assignment of a coalition member to a standard agency’s subcommittee, as a team leader/sponsor for the standard to be modified, developed and then ratified.

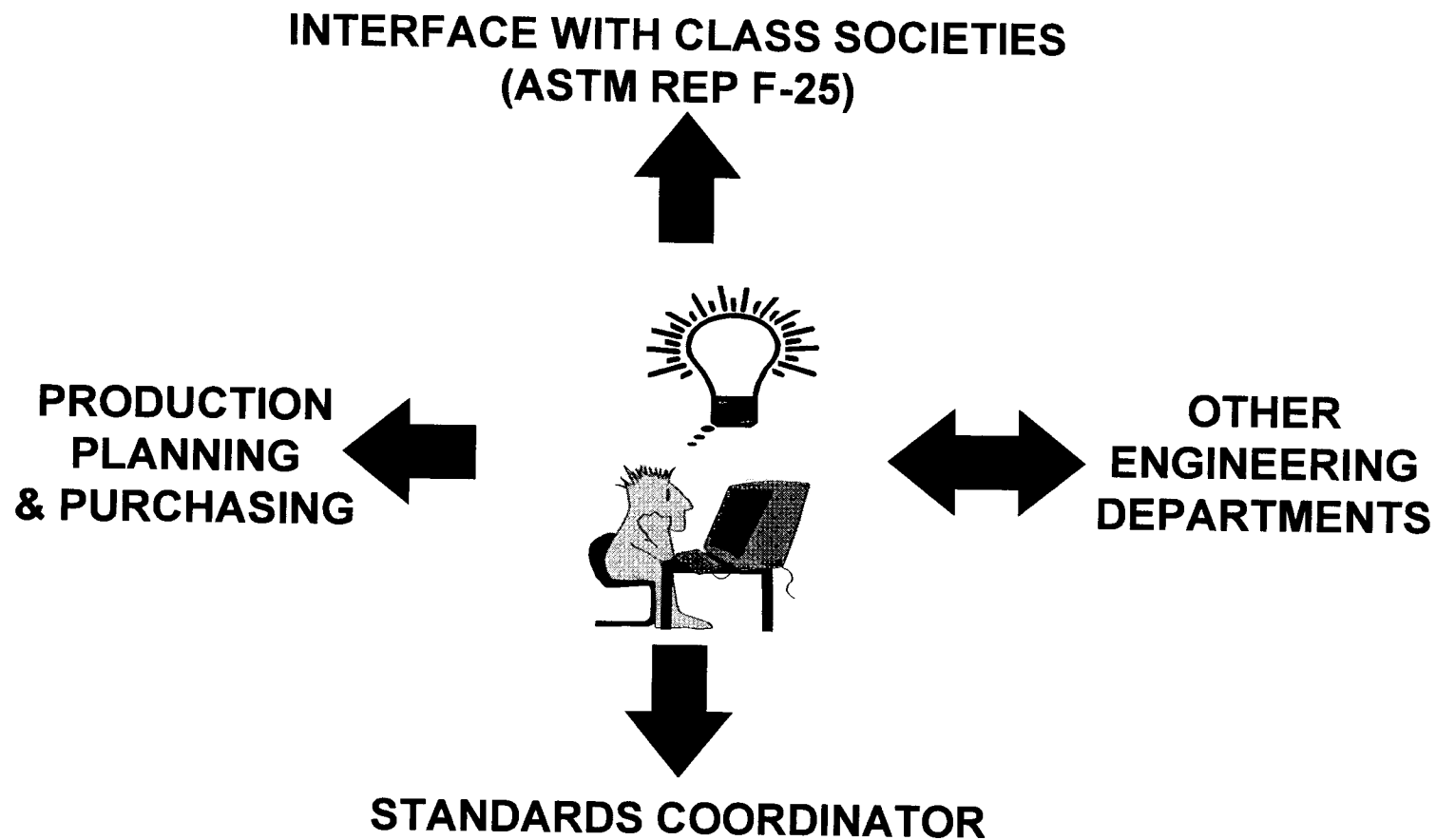
It is recognized that the resulting compilation of standards to be classified as the US National Shipbuilding Standards of choice will be a cross section of many standards agencies and organizations’ publications. It is also recognized that in the absence of an acceptable standard, then one must be developed by the normal processes of an existing standards agency. As approximately 30,000 standards currently exist, it is unlikely that the number of standards requiring development will impact the overall process. New and emerging technologies will be the primary cause for new standards development.

5.8 PUBLISH LISTING OF US NATIONAL SHIPBUILDING STANDARDS

When the finished standard is ratified and available for industry use, the final step in the process is for the standard to be listed in a publication of US Shipbuilding National Standards. The ultimate goal would be for MARAD (or an existing standards organization to be identified by MARAD) to be the recognized keeper of the US National Shipbuilding Standards publications. This document should be accorded formal US Government responsibility through direct or contracted maintenance of an ever changing and vital technical information resource.



STANDARD ORGANIZATION
FIGURE 6.2 a

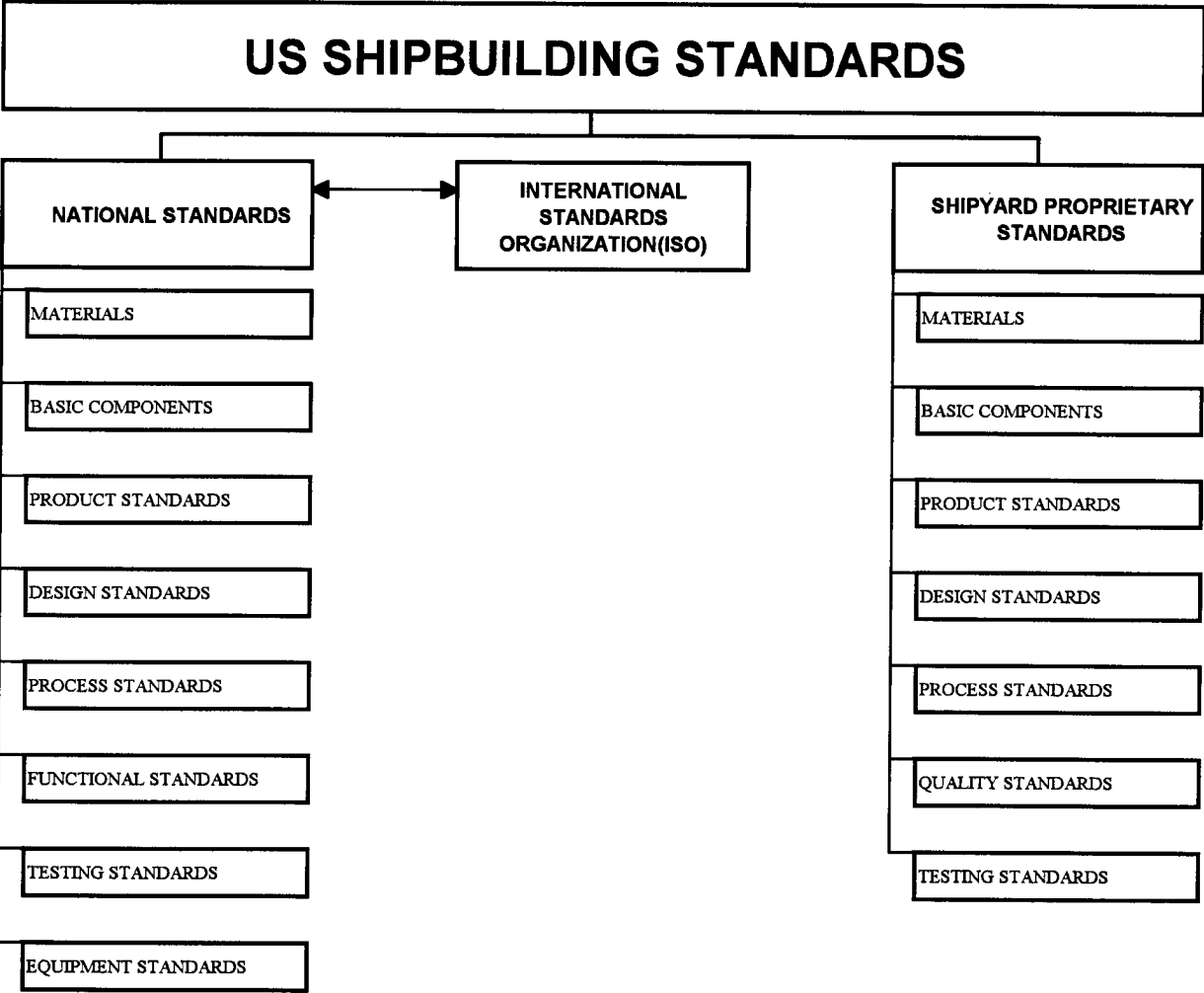


TYPICAL INTERFACES BY TECHNICAL STANDARDS PERSON

STANDARD ORGANIZATION
FIGURE 6.2 b

BLOCK OUTLINE

4/19/97



PHASE 1 STANDARDS FOR ADOPT, ADAPT, DEVELOP PROCESS

STANDARD CATEGORY	STANDARD	STD ORG	STD #
Piping	Standard Practice for Design and Installation of Rigid Pipe Hangers	ASTM	F708-92
	Pipe Supports	BSI	BS 3974
	Pipe Hangers and Supports - Materials, Design and Manufacturing	MSS	SP-58
	Pipe Hangers and Supports - selection and application	MSS	SP-69
	Pipe Hangers and Supports Fabrication and Installation Practices	MSS	SP-89
	Guidelines on Terminology for Pipe Hangers and Supports (R1991)	MSS	SP-90
	Standard Practice for Design and Installation of Rigid Pipe Hangers	ASTM	F708
	Pipe Support Devices (hangers and sway)	DOD	MIL-P-158A
	Design/Installation of Rigid Pipe Hangers with $\leq 650^{\circ}\text{F}$	ASTM	F708
Vent Fittings	Standard Practice for HVAC Duct Shapes; Identification and Description of Design Configuration	ASTM	F1005-91
	UL Standard for Safety Marine Rigid and Flexible Air Ducting	ANSI	1136
	Air Conditioning, Heating, and Ventilation, General	MASS	12.1
	HVAC Duct Shapes, Identification/Description of Design Configurations, Practice	ASTM	F1005
	Heating/Ventilation of Air Conditioning (HVAC) Symbols, Practice	ASTM	F856
Wireways	Recommended Practice For Electrical Installations Shipboard.	ANSI/IEE	45
	Electric Cable Installation	MASS	90.06
	Electric Cable Hangers and Saddles for Marine use	CNS	F5047

Table 1
Standards Selected for Phase 1

PHASE 1 STANDARDS FOR ADOPT, ADAPT, DEVELOP PROCESS

Ladders	Standard Practice for Inclined Cargo Tank Ladders	ASTM	F1437-92
	Standard Specification for Staple, Handgrab, Handle, and Stirup Rung	ASTM	F-783
	Ladders, Fixed, Vertical, Steel, Ship's	ASTM	F840
	Ladder; Stairway	MASS	5.03
	Ladder; Grating; Floorplate	MASSD	79.01
	Shipbuilding; Steel Dog - Step Ladders	ISO	5485
	Shipbuilding; Embarkation Ladders	ISO	5488
	Shipbuilding; Vertical Steel Ladders	ISO	3797
	Shipbuilding; Inland Vessels; Fixed Steel Deck Stairs	ISO	5485
	Inclined Cargo Tank Ladders	ASTM	F1437

Table 1
Standards Selected for Phase 1

Note:

At the time of this publication, UMTRI was in the process of promulgating an updated version of their compendium of Shipbuilding Standards. A thorough review of the new release needs to be accomplished and applicable standards found may added to the table. This table is intended to provide the user with a small quantity of standards identified for review under the Phase 1 approach.

STANDARDS ORGANIZATION ABBREVIATIONS AND SUBDIVISIONS

BY ABBREVIATION:

ABS	American Bureau of Shipping Rules for Building and Classing Steel Vessels
ABSOI	Nondestructive Inspection of Hull Welds
ABS02	Approved Welding Electrodes Wire-Flux & Wire Gas Combinations
ABS03	Offshore Mobile Drilling Units
ABS04	Steel Barges for Offshore Service
ABS05	Bulk Carriers for Service on the Great Lakes
ABS06	River Rules '71
ABS07	Inert Gas Installations on Vessels Carrying Oil in Bulk
ABS08	Certification of Cargo Containers
ABS09	Manual for Making Bronze Propeller Repairs
ABSIO	Repair, Welding, Cladding & Straightening of TO Boilers
ABSII	Burning Crude OH & Slops in Main & Auxiliary Boilers
ABS12	Steel Floating Drydocks
ABS13	Under-water Inspection in Lieu of Drydocking Survey
ABS14	Construction of Shipboard Elevators
ABS15	Certification of Construction & Survey of Cargo Gear on Merchant Vessels
ABS16	Certification of Self-Unloading Cargo Gear on Great Lakes Vessels
ABS17	Single Point Moorings
ABS18	Aluminum Vessels
ABS19	Classifications of Nuclear Ships
ABS20	Submersible Vessels
ABYC	American Boat and Yacht Council, Incorporated
AFNOR	Association Francis de Normalization (France)
AMCA	Air Moving and Conditioning Association, Incorporated
ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
BSI	British Standards Institute
Bundesam	German Standards
CGNVIC	U.S. Coast Guard Navigation and Vessel Inspection Circular
DEF-S	British Defense Standards
DIN	Deutsches Institute fur Normung (Gemmy)
DOD	Department of Defense
DOL	Department of Labor
EPA	Environmental Protection Agency
FCI	Fluid Controls Institute, Incorporated
FED-SPEC	Federal Specification
GL	Germanisher Lloyd

BY ABBREVIATION: (continued)

HEI	Heat Exchange Institute
I-H	Hydraulic Institute
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Incorporated
IES	Illuminating Engineering Society
IMCO	Intergovernmental Maritime Consultive Organization
IPCEA	Insulated Power Cable Engineers Association
ISO	International Organization for Standardization
JIC	Joint Industrial Council
JIS	Japanese Industrial Standards
MARAD	Maritime Administration
MASS	MARAD Standard Specification
MASSD	MARAD Standard Specification - Diesel
MIL	Military Specification
NISS	Manufacturers Standardization Society of the Valve & Fittings Industry
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NNI	Netherlands Normalisatie Institute
OCMIF	OH Companies International Marine Forum
PCC	Panama Canal Company
SAA	Standards Association of Australia
SCA	Suez Canal Authority
SNAME	Society of Naval Architects and Marine Engineers
SOLAS	Safety of Life at Sea
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers Association

BY ORGANIZATION:**Database Maintenance**

Air Movement and Control Association	AMCA
American Bureau of Shipping	ABS
American Boat and Yacht Council, Inc.	ABYC
American Gear Manufacturers Association	AGMA
American Iron and Steel Institute	AISI
American Society of Civil Engineers	ASCE
American Society of Heating, Refrigerating and Air Conditioning	ASHRAE
American Society of Mechanical Engineers	ASME
American Trucking Association	ATA
American Wood Preservers Association	AWPA
American National Standards Institute	ANSI
American Petroleum Institute	API
American Society for Testing and Materials	ASIM

BY ORGANIZATION: (continued)

Audio Engineering Society	AES
British Defense Standards, Def-S	MOD UK
British Standards Institution	BSI
Bundesam	BUND
Canadian General Standards Board	CGSB
Canadian Standards Association	CSA
Chemical Fabrics and Film Association, Inc.	CFFA
Chemical Specialties Manufacturers Association	CSMA
Chinese National Standards	CNS
Civil Aviation Authority	CAA
Civil Engineering Data	CED
Conference Europeene des Administrations des Postes et des Telecommunication	CEPT
Copper Development Association, Inc.	CDA
Cordage Institute	CI
Corps of the Engineers	COE
Data Interchange Standards Association	DISA
Department of Defense	DOD
Department of Labor	DOL
Det Norske Veritas	DNV
Deutches Institute fur Normung	DIN
Electronic Industries Association	EIA
Environmental Protection Agency	EPA
European Committee for Standardization	CEN
European Committee for Electrotechnical Standardization	CENELEC
European Council/Commission Legislative Documents	EC
European Telecommunications Standards Institute	ETSI
Federal Controls Institute, Inc.	FCI
Federal Specification	FED-SPEC
French Association for Standardization	AFNOR
Germanisher Lloyd	GL
Grocery Manufacturers of America, Inc.	GMA
Heat Exchange Institute	HEI
Hydraulic Institute	HI
Industrial Fabrics Association International	IFAI
Institute of Electrical and Electronics Engineers, Inc.	IEEE
International Electrotechnic Commission	IEC
International Radio Consultive Committee	ITU-R
International Telegraph and Telephone Consultative Committee	ITU-T
Illuminating Engineering Society of North America	IESNA
Intergovernmental Maritime Consultive Organization	INICO
Insulated Cable Engineers Association	IPCEA
International Organization for Standardization	ISO

BY ORGANIZATION: (continued)

Japanese Industrial Standards	JIS
Joint Industrial Council	JIC
Joint Technical Committee	JTC I
Lloyd's Register of Shipping	LR
Maritime Administration	MARAD
Marad Standard Specification	MASS
Marad Standard Specification (Diesel)	MASSD
Military Specification	MIL
Manufacturers Standardization Society of the Valve and Fittings Industry	MSS
National Electrical Manufacturers Association	NEMA
National Fire Protection Association	NFPA
National Institute of Standards and Technology	NIST
Netherlands Standard Institute	NNI
North Atlantic Treaty Organization	NATO
OH Companies International Marine Forum	OCIMF
Panama Canal Company	PCC
Safety of Life at Sea	SOLAS
Society of Automotive Engineers	SNE
Society of Naval Architects	SNAME
Standards Association of Australia	SAA
Standards New Zealand	SNZ
Steel Structures Painting Council	SSPC
Suez Canal Authority	SCA
Truck Trailer Manufacturers Association	TTMA
Tubular Exchanger Manufacturers Association	TEMA
Underwriters Laboratories, Inc.	UL
United States Coast Guard	USCG
U.S. Coast Guard Navigation and Vessel Inspection Circular	GNVIC
United States Department of Agriculture	USDA
United States Navy	USN
United States Public Health Service	USPHS

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