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July 1981

A Standards Application and Development Plan for Solar Thermal Technologies

H.R.W. Cobb



SERI

Solar Energy Research Institute

A Division of Midwest Research Institute

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Golden, Colorado 80401

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A STANDARDS APPLICATION
AND DEVELOPMENT PLAN
FOR SOLAR THERMAL
TECHNOLOGIES

H. R. W. COBB

JULY 1981

PREPARED UNDER TASK NO. 1016.00

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PREFACE

This report was prepared by the Solar Energy Research Institute (SERI) under Task No. 1016.00 for the U.S. Department of Energy (DOE) as part of its efforts to develop a quality assurance and standards plan for solar thermal (ST) technologies. This document, one of the keystones of the plan, permits a full exchange of information within the solar thermal community; and encourages the adaption and incorporation of research data into codes, standards, and test methods to be used in providing input for institutional and jurisdictional coverage, safety, reliability, and interchangeability in solar thermal systems.

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SUMMARY

The U.S. Department of Energy's (DOE) office of Advanced Thermal Power Technology Programs requested and funded a modicum of work to be done at the Solar Energy Research Institute (SERI) during FY 1980, developing procedures and standards for solar thermal (ST) technologies. The request reflected thermal's intent to conduct programs that will result in the installation of large number of collectors and heliostats and the necessity for established methods of assuring quality and reliability for components and systems. The comparatively lower budget allocated to the solar thermal program, compared with PV (approximately 10%), to develop a QA&S plan (and the comparative differences in the state of the arts of the two associated technologies) made using the same planning and development approach impractical. Because of legislative directives, some of the principal activities of a QA&S program for PV and solar heating and cooling of residences (SHAC) were in process for a number of years. This previous experience provided a "lessons learned" approach for the more recent QA&S program for ST technologies. In the two earlier solar RD&D programs, the requirements of the public laws were explicit in that criteria had to be defined and established. However, for the solar thermal technologies, QA&S is related to requirements in the legislation for development of "commercial practices." It is necessary to outline a different approach in the ST QA&S development program to meet the goals of the legislative directives. A rationale for a solar thermal QA&S plan is presented in a companion document to this one: A Quality Assurance and Standards Plan for Solar Thermal Technologies (SERI Report No. RR-742-846; July 1981).

The approach we have taken in developing a QA&S plan has been to obtain maximum input from appropriate sections of the industry within the time allowed. Accordingly, inquiries were made for input to a series of matrices that will be updated as the industry grows. The first objectives were to define the functions of systems, subsystems, and components; and list or establish applicable codes and standards, some of which need to be developed or modified for solar thermal technologies. The matrices in this document will form a keystone of the solar thermal QA&S plan.

Development of the functions and standards matrices was effected by canvassing a cross section of the solar thermal industry. The resultant replies were varied, ranging from an individual list of 250 standards from 43 standards-making bodies, to the proposal that normal marketplace forces would bring about the development of standards, in time. The latter, however, does not seem to be taking place quickly within the industry. Within the context of the relevant public laws, stating the need for a QA&S program relative to commercial practice, it is essential to identify standards and codes, test methods, etc., that should be developed, modified or that are currently applicable to the ST technologies.

We expect the first of the matrices to be modified considerably since the priorities suggested and items for development are necessarily somewhat arbitrary. It is the intent of this document that these matrices, that have been circulated, commented upon, and further developed within the industry, be submitted finally to the American National Standards Institute (ANSI) for review and action by consensus group standards-development bodies. The intent of the Office of Management and Budget's circular No. A-119, "Federal Participation in Voluntary Standards," and that of the proposed Federal Trade Commission rule 16 C.F.R. Part 457, "Standards and Certification," will be used to establish guidelines in the management of the program. All segments of the solar thermal community are invited to offer comments, proposals for standards, and

to suggest priorities for standards development on the form for additional information and comments that accompanies this document.

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SECTION 1.0

INTRODUCTION

The U.S. Department of Energy (DOE) initiated a planning activity for FY 1980, with the Solar Energy Research Institute (SERI), "to develop a Solar Thermal Quality Assurance and Standards (QA&S) project plan." Compared with similar tasks for photovoltaics (PV) applications and solar heating and cooling (SHAC) of residences, the solar thermal task was funded at a relatively modest estimated 1.25 person-years. The public laws were more explicit in establishing DOE directives with regard to PV and SHAC quality assurance and standards than for solar thermal technologies. In view of some reported difficulties in implementing QA&S for PV and SHAC technologies, and because funds were limited, a different approach to developing a plan was taken for the solar thermal program. Accordingly, DOE solar thermal project contractors, trade associations, and the like, were canvassed for definitions of functions of systems, subsystems, and components. They were also asked to list standards used, and whether those were modifiable or in need of development.

The response was mixed, ranging from a list of about 250 identified standards from 43 different standards associations for the 10-MW Barstow project to a great deal of interest (but little input) from utilities. Researchers commented that standards were a subject for future concern or that marketplace forces would create standards eventually or cause them to be developed.

Within the context of QA&S, standards development and implementation are only part of the issue. Performance and reliability systems development is equally important. A development plan for the latter is addressed separately [1], since, for an ongoing standards development plan, it is necessary to treat specific items for standards development in a document form such as this one, suitable for periodic updating.

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SECTION 2.0

INTENT OF THE PLAN

Potential benefits to be derived from standards development include:

- improved safety, reliability, and interchangeability;
- development of a strong industrial technology base;
- definition of the engineering aspects of systems and components to facilitate value engineering analysis;
- aid in accelerating the commercialization process of solar thermal systems by establishing standard acceptance criteria within the industry;
- assistance in demonstrating the technical rationale and economics of systems; and
- providing part of the basis for assuring utilities, institutional lenders, and local authorities of the engineering practicalities of proposed systems.

In the United States, most national standards are generated through a loose-knit voluntary committee system made up of various branches of government, professional, and technical societies (e.g., American Society of Mechanical Engineers); manufacturing and nonmanufacturing trade associations (e.g., National Electrical Manufacturers Association); and testing and inspection bodies (e.g., National Fire Protection Association). This voluntary standards-writing program is, in large part, administered by the American National Standards Institute (ANSI), which is a voluntary federation of more than 400 standards-writing bodies in the United States. Proper coordination of these diverse standards-writing organizations is necessary for the timely development of national standards for solar energy applications. DOE is funding the ANSI Steering Committee on Solar Energy Standards Development to provide this coordination effort. In conjunction with ANSI, SERI can serve as liaison to the solar standards-writing program and thereby assist in implementation of procedures to:

- appraise existing standards with regard to scope, usefulness, and applicability;
- determine the capabilities of the various standards development organizations;
- keep abreast of standards development work in progress and identify an appropriate time-frame within which action should be completed;
- determine the need for standards not already under development;
- establish priorities for new standards—taking into account the development procedures, capabilities, and resources of the existing standards-writing bodies;
- identify and eliminate overlap and duplication of standards and standards development work to the extent practicable;
- ensure periodic review and maintenance of standards produced; and
- work with ANSI to initiate projects for which standards-writing action is required and assist ANSI in assigning the project to the organization best able to carry out the program.

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SECTION 3.0

PROCEDURE

Solar thermal systems developers in industry need to know how materials and systems will perform when subjected to combinations of environmental and system operating conditions. Any limitations in the application of materials and systems should be understood and quantified, and such information made readily available to the designer. An efficient way of developing and maintaining this information, which may be updated as new information becomes available, is through the preparation, use, and maintenance of standards.

Standards-writing committees are using the matrix approach to organize their work programs more systematically. The matrix is, in effect, a scorecard that keeps track of standards-writing activities. Using this technique, the required combination of committees from the various standards-writing organizations can be identified, as needed, and their efforts directed to a series of coordinated short- or long-term voluntary programs. This will help ensure that the priorities associated with individual parts of the cooperative effort are properly defined and remain understood until each project is completed.

An initial objective of the standardization process is to divide the problem into manageable technological units that can be handled by existing standards-writing organizations. Standards developed by private organizations or government agencies already exist, and these should be referenced and integrated into the development program to avoid duplication of effort and to determine whether additional new work or refinements are required for the project. An important objective of the matrix approach is to identify areas for which new working groups are needed to develop new standards for specific tasks. As standards are completed, or the urgency of projects change, revisions to the matrix will keep it up to date. This provides the advantage of having agreed-upon, yet adjustable, objectives for accomplishments.

A master matrix of potential needs for ASTM standards required to help implement the National Energy Plan has been established [2]. Solar thermal energy is one of the energy sources identified within the matrix. The ASTM committee organization responsible for implementing the solar-standards-writing effort is identified [3]. The lead committee responsible for project management of the effort is Committee E-44 on Solar Energy Conversion. Subdivisions of Committee E-44 will head the development of standards needed in the following specific areas:

- Solar Energy Conversion Nomenclature (Subcommittee E44.01 on Nomenclature)—developing standard terms and definitions for solar energy applications.
- Solar Energy Conversion Environmental Parameters (Subcommittee E44.02 on Environmental Parameters)—developing standards needed to identify environmental parameters and to establish standard measuring and reporting procedures for data pertinent to solar energy conversion.
- Solar Energy Conversion Materials Performance (Subcommittee E44.04 on Materials Performance)—developing standards needed to relate the reliability and durability of materials in solar energy conversion applications.
- Solar Heating and Cooling Subsystems (Subcommittee E44.05 on Heating and Cooling Subsystems)—developing standards required to evaluate the design, performance, and reliability of collector, storage, transfer, control, energy conversion, and auxiliary energy hardware components or subsystems.

- Active Solar Heating and Cooling Systems (Subcommittee E44.06 on Heating and Cooling Systems)—developing standards required to evaluate the design, performance, installation, and reliability of active solar systems.
- Active Solar Energy Process Heating Systems (Subcommittee E44.07 on Process Heating Systems)—developing standards related to the design and performance analysis of active process heat systems and desalination systems, subsystems, and components—such as collectors, energy storage, energy conversion, and master control.
- Solar Thermal Conversion Power Systems (Subcommittee E44.08 on Solar Thermal Conversion Power systems)—developing standards required to evaluate the design and performance of solar thermal conversion power systems, subsystems, and components—such as collector, receiver, energy conversion, and master control.
- Solar Photovoltaic Electric Power Systems (Subcommittee E44.09 on Solar Photovoltaic Electric Power Systems)—developing standards required to evaluate the design and performance of photovoltaic power systems, including subsystems and components necessary for the conversion, storage, control, and distribution of power to an application load.
- Other committees address wind-driven power systems (E44.10), ocean-thermal power systems (E44.11), biomass conversion systems (E44.12), advanced solar energy conversion systems (E44.13), and passive solar heating and cooling (E44.14).

The above committee structure for a single standards-writing organization (i.e., ASTM) is provided to illustrate the interrelationship of subcommittee efforts. One example of an important interface is evaluating performance and ratings for each of the noted systems and subsystems in a similar manner.

The matrix approach provides a systematic method for identifying:

- standards that are already available to satisfy matrix elements;
- standards that can be revised to satisfy matrix elements;
- areas in which committees need to develop new standards and for which the technology exists to write such standards; and
- areas requiring the development of standards but for which research must be completed before the standards can be written.

SECTION 4.0

MATRICES

Typical systems addressed by the matrices are illustrated in Figs. 1-1 to 1-4. The matrices in Fig. 2 are defined by horizontal and vertical coordinates. The horizontal coordinates identify equipment at various levels of detail (i.e., the subsystems, assemblies, and components that represent the system's mechanical, structural, and electrical features). The horizontal coordinates are obtained directly from the equipment/functional summary in Table 1 and each horizontal is identified by a unique designation number [i.e., a horizontal element designator (HED) which appears on the matrix]. The first letter, H, identifies the element as a horizontal coordinate. The second letter (e.g., A) identifies the element as a system, or as a part of one of the seven designated subsystems. The numerical portion of the HED identifies individual assemblies or components. Reference to an overall subsystem is made by an HX.00 designation. These designations are provided for cross-reference in Table 1.

The vertical coordinates of the matrices identify the subject content of needed standards. The detailed outline of the vertical coordinates is developed from the general need to:

- identify the function and determine the desired performance under stated conditions (i.e., functional characteristics);
- identify the set of conditions that, if followed, will provide some degree of assurance of achieving the stated function (i.e., provisions to achieve function);
- identify methods and procedures to ensure that what was considered necessary has been and will be accomplished (i.e., quality assurance); and
- identify those items required to protect the public's and worker's health and safety.

The vertical coordinates are also identified with a unique designation number (i.e., vertical element designator—VED) which appears on the matrix. The first letter, V, identifies the element as being a vertical coordinate. The second letter (e.g., A, B, C, or D) identifies the element as being in one of the four major subject areas (i.e., definition of functional characteristics, provisions to achieve function, quality assurance, and health and safety). The numerical portion of the VED identifies individual items within each major subject area. Reference to an overall major subject area is made by a VX.00 designation, where X is A, B, C, or D. Individual subject items not specifically identified in the matrix are included in the VX.00 designation.

The HED and VED system of identification is used as a shorthand method of identifying subjects and equipment within this report.

The intersection of each horizontal coordinate with each vertical coordinate theoretically represents a possible standards development area. However, most such standards are either not needed or have a very low priority at this stage of solar thermal equipment and standards development.

The potential standards application areas identified in the matrix of Fig. 2 are based on the following premises:

- Standardization and standards development must not run ahead of existing commercial technology.
- Standards should generally be performance based, such that any reasonable method that produces a specified result is acceptable.
- In general, at this point in the development process, standards should concentrate on system and subsystem criteria to be followed eventually by those for assemblies and components. Several exceptions to this point, however, were part of the matrix development philosophy. They are:
 - In the area of classification (VA.01), it is considered that assemblies, as well as systems and subsystems, should be classified according to their importance to system performance and safety. Future standards probably will be identified according to need based on priorities brought out in the classification process.
 - In the area of material specifications (VB.21), guidance in the form of material acceptance standards is considered a first-priority item for assemblies and components, as well as for subsystems where guidance will be more general and will be directed toward equipment interfaces.
 - Performance/rating standards (VA.21) should be developed on a first-priority basis for assemblies as well as for systems and subsystems.
- Individual sets of standards should be developed for central receiver (HA.01) and distributed systems (HA.02) for specific applications [e.g., stand-alone (HA.03), repowering (HA.04), cogeneration (HA.05), and industrial process heat (HA.06)]. A central body of standards could be referenced as the core of standards for each specific application.

Relevant standards are sorted according to the standard subject matter (i.e., VED) and potential application to specific equipment (i.e., HED). In addition, a judgment was made as to whether a standard was acceptable as it was, or whether it would require significant modification to apply to solar thermal systems. This information has been summarized in Table 2 for standards listed in the organization tables.

The VEDs and applicable HEDs summarized in Table 2 are transferred to the matrix of Fig. 3. The matrix of this figure, therefore, provides a summary of areas where acceptable or modifiable standards exist for solar thermal systems.

Some observations regarding Table 2 and the overview matrix of Fig. 3 indicate that:

- The overview matrix highlights where standards exist at a specific HED/VED intersection, but further review is required to determine what additional standards, if any, are necessary to make a specific subject area complete.
- ASME Boiler and Pressure Vessel Code Section I, Power Boilers, and Section VIII, Pressure Vessels, can be used on an ad hoc basis in conjunction with code cases and specific inquiries to the Boiler and Pressure Vessel Committee to design and fabricate solar thermal components not directly addressed by the ASME Code. However, such a procedure is not likely to result in consistent implementation of the code for similar components designed by different organizations. For this reason, in Table 2, Sections I and VIII are noted as requiring modification for general application to solar thermal systems. Development of an overall solar design and construction standard is consistent with the scope of the Power Sub-

committee of the ASME Solar Energy Standards Committee, which is directed to developing a standard for the design, materials, fabrication, installation, and inspection of the pressurized components of solar thermal power systems. Such a standard will likely be based on the "design-by-rule" considerations of Section I and Section VIII, Division 1, with an alternative "design-by-analysis" portion patterned after Section VIII, Division 2.

- Standards developed for domestic heating and cooling equipment address materials, operating conditions, and procedures that are sufficiently different from those for solar thermal that such standards for this survey have been considered inappropriate for inclusion in Table 2 and the matrix of Fig. 3.
- Standards developed by the Institute of Electrical and Electronics Engineers (IEEE) include standards that are directed to the nuclear power industry. Certain of these standards address installation, reliability, qualification, and preoperational testing of electrical equipment. These standards provide useful guidance for the solar thermal program and are incorporated in Table 2 and in the matrix of Fig. 3. However, they require modification to attenuate the generally more restrictive nature of the nuclear standards.
- Although technical reports of the National Bureau of Standards (NBS) do not normally provide standards for direct implementation, such reports have been included in this overview because of their in-depth information value and direct application to standards practice. For example, work presented in NBS TN-899, "Development of Proposed Standards for Testing Solar Collectors and Thermal Storage Devices," was the basis for the development of standards by the American Society for Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) for testing the performance of solar collectors (ASHRAE 93-77) and thermal storage devices (ASHRAE 94-77). Other NBS reports (i.e., NBSIR 78-1548, NBS BSS 177) evaluate these performance test methods and provide further insight into the recommended test programs. NBS reports on environmental and safety considerations (NBSIR 77-1532) and materials performance (NBSIR 77-1314) for solar energy applications could serve as the basis for future standards on these subjects. These reports by themselves, however, provide valuable information pertinent to the design, construction, and operation of solar energy systems.

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SECTION 5.0

ASSOCIATE ORGANIZATIONS

A survey is included of the standards of nongovernmental organizations whose disciplines are related to the technical scope of the solar thermal program. These organizations are:

- American Concrete Institute (ACI)
- American Institute of Steel Construction (AISC)
- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- American Refrigeration Institute (ARI)
- American Society of Civil Engineers (ASCE)
- American Society for Heating, Refrigerating, and Airconditioning Engineers (ASHRAE)
- American Society of Mechanical Engineers (AMSE)
- American Society for Nondestructive Testing (ASNT)
- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- Cooling Tower Institute (CTI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Instrument Society of America (ISA)
- International Conference of Building Officials (ICBO)
- National Association of Corrosion Engineers (NACE)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

In addition, guidance documents of the Department of Energy and the National Bureau of Standards have been reviewed because of the direct technical involvement of these organizations in the U.S. solar energy program.

The survey was completed by reviewing lists of available standards or guidance documents of the above organizations. Those that were clearly not relevant were deleted from further review. Where the title of the standard was sufficiently descriptive, or where there was sufficient knowledge of the standard, the individual document was not reviewed. In all other cases (about 20%), individual standards were reviewed. All relevant standards are listed in Tables 3 to 24 under their appropriate organizations.

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SECTION 6.0

RECOMMENDATIONS

The ANSI Steering Committee on Solar Energy Standards Development (SCSE) has recently put forth a working paper [4] directed to the reorganization of its committee structure to expand the scope of solar energy conversion technologies that it addresses. The working paper notes that, without actually engaging in standards-writing activities, the SCSE shall:

- (1) Identify needs and formulate specific tasks leading to the development of national consensus standards for the utilization of solar energy;
- (2) Assign standards development projects to competent standards-writing organizations and maintain a continuous overview of their activities in order to assure the orderly and timely development of needed standards, minimizing, or avoiding entirely, duplication of effort and conflicting standards.

It is proposed that the overview matrices and supporting tables in this document be used as a starting point by ANSI SCSE for developing a comprehensive matrix to manage the solar thermal portion of the proposed program. If the matrices and supporting tables are used in such a manner, it is recommended that additional input from personnel active in the solar thermal program be solicited and incorporated as appropriate into the information base.

A sample form is provided for updating and canvassing additional information and comment on the matrices and supporting tables in this report.

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SECTION 7.0**REFERENCES**

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2. ANSI/ASTM E583-77. Recommended Practice for Systematizing the Development of (ASTM) Voluntary Consensus Standards for the Solution of Nuclear and Other Complex Problems.
3. ANSI/ASTM E584-77. Recommended Practice for Developing the (ASTM) Voluntary Consensus Standards Required to Help Implement the National Energy Plan.
4. Working Paper. Reorganization Plan for the Steering Committee on Solar Energy Standards Development (SCSE). 13 Mar. 1980.

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TABLES

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Table 1. SOLAR THERMAL SYSTEM^a EQUIPMENT/FUNCTIONAL RELATIONSHIP

Subsystem	Assembly	Component	HED ^b	Function
Collector (CS)	Reflector		HB.00	Focuses incoming solar radiation; may be provided with ability to track sun's position and relocate to receive optimum insolation.
			HB.01	Reflects solar radiation onto receiver or selected target.
		Reflector Panel	HB.02	Reflective surface, shape may provide convergent beam.
		Heliostat	HB.03	Insolation reflector to central receiver or furnace target.
		Parabolic Dish	HB.04	Point-focus, distributed receiver.
		Hemispheric Bowl	HB.05	Line-focus, distributed receiver.
		Trough	HB.06	Line-focus, distributed receiver.
		Reflector Support	HB.07	Supports and attaches reflector panel into system.
		Drive Unit	HB.08	Positions reflector support in azimuth and elevation, slews to stow position.
		Pedestal	HB.09	Mount for reflector support.
		Electrical System	HB.10	Power to control drive unit.
Field Electronics	HB.11	Command decoding, sensor processing, and data transmission for positioning control.		

^aCentral receiver (HA.01) adaptable to stand-alone (HA.03), repowering (HA.04), cogeneration (HA.05), and industrial process heat (HA.06) applications. Distributed receiver (HA.02) applications are primarily stand-alone, cogeneration, and industrial process heat.

^bHED: horizontal element designator utilized in Figs. 2 and 3 is provided here for cross reference.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function
Collector (CS) (continued)	Reflector (continued)	Protective Housing	HB.12	Shields reflector from atmosphere contamination.
		Control	HB.13	Controls position of individual reflectors, or that of the full array for steady-state and transient conditions.
		Array Controller	HB.14	Commands CS operating modes in response to MCS or operator-initiated command. Performs emergency defocus, stowage, and maintenance positioning.
		Field Controller	HB.15	Controls individual positions of a pre-selected group of collectors. Supervises command and data traffic between the array and individual controllers.
		Collector Controller	HB.16	Operates drive motor to position collector in the commanded direction on signal from positioning processor.
		Tracking Drive	HB.17	Mechanism for positioning collector when signalled by sensor (tracker)/position processor.
		Insulation (Collector)	HB.18	Minimizes heat loss from system; may also provide mechanical support.
Receiver (RS)			HC.00	Produces and distributes heated fluids, vapors, or gases to balance of plant.
	Receiver Unit (Absorber)		HC.01	Absorbs redirected solar energy (insolation) from the collector subsystem.
		Preheater Panel	HC.02	Absorbs portion of reflected insolation to preheat heat transfer medium (HTM).

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function
Receiver (RS) (continued)	Receiver Unit (Absorber) (continued)	Boiler Panel	HC.03	Absorbs bulk of reflected insolation in HTM and converts liquid to vapor/gas.
		Cavity (Receiver)	HC.04	Minimizes transient upset effects from passing cloud cover.
		External (Receiver)	HC.05	Lighter, simpler panel design of receiver.
		Outlet Piping	HC.06	Routes elevated temperature HTM/vapor from receiver to turbine or thermal storage.
		Downcomer Manifold	HC.07	Coolant path away from boiler.
		Flash Tank	HC.08	Separates water from steam during receiver startup and trip conditions.
		Feed Inlet Piping	HC.09	Provides coolant/HTM path toward boiler.
		Feed Pump	HC.10	Pumps feedwater/HTM through preheater and boiler panels.
		Insulation (Receiver)	HC.11	Provided on back of preheater and receiver (boiler) panels to minimize thermal losses and provide thermal protection for support structure and control components.
		Crane	HC.12	Receiver unit installation and maintenance.
		Heat Transfer Medium (HTM)	HC.13	Transfers energy from receiver to power producing system.



Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function	
Receiver (RS) (continued)	Control		HC.14	Controls and protects receiver subsystem, identifies failure events, and evaluates subsystem performance.	
		Instrumentation	HC.15	Senses and monitors parameters such as temperature, RS inlet and exit pressure of HTM, insolation, tracking position, etc.	
		Control Electronics	HC.16	Receives command signals from operator or MCS based on instrumentation data and translates these signals into specific actions of the receiver.	
		Valves	HC.17	Controls flow at inlet of boiler (receiver) panel in conjunction with temperature sensing of the exit steam. Provides safety relief and means of system isolation.	
	Ceramic Assembly			HC.18	Assembly to absorb redirected solar energy.
		Inlet Manifold		HC.19	Cavity for solar energy reception and collection.
		Outlet Manifold		HC.20	Collection system for heat delivery.
		Outer Shell		HC.21	Assembly encompassing manifolds.
		Absorber Unit		HC.22	Absorbs redirected solar energy; transfers heat to HTM.
		Reflector		HC.23	Reflects solar energy or heat energy.
		Heat Pipe		HC.24	Heat collector and delivery unit.
	Flexible Piping		HC.25	Permits limited differential rotation in piping system.	

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)



Subsystem	Assembly	Component	HED	Function
Thermal Storage (TSS)			HD.00	Stores thermal energy for use during nonsunshine periods; provides means for smoothing energy transients.
		Thermal Storage Unit	HD.01	Stores sensible thermal energy.
		Tank & Manifolds	HD.02	Vessel to contain heat storage medium with access to extraction and charging loops.
		Heat Storage Media (HSM)	HD.03	Heat sink for receiver energy.
		Heat Transfer Media (HTM)	HD.04	Transfers heat to and from heat storage media.
		Charging Loop	HD.05	Absorbs thermal energy by desuperheating, condensing, and subcooling receiver-generated steam.
		Desuperheater	HD.06	Reduces temperature of steam from receiver system.
		Thermal Storage Heater	HD.07	Transfers thermal energy of incoming steam from desuperheater to heat transfer fluid.
		Piping	HD.08	Provides path for heat transfer fluid between thermal storage unit and thermal storage heater.
		Pump	HD.09	Moves heat transfer media through charging loop.
	Ullage Maintenance Unit	HD.10	Maintains oxygen-free atmosphere and controls pressure in gas space of thermal storage unit.	

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function
Thermal Storage (TSS) (continued)	Charging Loop (continued)	Fluid Maintenance Unit	HD.11	Removes suspended and dissolved impurities from the heat transfer media.
		Extraction Loop	HD.12	Preheats, boils, and superheats incoming HTM with stored thermal energy to produce turbine admission steam.
		Steam Generator	HD.13	Transfers thermal energy stored in thermal storage unit to incoming feed-water to produce superheated steam.
		Piping	HD.14	Provides path for heat transfer fluid between thermal storage unit and steam generator.
		Pump	HD.15	Moves heat transfer media through extraction loop.
		Control	HD.16	Maintains design temperature of heat transfer media. Provides for automatic response to variations in demand for admission energy.
		Instrumentation	HD.17	Monitors important TSS operating parameters of charging loops, thermal storage, heaters, steam and heat transfer media temperature, extraction loop incoming heat transfer oil and exiting fluid/vapor temperature, pressure, and flow rate.
		Control Electronics	HD.18	Maintains proper temperature conditions in the TSS by controlling pump and valve operation based upon real-time computer analysis of the operating data.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)



Subsystem	Assembly	Component	HED	Function
Thermal Storage (TSS) (continued)	Control (continued)	Control Valves	HD.19	Control charging and extraction rates, provide safety relief.
		Auxiliary Thermal Storage	HD.20	Provides auxiliary heat storage.
Electrical Power Generating (EPGS)	Power Conversion		HE.00	Generates electricity.
			HE.01	Converts energy of HTM developed from collected thermal power into electrical power.
		Turbine	HE.02	Converts energy of HTM vapor to rotational energy.
		Generator/Alternator	HE.03	Converts rotational mechanical energy to electrical energy.
		Support Systems	HE.04	Provides lubrication and cooling.
		Controls/Instr.	HE.05	Controls output of turbine-generator to user demand.
		Heat Engine/Alternator	HE.06	Converts radiant heat to electricity through Brayton, Rankine, or Stirling cycle engine in conjunction with integral alternator.
			HE.07	Removal of excess heat from system.
			HE.08	Condenser heat sink.
			HE.09	Pipes, pumps, valves to provide and control flow.
	HE.10	Automatic and manual control of heat rejection demands on cooling tower.		

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function	
Electrical Power Generating (EPGS) (continued)	Feedwater Loop (HTM Feed Loop) (continued)		HE.11	Provides high quality feedwater/(HTM Feed) to receiver, thermal storage steam generators, and other system components.	
		Condenser	HE.12	Condenses turbine discharge steam or vapor.	
		Circulating System	HE.13	Pipes, pumps, valves to provide and control flow.	
		Heaters/Deaerator	HE.14	Heats feedwater or HTM to a temperature above atmospheric boiling to permit removal of dissolved gases.	
		Controls/Instr.	HE.15	Automatic and manual control of HTM or water system feed demands.	
		Auxiliary Steam Network		HE.16	Provides steam or vapor for preheating and thermal conditioning functions during start-up and standby periods.
			Electric Boiler	HE.17	Generates steam/vapor from power independent of solar facility.
			Circulation System	HE.18	Auxiliary electric boiler with distribution piping to receiver and admission steam networks.
			Controls/Instr.	HE.19	Provides for steam/vapor distribution to critical components during hot shutdown and for preferential use of receiver and/or thermal storage steam generator steam over that of the auxiliary electric boiler.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)



Subsystem	Assembly	Component	HED	Function
Electrical Power Generating (EPGS) (continued)	Electrical Distribution Equipment		HE.20	Connects generator to main power transformer and conventional transmission system for grid distribution.
		Transformers	HE.21	Voltage transformation.
		Switch Gear/Relays	HE.22	Electric switching.
		Cables/Connectors	HE.23	Conducts electric power.
		Controls/Instr.	HE.24	Generates appropriate signals to adjust turbine operations or generator load as part of the MCS coordinated control routines while the unit is synchronized to the grid.
Master Control (MCS)	Operations Control	Gear Box	HE.25	Changes velocity and redirects shaft drive.
			HF.00	Integrates independent controls of collector, receiver, thermal storage, and electric power generating subsystems.
			HF.01	Automatically controls plant, accounting for operating mode transitions and emergency actions.
		Console Display	HF.02	Provides operator with alarm information, operating status, and performance data.
		Computer/Software	HF.03	Analyzes data to manage and supervise plant and subsystems, carries out predetermined control strategy, computes subsystem and total plant performance.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function
Master Control (MCS) (continued)	Operations Control (continued)	Data Storage/ Printers	HF.04	Maintains a file of current readings of every control parameter and records all commands and significant data.
		Control Room Equipment	HF.05	Provides displays of plant status and allows for manual operation.
		Loop Flow Controllers	HF.06	HTM flow control.
		Pump Controller	HF.07	Controls pump performance.
		Vaporizer Level Controller	HF.08	Controls head.
		Valve Controller	HF.09	Controls position of valve.
		Heat Source Monitor	HF.10	Monitors heat input to system (sub-system).
		Tracker Controller	HF.11	Controls tracker.
		Pressure Controller	HF.12	Monitors and controls pressure in loop.
		Leak Monitor	HF.13	Monitors coolant inventory or senses coolant leaks.
		Toxic Vapor Monitor	HF.14	Senses toxic vapor leaks to atmosphere.
		Data Acquisition	HF.15	Requests, receives, processes, and stores engineering data describing plant operations.
		Console Display	HF.16	Hard copy or visual display of data evaluation results, control and alarm status, and environmental conditions.
		Computer/Software	HF.17	Processes real-time data as well as collects and stores data for off-line plant performance evaluation.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)



Subsystem	Assembly	Component	HED	Function	
Master Control (MSC) (continued)	Data Acquisition (continued)	Data Storage/ Printers	HF.18	Creates archival data files.	
		Sensors	HF.19	Provides independent data or interface with sensors for operations control.	
	Peripheral Control		HF.20	Back-up to operating control system, software development aid, and control simulation.	
		Console Display	HF.21	Exhibits selected variables.	
		Computer/Software	HF.22	Drives engineering displays for purpose of real-time or subsequent evaluation.	
		Data Storage/ Printers	HF.23	Maintains identical data base to operational control system.	
		Processor	HF.24	Processes information.	
		Position Encoder	HF.25	Relates position of object to a datum.	
	Beam Characterization (BCS)	Video Assembly	Microprocessor	HF.26	Processing unit using miniaturized system.
				HG.00	Provides automated method for performing periodic check on heliostat tracking accuracy and obtains data for determining beam quality.
			HG.01	Views passive target from fixed location in collector field.	
Video Camera System			HG.02	Scans target from reflector field.	
		Video Digitizer	HG.03	Digitizes analog video image.	

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)



Subsystem	Assembly	Component	HED	Function	
Beam Characterization (BCS) (continued)	Video Assembly (continued)	Environmental Housing	HG.04	Thermally controlled enclosure for the camera.	
		Pedestal	HG.05	Permanent support for video camera in position that does not interfere with heliostat operations or maintenance.	
	BCS Controller		BCS Controller	HG.06	Beam characterization measurement procedure controlled by MCS.
			Console Display	HG.07	Displays beam intensity and beam power information in real time or from stored data.
			Data Processor/Storage	HG.08	Determination of beam accuracy and beam quality from optical measurements performed by MCS computer.
			Target	HG.09	Provides calibrated data for evaluating beam accuracy.
		Screen	HG.10	Provides uniform reflection under high thermal loads.	
		Mounting Structure	HG.11	Supports target on tower.	
		Target Radiometer	HG.12	Measures background radiation and incident radiation from reflectors.	
	Plant Support (PSS)			HH.00	Provides site facilities and support equipment.
		Site Development		HH.01	Prepares area for development and operation.
			Roads & Parking	HH.02	Transportation.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function	
Plant Support (PSS) (continued)	Site Development (continued)	Grading	HH.03	Provides adequate surface drainage to prevent water accumulation in collector field.	
		Fencing	HH.04	Security.	
		Landscaping	HH.05	Erosion and dust control.	
	On-site Structures			HH.06	Building and foundation construction.
		Guard House		HH.07	Plant security.
		Administration Building		HH.08	Office building for plant management and technical support.
		Warehouse		HH.09	Receives and stores equipment, spare parts, and materials for plant servicing.
		Receiver Tower		HH.10	Elevates receiver unit and support riser/downcomer piping.
		Turbine/Generator Building		HH.11	Encloses turbine-generator, associated steam, feedwater and electrical equipment, and a master control room.
		Collector Field/Receiver Foundations		HH.12	Provides rigid mounting base for reflector assembly and receiver structures.
	Off-site Facilities	Meteorological Stations		HH.13	Contains solar and environmental monitoring equipment necessary for plant operation.
				HH.14	Off-site services.
		Visitor Center		HH.15	Provides central information center.

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Continued)

Subsystem	Assembly	Component	HED	Function	
Plant Support (PSS) (continued)	Off-site Facilities (continued)	Heliport	HH.16	Helicopter landing pad.	
		Water Supply	HH.17	Provides potable water.	
		Electrical Transmission Network	HH.18	Transmits electrical power off site.	
		Facility Services		HH.19	Supplemental needs.
			Raw/Service Water	HH.20	Satisfies cooling needs and fire-fighting requirements.
			Sprinklers, Extinguishers, Alarms	HH.21	Fire protection.
			Demineralizer	HH.22	Improves water quality.
			Oil Supply	HH.23	Coolant for rotating machinery and TSS heat transfer fluid.
			Lightning Ground	HH.24	Protects against receiver lightning strike.
			Lights	HH.25	Area lighting and aircraft warning lights for receiver tower.
			Power Distribution	HH.26	Provides uninterruptible power supply to isolate computing and process control equipment from momentary transients in the grid voltage to permit continued plant operation during such transients.
			Instrumentation	HH.27	Monitors weather for operating information.
			Control Wiring	HH.28	Provides control interface with all sub-systems.
	Collector Washer Equipment	HH.29	Cleans reflectors.		

Table 1. SOLAR THERMAL SYSTEM EQUIPMENT/FUNCTIONAL RELATIONSHIP (Concluded)

Subsystem	Assembly	Component	HED	Function
Plant Support (PSS) (continued)	Electrical Interface	Electrical Cable, Supports, and Connectors	HH.30	Provides electrical connections with CS, RS, TSS, EPGS, MCS, and BCS.
	Structural Interface	Foundations and Structural Supports	HH.31	Provides support for site structures, interconnecting cables and pipes for CS, RS, TSS, EPGS, MCS, and BCS.
	Fluid Interface	Piping, Valves, and Fittings	HH.32	Provides piping distribution systems between RS, TSS, EPGS, MCS, and BCS.
	Soils	Concrete	HH.33	Provides natural base for installation.
Electrical Storage and Supply Subsystem (ESSS)	Energy Storage	Pre-Tension	HH.34	Building material.
			HH.35	Strengthening system for concrete.
			HI.00	Stores energy and supplies electricity.
		Power Components	HI.01	Supplies electrical power.
		Inverter	HI.02	Converts direct current to alternating current.
		Rectifier	HI.03	Converts alternating current to direct current.
		Batteries	HI.04	Stores energy in chemical form.
		Switch Gear	HI.05	Connects/disconnects electrical conductors.
Switch Controller	HI.06	Operates switch gear.		

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS

VED ^a	Subject	Applicable HED ^b	Primary Standards	Related Standards	ACC/RM ^c	Responsible Organization
VA.15	DESIGN CRITERIA <u>Functional Characteristics</u> (Mechanical, Structural, Safety, Reliability Criteria)	HA.00		76-1187	RM	NBS

^aVED: Vertical Element Designator; see page 7.

^bHED: Horizontal Element Designator; see page 7.

^cACC: Standard acceptable for solar thermal systems.

RM: Standard requires modification for solar thermal systems.



Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VA.16	MECHANICAL					
	Operational Behavior (Heating, Ventilating, Air Conditioning, Water Supply, Fire Protection)	(HH.00 HH.06 HH.14 HH.17 HH.19 HH.20)	ERDAM Part 6300		ACC	DOE

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VA.17	<u>STRUCTURAL Operational Behavior</u> (Buildings, Roads)	(HH.00 HH.01 HH.02 HH.03 HH.06 HH.14 HH.16)	ERDAM Part 6300		ACC	DOE

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VA.19	<u>ELECTRICAL Operational Behavior</u> (Wiring, Lighting, Lightning Protection)	(HH.00 HH.06 HH.14 HH.19 HH.24 HH.25)	ERDAM		ACC	DOE

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VA.21	EFFICIENCIES/RATINGS PERFORMANCE					
	(Collector/Receiver)	(HB.00 HC.00)	93-77	910-80 BSS-117 TN-899	ACC ACC ACC ACC	ASHRAE ARI NBS NBS
	(Thermal Storage)	HD.00	94-77	78-1548	ACC ACC	ASHRAE NBS
	(Turbine)	HE.02	PTC 6-76	PTC 6S-70	ACC ACC	ASME ASME
	(Fans)	(HH.08 HH.15)	PTC 9-70 PTC 10-65		ACC ACC	ASME ASME
	(Heaters/Deaerators)	HE.14	PTC 12.1-78 PTC 12.3-77		ACC ACC	ASME ASME
	(Condenser)	HE.12	PTC 12.2-55		ACC	ASME
	(Turbine Control)	HE.02	PTC 20.1-77	PTC 20.3-70	ACC ACC	ASME ASME
	(Safety/Relief Valves)	(HC.01 HD.01)	PTC 25.3-76		ACC	ASME

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.02	<u>MECHANICAL Design, Analysis</u>					
	(Boiler)	(HC.02 HC.03)	Section I		RM	ASME
	(Power Piping)	(HC.06 HC.07 HC.09 HD.08 HD.14 HE.01 HE.07 HE.11 HE.16 HH.32)	B31.1		ACC	ASME
	(Pressure Vessels)	(HC.00 HD.00 HE.00 HH.19)	Section VIII		RM	ASME
	(Tanks)	(HD.02 HH.19)	STD-650	Spec. 12D Spec. 12F	ACC ACC ACC	API API API

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.02 (continued)	MECHANICAL (continued) <u>Design, Analysis</u> (Control Valves)	(HC.17 HD.19)	S75.01		ACC	ISA
				RP4.1	ACC	ISA
				RP4.2	ACC	ISA
	(HVAC)	(HH.06 HH.14)	UMC		ACC	ICBO
				360-75	ACC	ARI
				390-78	ACC	ARI
				430-78	ACC	ARI
				610-74	ACC	ARI
				650-73	ACC	ARI
				850-78	ACC	ARI

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.05	STRUCTURAL Design, Analysis					
	(Building Construction)	(HH.06 HH.14)	M010 S302 UBC PC		ACC	AISC
					ACC	AISC
					ACC	ICBO
					ACC	ICBO
				318-77	ACC	ACI
				S314	ACC	AISC
				S326	ACC	AISC
	(Water and Waste Pipes)	(HH.17 HH.20)	Prac. No. 37 C101-67 C150-76		ACC	ASCE
					ACC	AWWA
					ACC	AWWA
				C857-78	ACC	ASTM
				C858-78	ACC	ASTM
				C890-78	ACC	ASTM
				D2837-76	ACC	ASTM
(Cooling Tower)	HE.08	STD-103(Pt. 2) STD-114(Pt. 2) STD-115(Pt. 2)		ACC	CTI	
				ACC	CTI	
				ACC	CTI	
			STD-119	ACC	CTI	
(Glass Stress Analysis)	HB.02		F218-68	ACC	ASTM	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.13 (continued)	ELECTRICAL/INSTRUMENTATION (continued) <u>Design, Analysis</u> (Distribution-continued)			TC6-78 TC8-78 TC9-78 TC10-78 C37.97-79	ACC ACC ACC ACC ACC	NEMA NEMA NEMA NEMA ANSI
	(Control Room Design)	HF.00		566-77	RM	IEEE
	(Instrumentation)	(HC.15 HD.17 HE.15 HE.19 HE.24)		S5.1 S5.4 S7.3 S37.1 S37.3 S37.5 S37.6 S37.8 S37.10 S37.12	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ISA ISA ISA ISA ISA ISA ISA ISA ISA ISA
				PTC 19.2-64 PTC 19.3-74	ACC ACC	ASME ASME
				E251-67 E608-78	ACC ACC	ASTM ASTM
	(Computer Programming)	HF.00		S61.1 S61.2	ACC ACC	ISA ISA
	(Display)	(HF.02 HF.07 HF.12)		II 1-76	ACC	NEMA
	(Transformers)	HE.21		ST20-72 TR1-74 C57.12.80-78	ACC ACC ACC	NEMA NEMA ANSI

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.20	<u>RELIABILITY</u> <u>Design, Analysis</u> (Analysis)	HA.00		352-75 500-77 577-76	RM RM RM	IEEE IEEE IEEE



Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.22	PROPERTIES AND TESTS					
	(Roofing Material)	(HH.06 HH.14)		D226-77 D227-78 D249-73 D250-77 D312-78	ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM
	(Soils)	HA.00		D427-74 D854-58 D1194-72 D2850-70 D3080-72 D3397-75	ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM
	(Electrical Insulation)	(HB.00 HC.00 HD.00 HE.00 HF.00 HG.00 HH.00)		D572-73 D574-74 D752-73 D753-73 D754-74 D755-74 D1047-74	ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Aggregate, Stone)	HH.02		D692-79 D693-77	ACC ACC	ASTM ASTM
	(Lumber)	HE.08	STD-103 (Part 1) STD-114 (Part 1) STD-115 (Part 1)		ACC ACC ACC	CTI CTI CTI

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.23	METALS						
	<u>Properties and Tests</u>						
		(Power Piping, B31.1)	(HC.01	Section II (Part A)		ACC	ASME
		(Power Boilers, SI)	HD.01				
		(Pressure Vessels, SVIII)	HD.05				
			HD.12		A 36-88a	ACC	ASTM
			HE.07		A 53-78	ACC	ASTM
			HE.11		A 105-77	ACC	ASTM
			HE.16		A 106-78	ACC	ASTM
			HH.33)		A 135-73a	ACC	ASTM
					A 178-75	ACC	ASTM
					A 181-77	ACC	ASTM
					A 182-78	ACC	ASTM
					A 192-75	ACC	ASTM
					A 210-76a	ACC	ASTM
					A 213-76a	ACC	ASTM
				A 216-77	ACC	ASTM	
				A 217-77a	ACC	ASTM	
				A 226-75	ACC	ASTM	
				A 285-78	ACC	ASTM	
				A 299-78	ACC	ASTM	
				A 335-76	ACC	ASTM	
				A 369-76	ACC	ASTM	
				A 387-78	ACC	ASTM	
				A 515-78	ACC	ASTM	
				A 516-78	ACC	ASTM	
				Section II (Part B)		ACC	ASME
				B 61-76	ACC	ASTM	
				B 62-76	ACC	ASTM	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Additional Section VIII and Power Piping Materials)	(HC.00 HD.00 HE.00 HH.32)		A179-75 A199-77 A214-75 A238-78 A233-77 A350-77a B108-76 B161-75 B167-76 B209-79 B210-78 B234-77 B241-76 B247-78 B402-79 B423-75 B424-75	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM



Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Additional Section VIII and Power Boiler Materials)	(HC.00 HD.00 HE.00 HH.32)		A31-76	ACC	ASTM
				A202-78	ACC	ASTM
				A204-78	ACC	ASTM
				A209-76	ACC	ASTM
				A225-78	ACC	ASTM
				A250-75	ACC	ASTM
				A266-78	ACC	ASTM
				A302-78	ACC	ASTM
				A336-78	ACC	ASTM
				A423-75	ACC	ASTM
				A442-78	ACC	ASTM
				B42-78	ACC	ASTM
				B111-79	ACC	ASTM
				B161-75	ACC	ASTM
				A240-78a	ACC	ASTM
				A249-77	ACC	ASTM
				A268-77	ACC	ASTM
				A312-77	ACC	ASTM
				A351-78	ACC	ASTM
				A376-77	ACC	ASTM
				A430-77	ACC	ASTM
				(Additional Power Piping and Power Boiler Materials)	(HC.00 HD.00 HE.00 HH.32)	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Additional Power Piping Materials—continued)			B68-79	ACC	ASTM	
				B168-75	ACC	ASTM	
				B251-76	ACC	ASTM	
				B315-79	ACC	ASTM	
				B361-76	ACC	ASTM	
				B547-78a	ACC	ASTM	
	(Additional Section VIII Materials)	(HD.00 HE.00 HH.32)			A203-78	ACC	ASTM
					A311-64	ACC	ASTM
					A320-78	ACC	ASTM
					A334-77	ACC	ASTM
					A352-77	ACC	ASTM
					A372-78	ACC	ASTM
					A414-71	ACC	ASTM
					A455-78	ACC	ASTM
					A487-78	ACC	ASTM
					A508-78a	ACC	ASTM
					A524-78	ACC	ASTM
					A533-78	ACC	ASTM
					A537-78	ACC	ASTM
					A556-76	ACC	ASTM
					A612-78	ACC	ASTM
					A662-78	ACC	ASTM
					A695-74	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Additional Section VIII Materials—continued)					
				B26-78	ACC	ASTM
				B163-75	ACC	ASTM
				B211-79	ACC	ASTM
				B221-76a	ACC	ASTM
				B308-78	ACC	ASTM
				B395-79	ACC	ASTM
				B407-77	ACC	ASTM
				B408-77	ACC	ASTM
				B409-77	ACC	ASTM
		B514-79	ACC	ASTM		
	(Additional Power Boiler Materials)	(HC.02 HC.03)		A660-76	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Structural)	(HB.00		A6-78	ACC	ASTM
		HC.00		A36-77a	ACC	ASTM
		HD.00		A325-78a	ACC	ASTM
		HE.00		A441-77	ACC	ASTM
		HH.06		A490-78	ACC	ASTM
		HH.14)		A500-78	ACC	ASTM
				A501-76	ACC	ASTM
				A514-77	ACC	ASTM
				A529-75	ACC	ASTM
				A570-78	ACC	ASTM
				A572-78	ACC	ASTM
				A588-77a	ACC	ASTM
				A606-75	ACC	ASTM
				A607-75	ACC	ASTM
		A618-74	ACC	ASTM		

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u>						
	(Additional Casting Materials—continued)				A743-77	ACC	ASTM
					A744-77	ACC	ASTM
					A747-77	ACC	ASTM
					A748-77	ACC	ASTM
					A757-78	ACC	ASTM
		(Additional Piping Materials and Fittings)	(HC.00		A338-61	ACC	ASTM
			HD.00		A381-76	ACC	ASTM
			HE.00		A409-77	ACC	ASTM
			HH.19		A523-78	ACC	ASTM
			HH.32)		A671-77	ACC	ASTM
					A672-77	ACC	ASTM
					A691-77	ACC	ASTM
					A694-74	ACC	ASTM
					A696-77	ACC	ASTM
					A714-78	ACC	ASTM
				A727-76	ACC	ASTM	
				A731-76	ACC	ASTM	
				A733-76	ACC	ASTM	
		A758-78	ACC	ASTM			
		B407-77	ACC	ASTM			
		B514-79	ACC	ASTM			

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Additional Pressure Vessel Materials)	(HH.19 HH.32)		A20-78	ACC	ASTM
				A353-78	ACC	ASTM
				A457-71	ACC	ASTM
				A517-78	ACC	ASTM
				A538-77	ACC	ASTM
				A542-78	ACC	ASTM
				A543-78	ACC	ASTM
				A553-78	ACC	ASTM
				A562-78	ACC	ASTM
				A590-72a	ACC	ASTM
				A592-74	ACC	ASTM
				A605-72	ACC	ASTM
				A645-78	ACC	ASTM
				A658-72	ACC	ASTM
				A723-77	ACC	ASTM
				A724-78	ACC	ASTM
				A734-78	ACC	ASTM
				A735-78	ACC	ASTM
				A736-78	ACC	ASTM
				A737-78	ACC	ASTM
	A738-78a	ACC	ASTM			
	A739-76	ACC	ASTM			

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u>					
	(Additional Heat Exchanger and/or Condenser Tube Materials)	HE.12		A498-68 A520-72 A557-76 A608-70 A688-78 A692-74 B111-79 B163-77 B338-78 B359-79 B404-73	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Absorber Panels)	HB.02		B638-78	ACC	ASTM
	(Reflector Support)	HB.07		B85-76 B90-70 B91-72 B94-77 B107-76 B179-78 B211-79 B221-76a B308-78 B429-73 B597-76	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u>					
	(Miscellaneous Plant Support—continued)	HB.01		A193-78a A194-78 A457-71 A477-79 A637-70 A638-70 A639-70 B75-79 B88-78	ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Turbine Materials)	(HE.02 HE.03)		A288-77 A289-77 A290-78 A291-78 A293-77a A294-77 A437-77 A469-77 A470-78 A471-77 A472-74 A473-76	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Electrical Uses)	(HB.10 HB.11 HC.15 HC.16 HD.17 HD.18 HE.23 HE.24 HF.00 HG.00 HH.19 HH.30)		B32-76 B33-74 B48-68 B105-76 B187-79 B188-79 B189-74 B236-73 B286-74 B317-73 B324-69 B416-69	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u>					
	(Other Available Materials for Structural and Mechanical Purposes)	(HB.00 HC.00 HD.00 HE.00 HH.00)	A242-75		ACC	ASTM
				A29-76	ACC	ASTM
				A49-78	ACC	ASTM
				A67-78	ACC	ASTM
				A108-73	ACC	ASTM
				A109-72	ACC	ASTM
				A143-74	ACC	ASTM
				A167-77	ACC	ASTM
				A176-78	ACC	ASTM
				A177-69	ACC	ASTM
				A255-67	ACC	ASTM
				A256-46	ACC	ASTM
				A263-77	ACC	ASTM
				A264-77	ACC	ASTM
				A265-77	ACC	ASTM
				A269-76	ACC	ASTM
				A284-77	ACC	ASTM
				A314-76	ACC	ASTM
				A321-74	ACC	ASTM
				A331-74	ACC	ASTM
				A354-78a	ACC	ASTM
				A366-72	ACC	ASTM
				A412-75	ACC	ASTM
				A427-74	ACC	ASTM
				A434-76	ACC	ASTM
				A446-76	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Other Available Materials for Structural and Mechanical Purposes— continued)					
				A449-78a	ACC	ASTM
				A453-78	ACC	ASTM
				A458-79	ACC	ASTM
				A480-75	ACC	ASTM
				A484-76	ACC	ASTM
				A499-76	ACC	ASTM
				A502-76	ACC	ASTM
				A505-78	ACC	ASTM
				A506-73	ACC	ASTM
				A507-73	ACC	ASTM
				A511-77b	ACC	ASTM
				A512-77a	ACC	ASTM
				A513-78	ACC	ASTM
				A519-77b	ACC	ASTM
				A525-78a	ACC	ASTM
				A526-71	ACC	ASTM
				A527-71	ACC	ASTM
				A528-71	ACC	ASTM
				A540-77	ACC	ASTM
				A554-77	ACC	ASTM
				A563-78a	ACC	ASTM
				A564-74	ACC	ASTM
				A568-74	ACC	ASTM
				A569-72	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u>					
	(Other Available Materials for Structural and Mechanical Purposes— continued)			A573-77	ACC	ASTM
				A579-77	ACC	ASTM
				A582-78	ACC	ASTM
				A591-77	ACC	ASTM
				A595-74	ACC	ASTM
				A599-77	ACC	ASTM
				A611-72	ACC	ASTM
				A619-75	ACC	ASTM
				A620-75	ACC	ASTM
				A621-75	ACC	ASTM
				A622-75	ACC	ASTM
				A632-76	ACC	ASTM
				A633-78	ACC	ASTM
				A635-74	ACC	ASTM
				A642-71	ACC	ASTM
				A650-78	ACC	ASTM
				A659-72	ACC	ASTM
				A663-77	ACC	ASTM
				A666-72	ACC	ASTM
				A668-77	ACC	ASTM
				A669-76	ACC	ASTM
				A673-77	ACC	ASTM
				A675-77	ACC	ASTM
				A678-75	ACC	ASTM
				A687-78	ACC	ASTM
				A693-79	ACC	ASTM
				A699-77	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.23 (continued)	<u>METALS (continued)</u> <u>Properties and Tests</u> (Other Available Materials for Structural and Mechanical Purposes— continued)					
				A705-74	ACC	ASTM
				A707-76	ACC	ASTM
				A710-77	ACC	ASTM
				A711-74	ACC	ASTM
				A715-75	ACC	ASTM
				A749M-77	ACC	ASTM
				B408-77	ACC	ASTM
				B409-77	ACC	ASTM
				E8-79	ACC	ASTM
				E9-77	ACC	ASTM
				E21-70	ACC	ASTM
				E151-64	ACC	ASTM
				E209-65	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.24	<u>CONCRETE/REBAR Properties and Tests</u>					
	(General)	(HG.05	211.1-77		ACC	ACI
		HH.06	315-74		ACC	ACI
		HH.10		211.3-75	ACC	ACI
		HH.12		223-77	ACC	ACI
		HH.14		305R-77	ACC	ACI
		HH.19)		306R-78	ACC	ACI
				A82-76	ACC	ASTM
				A416-74	ACC	ASTM
				A421-78	ACC	ASTM
				A496-72	ACC	ASTM
				A615-78	ACC	ASTM
				A616-76	ACC	ASTM
				A617-76	ACC	ASTM
				A722-75	ACC	ASTM
				C10-76	ACC	ASTM
				C29-78	ACC	ASTM
				C31-69	ACC	ASTM
				C33-78	ACC	ASTM
				C39-72	ACC	ASTM
				C42-77	ACC	ASTM
				C78-75	ACC	ASTM
				C88-76	ACC	ASTM
				C91-78	ACC	ASTM
				C94-78	ACC	ASTM
				C116-68	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.24 (continued)	CONCRETE/REBAR (continued) <u>Properties and Tests</u> (General-continued)					
				C125-79a	ACC	ASTM
				C136-76	ACC	ASTM
				C138-77	ACC	ASTM
				C143-78	ACC	ASTM
				C150-78a	ACC	ASTM
				C151-77	ACC	ASTM
				C157-75	ACC	ASTM
				C171-69	ACC	ASTM
				C172-71	ACC	ASTM
				C173-78	ACC	ASTM
				C204-79	ACC	ASTM
				C215-60	ACC	ASTM
				C231-78	ACC	ASTM
				C233-78	ACC	ASTM
				C234-71	ACC	ASTM
				C260-77	ACC	ASTM
				C293-79	ACC	ASTM
				C294-69	ACC	ASTM
				C295-65	ACC	ASTM
				C309-74	ACC	ASTM
				C330-77	ACC	ASTM
				C342-67	ACC	ASTM
				C359-75	ACC	ASTM
				C360-63	ACC	ASTM
				C403-77	ACC	ASTM
				C469-65	ACC	ASTM
				C470-76	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.24 (continued)	CONCRETE/REBAR (continued) <u>Properties and Tests</u> (Buildings-continued)					
				C55-75	ACC	ASTM
				C62-75a	ACC	ASTM
				C140-75	ACC	ASTM
				C144-76	ACC	ASTM
				C145-75	ACC	ASTM
				C163-64	ACC	ASTM
				C165-77	ACC	ASTM
				C166-61	ACC	ASTM
				C195-77	ACC	ASTM
				C196-77	ACC	ASTM
				C203-58	ACC	ASTM
				C279-54	ACC	ASTM
				C317-76	ACC	ASTM
				C331-77	ACC	ASTM
				C332-77a	ACC	ASTM
				C353-73	ACC	ASTM
				C354-73	ACC	ASTM
				C383-58	ACC	ASTM
				C399-74	ACC	ASTM
				C404-76	ACC	ASTM
				C405-60	ACC	ASTM
				C410-60	ACC	ASTM
				C495-77a	ACC	ASTM
				C513-69	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.25	<u>GLASS</u> <u>Properties and Tests</u> (Mechanical Properties)	HB.02		C623-71 C693-74 C730-75	ACC ACC ACC	ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.27	<u>ADHESIVES</u> <u>Properties and Tests</u>					
	(General)	HB.02		D896-66	ACC	ASTM
				D897-78	ACC	ASTM
				D905-49	ACC	ASTM
				D907-77	ACC	ASTM
				D950-78	ACC	ASTM
				D1002-72	ACC	ASTM
				D1144-57	ACC	ASTM
				D1151-72	ACC	ASTM
				D1174-55	ACC	ASTM
				D1183-70	ACC	ASTM
				D1184-69	ACC	ASTM
				D1286-57	ACC	ASTM
				D1344-78	ACC	ASTM
				D1876-72	ACC	ASTM
				D2094-69	ACC	ASTM
				D2095-72	ACC	ASTM
				D2295-72	ACC	ASTM
				D2651-79	ACC	ASTM
				D2918-71	ACC	ASTM
				D2919-71	ACC	ASTM
				D3166-73	ACC	ASTM
				D3632-77	ACC	ASTM
				E229-70	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.28	<u>PLASTICS</u> <u>Properties and Tests</u> (General)	HB.12		D543-67 D637-50 D638-77a D648-72 D673-70 D695-77 D696-79 D702-68 D732-78 D746-79 D747-70 D759-66 D794-68 D864-52 D883-78a D1042-51 D1043-72 D1435-75 D1693-70 D1708-66 D2991-71 G29-75	ACC ACC	ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.28 (continued)	PLASTICS (continued) <u>Properties and Tests</u>	(HH.17 HH.20)		D1598-76	ACC	ASTM
				D1599-74	ACC	ASTM
	D2464-76			ACC	ASTM	
	D2465-73			ACC	ASTM	
	D2466-78			ACC	ASTM	
	D2467-76a			ACC	ASTM	
	D2468-76			ACC	ASTM	
	D2469-76			ACC	ASTM	
	D2846-79			ACC	ASTM	
	F437-77			ACC	ASTM	
	F438-77			ACC	ASTM	
	F439-77			ACC	ASTM	
	F441-77			ACC	ASTM	
	F442-77			ACC	ASTM	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.29	COATINGS <u>Properties and Tests</u>					
	(Zinc, Cadmium)	(HB.00 HC.00 HD.00 HE.00 HH.00)		A90-69 A112-76 A123-78 A153-78 A164-71 A165-71 A384-76 A385-76 A386-78 A427-68	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Reflector Panel)	HB.02		A463-77 A657-74 A676-72 B177-68 B254-79 B533-70 B571-72 B602-75 B630-77 B650-78	ACC ACC ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Target)	HG.10		E259-66	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.30 (continued)	INSULATION (continued) <u>Properties and Tests</u> (Buildings)	(HH.06 HH.14)		C167-64 C262-64 C727-72 C728-72 C755-73 C764-73 C800-75	ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.34	OIL <u>Heat Transfer Mediums</u>					
	(Steam Turbine)	HE.02		D665-60 D943-76	ACC	ASTM
	(Autoignition)	HH.21		D2155-66	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.37	PERFORMANCE (Optical)	HB.12	74-73		ACC	ASHRAE	
				D542-50	ACC	ASTM	
					D881-78	ACC	ASTM
					D1003-61	ACC	ASTM
					E424-71	ACC	ASTM
		(Aging)	HB.12		D756-78	ACC	ASTM
		(Reflectance)	HB.02		C812-75	ACC	ASTM
				C813-75	ACC	ASTM	
				E429-78	ACC	ASTM	
		(Materials)	HA.00	77-1314		ACC	NBS

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.38	THERMAL/MECHANICAL FATIGUE AND SHOCK					
	<u>Performance</u>					
	(Fatigue—General)	HA.00		E206-72 E466-76 E467-76 E468-76 E606-77T	ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM
	(Fracture Toughness)	HB.01		B645-78 B646-78 B616-78	ACC ACC ACC	ASTM ASTM ASTM
	(Fatigue, Hardness, Impact Resistance—Plastics)	HB.12		D671-71 D2583-75 F320-78	ACC ACC ACC	ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.39 (continued)	CORROSION (continued)						
	<u>Performance</u>						
	(Underground)						
			(HH.14		RP-01-69	ACC	NACE
			HH.19		RP-02-75	ACC	NACE
			HH.32)		RP-03-75	ACC	NACE
					G42-75T	ACC	ASTM
					G51-77	ACC	ASTM
	(Atmospheric)						
			(HB.00		G7-77a	ACC	ASTM
			HC.00		G33-72	ACC	ASTM
			HH.06		G41-74	ACC	ASTM
		HH.14		G50-76	ACC	ASTM	
		HH.19)		G52-76	ACC	ASTM	
(Solvents)							
		HB.02		D3263-77	ACC	ASTM	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.40	EROSION					
	(Coatings)	HB.02		TM-03-75	ACC	NACE
	(Concrete)		(HH.06 HH.14)	C418-76	ACC	ASTM
				C779-76	ACC	ASTM
	(Plastics)		HB.12	D1044-78	ACC	ASTM
				D1242-56	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.41	CREEP					
	(Concrete)	HH.10		C512-76	ACC	ASTM
	(Adhesives)	HB.02		D2293-69	ACC	ASTM
				D2294-69	ACC	ASTM
	(Plastics)	HB.12		D2990-77	ACC	ASTM
	(Metals)	HC.01		E139-70	ACC	ASTM
E150-64				ACC	ASTM	

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization	
VB.44	<u>WELDING Construction</u>						
	(Structural)	(HB.00	D1.1-79		ACC	AWS	
		HC.00	D1.4-79		ACC	AWS	
		HD.00		D1.3-78	ACC	AWS	
		HE.00					
		HH.06					
		HH.14					
		HH.19					
		HH.31)					
	(Pressure Boundaries)	(HC.01	Section I			RM	ASME
		HD.01	Section VIII			RM	ASME
		HD.05					
		HD.12					
		HE.07	B31.1			ACC	ASME
	HE.11						
	HE.16			D10.4-66	ACC	AWS	
	HH.32)						

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.44 (continued)	WELDING (continued) <u>Construction</u> (Filler Metal)	(HB.00 HC.00 HD.00 HE.00 HH.00)	Section II (Part C)		ACC	ASME
				A5.1-78	ACC	AWS
				A5.2-69	ACC	AWS
				A5.3-69	ACC	AWS
				A5.4-78	ACC	AWS
				A5.5-69	ACC	AWS
				A5.6-76	ACC	AWS
				A5.7-77	ACC	AWS
				A5.8-76	ACC	AWS
				A5.9-77	ACC	AWS
				A5.10-69	ACC	AWS
				A5.11-76	ACC	AWS
				A5.12-69	ACC	AWS
				A5.13-70	ACC	AWS
				A5.14-76	ACC	AWS
				A5.17-76	ACC	AWS
				A5.18-79	ACC	AWS
				A5.19-69	ACC	AWS
				A5.20-79	ACC	AWS
				A5.21-70	ACC	AWS
				A5.22-74	ACC	AWS
				A5.23-76	ACC	AWS

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VB.45	BRAZING (Construction)	(HB.00 HC.00 HD.00 HE.00 HH.00)	BRM-76	C3.2-63	ACC ACC	AWS AWS

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.00	QUALITY ASSURANCE	HA.00	ERDAM Part 0820		ACC	DOE



Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.13	QUALIFICATION TESTING <u>Process and Configuration</u> <u>Qualification</u>					
	(Seismic)	(HA.00 HB.00 HC.00 HD.00 HE.00 HF.00 HG.00 HH.00)		344-75 C37.98-78	RM ACC	IEEE ANSI
	(Firestop)	(HH.26 HH.30)		634-78	ACC	IEEE
	(Cooling Tower)	HE.08		STD-201	ACC	CTI

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.14	MATERIAL TEST METHODS <u>Process and Configuration</u> <u>Qualification</u> (Soils)	HA.00		D1452-65 D1556-64 D1557-78 D2167-66 D2216-71 D2922-78 D2937-71 D3017-78	ACC ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.15	CONSTRUCTION CONTROL					
	(Shop Painting)	(HH.06 HH.14)	S324		ACC	AISC
	(Electrical Equipment)	HA.00		336-77	RM	IEEE

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.17	<u>INSPECTION Construction Control</u>					
	(Concrete)	(HH.06 HH.14)	311-75		ACC	ACI
	(Steel, Welding)	(HB.00 HC.00 HD.00 HE.00 HH.06 HH.14 HH.19 HH.31)	S323 WI-68		ACC ACC ACC	AISC AWS AWS
				B1.0-77		

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.18	CONTROL OF SPECIAL PROCESSES <u>Construction Control</u>					
	(Concrete)	(HH.06 HH.14)		302-69 308-71 347-78	ACC ACC ACC	ACI ACI ACI
	(Mounting Sensors)	(HB.00 HC.00 HD.00 HE.00)		E650-78	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.19	WELDING AND BRAZING <u>Control of Special Processes</u> (Pressure Boundaries)	(HC.01 HD.01 HD.05 HD.12 HE.01 HE.07 HE.11 HE.16 HH.32)	Section IX		ACC	ASME
	(Structural)	(HB.00 HC.00 HD.00 HE.00 HH.06 HH.14 HH.19 HH.31)	B3.0-77	A488-77a	ACC ACC	AWS ASTM

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Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.21	NONDESTRUCTIVE TESTING <u>Construction Control</u>					
	(General)	(HB.00 HC.00 HD.00 HE.00 HH.00)	SNT-TC-1A-1975		ACC	ASNT
				A275-78	ACC	ASTM
				A340-77	ACC	ASTM
				A388-78	ACC	ASTM
				A435-75	ACC	ASTM
				A577-77	ACC	ASTM
				A578-77 ^c	ACC	ASTM
				A609-78	ACC	ASTM
				A745-77	ACC	ASTM
				E94-77	ACC	ASTM
				E109-63	ACC	ASTM
				E113-67	ACC	ASTM
				E114-75	ACC	ASTM
				E125-63	ACC	ASTM
				E142-77	ACC	ASTM
				E155-79	ACC	ASTM
				E164-74	ACC	ASTM
				E165-75	ACC	ASTM
				E186-75	ACC	ASTM
				E213-79	ACC	ASTM
				E214-68	ACC	ASTM
				E242-68	ACC	ASTM
				E243-74	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.21 (continued)	NONDESTRUCTIVE TESTING (continued)					
	<u>Construction Control</u>					
	(General—continued)			E268-76	ACC	ASTM
				E269-78	ACC	ASTM
				E270-78	ACC	ASTM
				E273-68	ACC	ASTM
				E280-75	ACC	ASTM
				E309-77	ACC	ASTM
				E376-69	ACC	ASTM
				E426-76	ACC	ASTM
				E433-71	ACC	ASTM
				E446-78	ACC	ASTM
				E500-74	ACC	ASTM
				E505-75	ACC	ASTM
				E569-76	ACC	ASTM
				E571-76	ACC	ASTM
				E610-77	ACC	ASTM
				E689-79	ACC	ASTM
				E690-79	ACC	ASTM
	(Turbines)	HE.02		A418-77	ACC	ASTM
				A531-74	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.24	PREOPERATIONAL TESTING <u>Operational</u> <u>Phase Control</u> (Guide for Planning)	HA.00		415-76	RM	IEEE



Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.25 (continued)	INSPECTION AND ON-LINE MONITORING (continued) <u>Operational Phase</u> <u>Control</u> (Water Quality and Deposits—continued)					
				D1246-77	ACC	ASTM
				D1253-76	ACC	ASTM
				D1254-67	ACC	ASTM
				D1293-78	ACC	ASTM
				D1339-78	ACC	ASTM
				D1385-78	ACC	ASTM
				D1426-79	ACC	ASTM
				D1427-68	ACC	ASTM
				D1589-60	ACC	ASTM
				D1687-77	ACC	ASTM
				D1688-77	ACC	ASTM
				D1691-77	ACC	ASTM
				D1888-78	ACC	ASTM
				D1889-71	ACC	ASTM
				D3082-74	ACC	ASTM
				D3223-73	ACC	ASTM
				D3370-76	ACC	ASTM
				D3372-75	ACC	ASTM
				D3373-75	ACC	ASTM
				D3557-78	ACC	ASTM
				D3558-77	ACC	ASTM
				D3559-78	ACC	ASTM
				F329-78	ACC	ASTM
				PTC 19.11-70	ACC	ASME

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.25 (continued)	INSPECTION AND ON-LINE MONITORING (continued) <u>Operational Phase</u> <u>Control</u>					
	(Atmosphere)	HA.00		D1704-78 D2009-65 D2010-65 D2011-65 D2012-69 D2912-76 D2914-78	ACC ACC ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM ASTM ASTM
	(Steam Sampling)	(HC.06 HD.06 HD.13 HE.02)	D1066-69	D2186-71	ACC ACC	ASTM ASTM
	(Gases)	(HE.20 HH.19)		D3284-73 D3305-74	ACC ACC	ASTM ASTM
	(Temperature)	HG.09		E639-78	ACC	ASTM
	(Calibration)	HH.30		E220-72	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.26	<u>MAINTENANCE</u> <u>Operational Phase Control</u>					
	(Generators)	HE.03		56-77 67-72	ACC ACC	IEEE IEEE
	(Cooling Towers)	HE.08		WMS-104 WMS-117	ACC ACC	CTI CTI
	(Batteries)	(HH.26 HH.30)		450-75	ACC	IEEE
	(Painting)	(HB.00 HC.00 HD.00 HE.00 HG.00 HH.00)		D610-68	ACC	ASTM

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Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.27	REFLECTOR CLEANING <u>Maintenance</u> (Metal Cleaners, Particulate Contamination)	(HB.02 HH.29)		D800-58 D930-67 D1281-67 D1374-57 F24-65	ACC ACC ACC ACC ACC	ASTM ASTM ASTM ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)



VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.30	<u>TESTING</u> <u>Operational Phase</u> <u>Control</u>					
	(Insulation Testing, Rotating Machinery)	HE.03		43-74 95-77	ACC ACC	IEEE IEEE
	(Electrical Tests, General)	(HE.20 HH.26 HH.30)		4-78 48-75 62-78 82-63 83-63 271-66 112-78	ACC ACC ACC ACC ACC ACC ACC	IEEE IEEE IEEE IEEE IEEE IEEE IEEE
	(Heat Loss)	(HC.00 HD.00 HE.00 HH.00)		C57.12.90-78 C680-71	ACC ACC	ANSI ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VC.31	CONDUCT OF OPERATIONS <u>Operational Phase</u> <u>Control</u> (Record Maintenance)	HA.00		D3208-76 D3301-74	ACC ACC	ASTM ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.01	FIRE PROTECTION <u>Health and Safety</u> (Fire Fighting and Prevention)	HH.21	1-75			
				10-78	ACC	NFPA
				11-78	ACC	NFPA
				11A-76	ACC	NFPA
				11B-77	ACC	NFPA
				12-77	ACC	NFPA
				12A-77	ACC	NFPA
				12B-77	ACC	NFPA
				13-78	ACC	NFPA
				13A-78	ACC	NFPA
				13E-78	ACC	NFPA
				14-78	ACC	NFPA
				15-79	ACC	NFPA
				16-74	ACC	NFPA
				17-75	ACC	NFPA
				18-79	ACC	NFPA
				19B-71	ACC	NFPA
				20-78	ACC	NFPA
				21-75	ACC	NFPA
				22-78	ACC	NFPA
				24-77	ACC	NFPA
				26-76	ACC	NFPA
				27-75	ACC	NFPA
				30-77	ACC	NFPA
				31-78	ACC	NFPA

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.01 (continued)	FIRE PROTECTION (continued) <u>Health and Safety</u> (Fire Fighting and Prevention—continued)					
				43A-75	ACC	NFPA
				43C-75	ACC	NFPA
				50A-78	ACC	NFPA
				50B-78	ACC	NFPA
				51-77	ACC	NFPA
				51B-77	ACC	NFPA
				58-79	ACC	NFPA
				63-75	ACC	NFPA
				69-78	ACC	NFPA
				70-78	ACC	NFPA
				70B-77	ACC	NFPA
				70E-79	ACC	NFPA
				71-77	ACC	NFPA
				72A-79	ACC	NFPA
				72B-79	ACC	NFPA
				72C-75	ACC	NFPA
				72D-79	ACC	NFPA
				72E-78	ACC	NFPA
				75-76	ACC	NFPA
				77-77	ACC	NFPA
				78-77	ACC	NFPA
				80A-75	ACC	NFPA
				90A-78	ACC	NFPA
				90B-78	ACC	NFPA
				91-73	ACC	NFPA
				101-76	ACC	NFPA
				203M-70	ACC	NFPA

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.01 (continued)	FIRE PROTECTION (continued) <u>Health and Safety</u> (Fire Fighting and Prevention—continued)					
				204-68	ACC	NFPA
				206-76	ACC	NFPA
				214-77	ACC	NFPA
				231-79	ACC	NFPA
				231A-75	ACC	NFPA
				232-75	ACC	NFPA
				241-75	ACC	NFPA
				292M-74	ACC	NFPA
				321-76	ACC	NFPA
				325M-77	ACC	NFPA
				327-75	ACC	NFPA
				329-77	ACC	NFPA
				496-74	ACC	NFPA
				704-75	ACC	NFPA
				901-76	ACC	NFPA
				1921-75	ACC	NFPA
				1961-79	ACC	NFPA
				1962-79	ACC	NFPA
				1963-79	ACC	NFPA
				RP 2003	ACC	API
				Pub.2021	ACC	API
				Pub.2023	ACC	API
				UL-19	ACC	UL
				UL-33	ACC	UL
				UL-38	ACC	UL

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.01 (continued)	FIRE PROTECTION (continued) <u>Health and Safety</u> (Fire Fighting and Prevention—continued)					
				UL-58	ACC	UL
				UL-92	ACC	UL
				UL-107	ACC	UL
				UL-109	ACC	UL
				UL-142	ACC	UL
				UL-154	ACC	UL
				UL-193	ACC	UL
				UL-194	ACC	UL
				UL-199	ACC	UL
				UL-203	ACC	UL
				UL-213	ACC	UL
				UL-217	ACC	UL
				UL-236	ACC	UL
				UL-260	ACC	UL
				UL-262	ACC	UL
				UL-268	ACC	UL
				UL-299	ACC	UL
				UL-312	ACC	UL
				UL-346	ACC	UL
				UL-393	ACC	UL
				UL-401	ACC	UL
				UL-448	ACC	UL
				UL-521	ACC	UL
				UL-539	ACC	UL
				UL-555	ACC	UL
				UL-1480	ACC	UL
				UL-1481	ACC	UL
				D296	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.02 (continued)	ELECTRICAL AND LIGHTNING PROTECTION (continued)					
	<u>Health and Safety</u>					
	(Hazardous Locations)	HH.06		S12.4 S12.10 S12.11 RP12.1	ACC ACC ACC ACC	ISA ISA ISA ISA
	(Implosion)	(HF.02 HF.07 HF.12)		70C-74 UL-1418	ACC ACC	NFPA UL
	(Temperature Regulation)	HH.21		UL-873	ACC	UL

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Continued)

VED	Subject	Applicable HED	Primary Standards	Related Standards	ACC/RM	Responsible Organization
VD.04	SECURITY <u>Health and Safety</u> (Exit Devices)	(HH.06 HH.14)		F571-79	ACC	ASTM

Table 2. SUMMARY OF ACCEPTABLE AND MODIFIABLE STANDARDS FOR SOLAR THERMAL SYSTEMS
(Concluded)

VED	Subject	Applicable HED	Primary Standards	Related Standards	Responsible ACC/RM Organization
VD.05	<u>ENVIRONMENTAL Health and Safety</u>				
	(Sound Measurement)	HA.00	575-79	ACC	ARI
	(Disposal of Heat Transfer Fluids)	(HC.13 HD.03)	78-1532	ACC	NBS

Table 3. AMERICAN CONCRETE INSTITUTE (ACI)

211.1-77 (ANSI)	Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
211.2-69 (ANSI)	Recommended Practice for Selecting Proportions for Structural Lightweight Concrete
211.3-75 (ANSI)	Recommended Practice for Selecting Proportions for No-Slump Concrete
223-77 (ANSI)	Recommended Practice for the Use of Shrinkage-Compensating Concrete
301-72 (ANSI)	Specifications for Structural Concrete for Buildings
302-69 (ANSI)	Recommended Practice for Concrete Floor and Slab Construction
305R-77	Hot Weather Concreting
306R-78	Cold Weather Concreting
308-71 (ANSI)	Recommended Practice for Curing Concrete
311-75 (ANSI)	Recommended Practice for Concrete Inspection
315-74	Manual for Standard Practice for Detailing Reinforced Concrete Structures
318-77 (ANSI)	Building Code Requirements for Reinforced Concrete
347-78 (ANSI)	Recommended Practice for Concrete Formwork

Table 4. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

M010	Manual of Steel Construction, 7th Edition (1970)
S302	Code of Standard Practice for Buildings and Bridges (1976)
S314	Specification for Structural Joints Using ASTM A325 or A490 Bolts (1978)
S323	Quality Criteria and Inspection Standards, 2nd Edition (1980)
S324	A Guide to the Shop Painting of Structural Steel (1972)
S326	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (1978)

Table 5. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B16.1-75	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
B16.3-77	Malleable Iron Threaded Fittings, Class 150 and 300
B16.4-77	Cast Iron Threaded Fittings, Class 125 and 250
B16.5-77	Steel Pipe Flanges and Flanged Fittings (Including Ratings for Class 150, 300, 400, 600, 900, 1500 and 2500)
B16.9-78	Factory-Made Wrought Steel Buttwelding Fittings
B16.10-73	Face-to-Face and End-to-End Dimensions of Ferrous Valves
B16.11-73	Forged Steel Fittings, Socket-Welding and Threaded
B16.14-77	Ferrous Pipe Plugs, Bushings and Locknuts with Pipe Threads
B16.15-78	Cast Bronze Threaded Fittings, Class 125 and 250
B16.18-78	Cast Copper Alloy Solder-Joint Pressure Fittings
B16.20-73	Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
B16.21-78	Nonmetallic Flat Gaskets for Pipe Flanges
B16.22-73	Wrought Copper and Bronze Solder-Joint Pressure Fittings
B16.24-79	Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
B16.25-79	Buttwelding Ends
B16.26-75	Cast Copper Alloy Fittings for Flared Copper Tubes
B16.28-78	Wrought Steel Buttwelding Short Radius Elbows and Returns
B30.3-75	Hammerhead Tower Cranes
B30.4-73	Portal, Tower and Pillar Cranes
B30.10-75	Hooks
B31	Guide, Corrosion Control for ANSI B31.1 Power Piping Systems
B31.1-77	Power Piping (With Addenda up to the 1980 Edition)
B36.10-79	Welded and Seamless Wrought Steel Pipe
B36.19	Stainless Steel Pipe
C2	National Electrical Safety Code, 1977
C37.97-79	Guide for Protective Relay Applications to Power System Buses
C37.98-78	Standard for Seismic Testing of Relays
C57.12.80-78	Terminology for Power and Distribution Transformers
C57.12-90a-78	Distribution and Power Transformer Short-Circuit Test Code
C57.105-78	Guide for Transformer Connections in Three-Phase Distribution Systems

Table 6. AMERICAN PETROLEUM INSTITUTE (API)

RP 2003	Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents
Spec. 12B	Specification for Bolted Tanks for Storage of Production Liquids
Spec. 12D	Specification for Field Welded Tanks for Storage of Production Liquids
Spec. 12F	Specification for Shop Welded Tanks for Storage of Production Liquids
Std. 650 (ANSI)	Welded Steel Tanks for Oil Storage
Publ. 2021	Guide for Fighting Fires in and around Petroleum Storage Tanks
Publ. 2023	Guide for Safe Storage and Handling of Heated Petroleum-Derived Asphalt Products and Crude Oil Residual

Table 7. AMERICAN REFRIGERATION INSTITUTE (ARI)

360-75	Standard for Commercial and Industrial Unitary Air-Conditioning Equipment
390-78	Standard for Computer Room Unitary Air-Conditioning Equipment
410-72	Forced-Circulation Air-Cooling and Air-Heating Coils
430-78	Standard for Central-Station Air-Handling Units
441-66	Room Fan Coil Air Conditioners
575-79	Standard for Method of Measuring Machinery Sound within Equipment Rooms
610-74	Standard for Central System Humidifiers
650-73	Standard for Air Outlets and Inlets
850-78	Standard for Commercial and Industrial Air Filter Equipment
910-80	Standard for Solar Collectors

Table 8. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

Practice No. 37 Design and Construction of Sanitary and Storm Sewers (1969)

Table 9. AMERICAN SOCIETY FOR HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

15-78	Safety Code for Mechanical Refrigeration
74-73	Method of Measuring Solar-Optical Properties of Materials
93-77 (ANSI)	Methods of Testing to Determine the Thermal Performance of Solar Collectors
94-77 (ANSI)	Methods of Testing Thermal Storage Devices Based on Thermal Performance

**Table 10. AMERICAN SOCIETY OF MECHANICAL ENGINEERS
(ASME)**

ASME Boiler and Pressure Vessel Code and Addenda (1977) (ANSI)

Section I	Power Boilers
Section II	Material Specifications
	Part A—Ferrous Materials
	Part B—Nonferrous Materials
	Part C—Welding Rods, Electrodes and Filler Metals
Section V	Nondestructive Examination
Section VIII	Pressure Vessels
Section IX	Welding and Brazing Qualifications

**Table 10. AMERICAN SOCIETY OF MECHANICAL ENGINEERS
(ASME) (concluded)**

PTC 6-76 (ANSI)	Steam Turbines
PTC 6S-70 (ANSI)	Simplified Procedures for Routine Performance Tests of Steam Turbines
PTC 9-70 (ANSI)	Displacement Compressors, Vacuum Pumps and Blowers
PTC 10-65 (ANSI)	Compressors and Exhausters
PTC 12.1-78 (ANSI)	Closed Feedwater Heaters
PTC 12.2-55 (ANSI)	Steam Condensing Apparatus
PTC 12.3-77 (ANSI)	Deaerators
PTC 19.2-64	Pressure Measurement
PTC 19.3-74 (ANSI)	Temperature Measurement
PTC 19.11-70 (ANSI)	Water and Steam in the Power Cycle (Purity and Quality Lead Detection and Measurement)
PTC 20.1-77 (ANSI)	Speed and Load-Governing Systems for Steam Turbine-Generator Units
PTC 20.3-70 (ANSI)	Pressure Control Systems Used on Steam Turbine-Generator Units
PTC 25.3-76 (ANSI)	Safety and Relief Valves

Table 11. AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

SNT-TC-1A-1975 Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A6-78 (ANSI)	Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use, Specifications for General Requirements for
A20-78 (ANSI)	Steel Plates for Pressure Vessels, Specifications for General Requirements for
A27-77 (ANSI)	Mid- to Medium-Strength Carbon-Steel Castings for General Application, Specifications for
A29-76 (ANSI)	Steel Bars, Carbon and Alloy, Hot-Rolled and Cold-Finished, Specifications for General Requirements for
A31-76 (ANSI)	Boiler Rivet Steel and Rivets, Specifications for
A36-77a (ANSI)	Structural Steel, Specifications for
A47-77 (ANSI)	Malleable Iron Castings, Specifications for
A48-76 (ANSI)	Gray Iron Castings, Specifications for
A49-78 (ANSI)	Heat-Treated Carbon Steel Joint Bars, Specifications for
A53-78 (ANSI)	Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless, Specifications for
A67-78 (ANSI)	Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked, Specifications for
A74-75 (ANSI)	Cast Iron Soil Pipe and Fittings, Specifications for
A82-76 (ANSI)	Cold-Drawn Steel Wire for Concrete Reinforcement, Specifications for
A90-69 (ANSI)	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles, Tests for (1978)
A105-77 (ANSI)	Forgings, Carbon Steel, for Piping Components, Specifications for
A106-78 (ANSI)	Seamless Carbon Steel Pipe for High-Temperature Service, Specifications for
A108-73 (ANSI)	Steel Bars, Carbon, Cold-Finished, Standard Quality, Specifications for
A109-72 (ANSI)	Steel, Carbon, Cold-Rolled Strip, Specifications for
A112-76 (ANSI)	Zinc-Coated (Galvanized) Steel Tie Wires, Specifications for
A120-78 (ANSI)	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses, Specifications for

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A121-77 (ANSI)	Zinc-Coated (Galvanized) Steel Barbed Wire, Specifications for
A123-78 (ANSI)	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Specifications for
A126-73 (ANSI)	Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Specifications for
A128-75a (ANSI)	Austenitic Manganese Steel Castings, Specifications for
A134-74 (ANSI)	Electric-Fusion (Arc) Welded Steel Plate Pipe (Sizes 16 in. and over), Specifications for
A135-73a (ANSI)	Electric-Resistance-Welded Steel Pipe, Specifications for
A139-74 (ANSI)	Electric-Fusion (Arc) Welded Steel Pipe (Sizes 4 in. and over), Specifications for
A143-74 (ANSI)	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement, Recommended Practice for
A148-73 (ANSI)	High-Strength Steel Castings for Structural Purposes, Specifications for
A153-78 (ANSI)	Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Specifications for
A164-71 (ANSI)	Electrodeposited Coatings of Zinc on Steel, Specifications for
A165-71 (ANSI)	Electrodeposited Coatings of Cadmium on Steel, Specifications for
A167-77 (ANSI)	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip, Specifications for
A176-78 (ANSI)	Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip, Specifications for
A177-69 (ANSI)	High-Strength Stainless and Heat-Resisting Chromium-Nickel Steel Sheet and Strip, Specifications for
A178-75 (ANSI)	Electric-Resistance-Welded Carbon Steel Boiler Tubes, Specifications for
A179-75 (ANSI)	Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes, Specifications for
A181-77 (ANSI)	Forgings, Carbon Steel for General Purpose Piping, Specifications for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

A182-78 (ANSI)	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service, Specifications for
A184-74 (ANSI)	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement, Specifications for
A185-73 (ANSI)	Welded Steel Wire Fabric for Concrete Reinforcement, Specifications for
A192-75 (ANSI)	Seamless Carbon Steel Boiler Tubes for High-Pressure Service, Specifications for
A193-78a (ANSI)	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service, Specifications for
A194-78 (ANSI)	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, Specifications for
A199-77 (ANSI)	Seamless Cold-Drawn Intermediate Alloy-Steel Heat-Exchanger and Condenser Tubes, Specifications for
A202-78 (ANSI)	Pressure Vessel Plates, Alloy-Steel, Chromium-Manganese-Silicon, Specifications for
A203-78 (ANSI)	Pressure Vessel Plates, Alloy-Steel, Nickel, Specifications for
A204-78 (ANSI)	Pressure Vessel Plates, Alloy-Steel, Molybdenum, Specifications for
A209-76 (ANSI)	Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes, Specifications for
A210-76a (ANSI)	Seamless Medium-Carbon Steel Boiler and Superheater Tubes, Specifications for
A211-75 (ANSI)	Spiral-Welded Steel or Iron Pipe, Specifications for
A213-76a (ANSI)	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes, Specifications for
A214-75 (ANSI)	Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes, Specifications for
A216-77 (ANSI)	Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service, Specifications for
A217-77a (ANSI)	Martensitic Stainless Steel and Alloy-Steel Castings for Pressure-Containing Parts Suitable for High-Temperature Service, Specifications for
A220-76 (ANSI)	Pearlitic Malleable Iron Castings, Specifications for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

A225-78 (ANSI)	Pressure Vessel Plates, Alloy-Steel, Manganese-Vanadium, Specifications for
A226-75 (ANSI)	Electric-Resistance-Welded Carbon Steel Boiler and Superheater Tubes for High-Pressure Service, Specifications for
A234-78 (ANSI)	Piping Fittings of Wrought Carbon Steel and Alloy-Steel for Moderate and Elevated Temperatures, Specifications for
A240-78a (ANSI)	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Fusion-Welded Unified Pressure Vessels, Specifications for
A242-75 (ANSI)	High-Strength Low-Alloy Structural Steel, Specifications for
A249-77 (ANSI)	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes, Specifications for
A250-75 (ANSI)	Electric-Resistance-Welded Carbon Molybdenum Alloy-Steel Boiler and Superheater Tubes, Specifications for
A254-78 (ANSI)	Copper Brazed Steel Tubing, Specifications for
A255-67 (ANSI)	End-Quench Test for Hardenability of Steel
A256-46 (ANSI)	Compression Testing of Cast Iron
A262-77a (ANSI)	Susceptibility to Intergranular Attack in Stainless Steels, Recommended Practices for Detecting
A263-77 (ANSI)	Corrosion-Resisting Chromium Steel Clad Plate, Sheet, and Strip, Specifications for
A264-77 (ANSI)	Stainless Chromium-Nickel Steel Clad Plate, Sheet, and Strip, Specifications for
A265-77 (ANSI)	Nickel and Nickel-Base Alloy Clad Steel Plate, Specifications for
A266-78 (ANSI)	Forgings, Carbon Steel, for Pressure Vessel Components, Specifications for
A268-77 (ANSI)	Seamless and Welded Ferritic Stainless Steel Tubing for General Service, Specifications for
A269-76 (ANSI)	Seamless and Welded Austenitic Stainless Steel Tubing for General Service, Specifications for
A275-78 (ANSI)	Magnetic Particle Examination of Steel Forgings
A276-78 (ANSI)	Stainless and Heat-Resisting Steel Bars and Shapes, Specifications for

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A278-75 (ANSI)	Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 $\frac{1}{2}$ F (345 $\frac{1}{2}$ C), Specifications for
A283-78 (ANSI)	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars, Specifications for
A284-77 (ANSI)	Low and Intermediate Tensile Strength Carbon-Silicon Steel Plates for Machine Parts and General Construction, Specifications for
A285-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength, Specifications for
A288-77 (ANSI)	Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators, Specifications for
A289-77 (ANSI)	Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators, Specifications for
A290-78 (ANSI)	Carbon and Alloy Steel Forgings for Rings for Reduction Gears, Specifications for
A291-78 (ANSI)	Carbon and Alloy Steel Forgings for Pinions and Gears for Reduction Gears, Specifications for
A293-77a (ANSI)	Steel Forgings, Carbon and Alloy, for Turbine Rotors and Shafts, Specifications for
A294-77 (ANSI)	Heat-Treated Alloy Steel Forgings for Turbine Wheels and Disks, Specifications for
A296-77 (ANSI)	Corrosion-Resistant Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Alloy Castings for General Application, Specifications for
A297-76 (ANSI)	Heat-Resistant Iron Chromium and Iron-Chromium-Nickel Alloy Castings for General Application, Specifications for
A299-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, Manganese-Silicon, Specifications for
A302-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel, Specifications for
A307-78 (ANSI)	Carbon Steel Externally Threaded Standard Fasteners, Specifications for
A308-78 (ANSI)	Steel, Sheet, Cold-Rolled, Long Terne Coated, Specifications for
A309-54 (ANSI)	Weight and Composition of Coating on Long Terne Sheet by the Triple Spot Test, Test for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

A311-64 (ANSI)	Stress Relief Annealed Cold-Drawn Carbon Steel Bars, Specifications for
A312-77 (ANSI)	Seamless and Welded Austenitic Stainless Steel Pipe, Specifications for
A314-76 (ANSI)	Stainless and Heat-Resisting Steel Billets and Bars for Forging, Specifications for
A319-71 (ANSI)	Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts, Specifications for
A320-78 (ANSI)	Alloy-Steel Bolting Materials for Low-Temperature Service, Specifications for
A321-74 (ANSI)	Steel Bars, Carbon, Quenched and Tempered, Specifications for
A322-76 (ANSI)	Hot-Rolled Alloy Steel Bars, Specifications for
A325-78a (ANSI)	High-Strength Bolts for Structural Steel Joints, Specifications for
A327-72 (ANSI)	Impact Testing of Cast Irons
A331-74 (ANSI)	Steel Bars, Alloy, Cold-Finished, Specifications for
A333-77 (ANSI)	Seamless and Welded Steel Pipe for Low-Temperature Service, Specifications for
A334-77 (ANSI)	Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service, Specifications for
A335-76 (ANSI)	Seamless Ferritic Alloy Steel Pipe for High-Temperature Service, Specifications for
A336-78 (ANSI)	Alloy Steel Forgings for Seamless Drums, Heads, and Other Pressure Vessel Components, Specifications for
A338-61 (ANSI)	Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 650½F (345½C), Specifications for
A340-77 (ANSI)	Magnetic Testing, Definition of Terms, Symbols, and Conversion Factors Relating to
A350-77a (ANSI)	Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components, Specifications for
A351-78 (ANSI)	Austenitic Steel Castings for High-Temperature Service, Specifications for

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A352-77 (ANSI)	Ferritic Steel Castings for Pressure-Containing Parts Suitable for Low-Temperature Service, Specifications for
A353-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered, Specifications for
A354-78a (ANSI)	Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners, Specifications for
A356-77 (ANSI)	Heavy-Walled Carbon and Low-Alloy Steel Castings for Steam Turbines, Specifications for
A358-78 (ANSI)	Electric-Fusion-Welded Austenitic Chromium Nickel Alloy Steel Pipe for High-Temperature Service, Specifications for
A361-76 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding, Specifications for
A366-72 (ANSI)	Steel, Carbon, Cold-Rolled Sheet, Commercial Quality, Specifications for
A367-60 (ANSI)	Chill Testing of Cast Iron (1978)
A368-76 (ANSI)	Stainless and Heat-Resisting Steel Wire Strand, Specifications for
A369-76 (ANSI)	Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service, Specifications for
A372-78 (ANSI)	Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels, Specifications for
A376-77 (ANSI)	Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service, Specifications for
A377-77 (ANSI)	Gray Iron and Ductile Iron Pressure Pipe, Specifications for
A380-78 (ANSI)	Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems, Recommended Practice for
A381-76 (ANSI)	Metal-Arc-Welded Steel Pipe for Use with High-Temperature Transmission Systems, Specifications for
A384-76 (ANSI)	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies, Recommended Practice for
A385-76 (ANSI)	High-Quality Zinc Coatings (Hot-Dip), Recommended Practice for Providing
A386-78 (ANSI)	Zinc Coating (Hot-Dip) on Assembled Steel Products, Specifications for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

A387-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Chromium Molybdenum, Specifications for
A388-78 (ANSI)	Ultrasonic Examination of Heavy Steel Forgings, Recommended Practice for
A389-77a (ANSI)	Alloy Steel Castings Specially Heat-Treated for Pressure-Containing Parts Suitable for High-Temperature Service, Specifications for
A391-65 (ANSI)	Alloy Steel Chain, Specifications for (1975)
A392-74 (ANSI)	Zinc-Coated Steel Chain-Link Fence Fabric, Specifications for
A394-78 (ANSI)	Galvanized Steel Transmission Tower Bolts, Specifications for
A395-77 (ANSI)	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures, Specifications for
A403-78 (ANSI)	Wrought Austenitic Stainless Steel Piping Fittings, Specifications for
A405-70 (ANSI)	Seamless Ferritic Alloy-Steel Pipe Specially Heat Treated for High-Temperature Service, Specifications for
A409-77 (ANSI)	Welded Large Outside Diameter Light-Wall Austenitic Chromium-Nickel Alloy Steel Pipe for Corrosive or High-Temperature Service, Specifications for
A411-65 (ANSI)	Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire, Specifications for (1976)
A412-75 (ANSI)	Stainless and Heat-Resisting Chromium-Nickel-Manganese Steel Plate, Sheet, and Strip, Specifications for
A413-72 (ANSI)	Carbon Steel Chain, Specifications for
A414-71 (ANSI)	Carbon Steel Sheets for Pressure Vessels, Specifications for
A416-74 (ANSI)	Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete, Specifications for
A418-77 (ANSI)	Ultrasonic Inspection of Turbine and Generator Steel Rotor Forgings
A420-78 (ANSI)	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service, Specifications for
A421-78 (ANSI)	Uncoated Stress-Relieved Wire for Prestressed Concrete, Specifications for

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A423-75 (ANSI)	Seamless and Electric Welded Low-Alloy Steel Tubes, Specifications for
A426-76 (ANSI)	Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service, Specifications for
A427-74 (ANSI)	Wrought Alloy Steel Rolls for Cold and Hot Reduction, Specifications for
A428-68	Weight of Coating on Aluminum-Coated Iron or Steel Articles, Test for (1978)
A430-77 (ANSI)	Austenitic Steel Forged and Bored Pipe for High-Temperature Service, Specifications for
A434-76 (ANSI)	Steel Bars, Alloy, Hot-Rolled or Cold-Finished, Quenched and Tempered, Specifications for
A435-75 (ANSI)	Straight-Beam Ultrasonic Examination of Steel Plates for Pressure Vessels, Specifications for
A436-78	Austenitic Gray Iron Castings, Specifications for
A437-77 (ANSI)	Alloy-Steel Turbine-Type Bolting Material Specially Heat Treated for High-Temperature Service, Specifications for
A438-62	Transverse Testing of Gray Cast Iron (1974)
A439-77 (ANSI)	Austenitic Ductile Iron Castings, Specifications for
A441-77 (ANSI)	High-Strength Low-Alloy Structure Manganese Vanadium Steel, Specifications for
A442-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, Improved Transition Properties, Specifications for
A444-78 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Culverts and Underdrains, Specifications for
A446-76 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality, Specifications for
A447-74 (ANSI)	Chromium-Nickel-Iron Alloy Castings (25-12 Class) for High-Temperature Service, Specifications for
A449-78a (ANSI)	Quenched and Tempered Steel Bolts and Studs, Specifications for
A450-78 (ANSI)	Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes, Specifications for General Requirements for

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A451-78 (ANSI)	Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service, Specifications for
A452-75 (ANSI)	Centrifugally Cast Austenitic Steel Cold-Wrought Pipe for High-Temperature Service, Specifications for
A453-78 (ANSI)	Bolting Materials, High-Temperature, 50-120 psi Yield Strength, with Expansion Coefficients Comparable to Austenitic Steels, Specifications for
A455-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, High Strength Manganese, Specifications for
A457-71 (ANSI)	Hot-Worked, Hot-Cold-Worked, and Cold-Worked Alloy Steel Plate, Sheet, and Strip for High Strength at Elevated Temperatures, Specifications for (1979)
A458-79 (ANSI)	Hot-Worked, Hot-Cold-Worked, and Cold-Worked Alloy Steel Bars for High Strength at Elevated Temperatures, Specifications for
A459-71 (ANSI)	Zinc-Coated Flat Steel Armoring Tape, Specifications for
A463-77 (ANSI)	Steel Sheet, Cold-Rolled, Aluminum-Coated Type 1, Specifications for
A469-77 (ANSI)	Vacuum-Treated Steel Forgings for Generator Rotors, Specifications for
A470-78 (ANSI)	Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts, Specifications for
A471-77 (ANSI)	Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels, Specifications for
A472-74 (ANSI)	Heat Stability of Steam Turbine Shafts and Rotor Forgings, Test for
A473-76 (ANSI)	Stainless and Heat-Resisting Steel Forgings, Specifications for
A474-68	Aluminum-Coated Steel Wire Strand, Specifications for (1976)
A475-78 (ANSI)	Zinc-Coated Steel Wire Strand, Specifications for
A477-79 (ANSI)	Hot-Worked, Hot-Cold-Worked, and Cold-Worked Alloy Steel Forgings and Forging Billets for High Strength at Elevated Temperatures, Specifications for
A479-78 (ANSI)	Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels, Specifications for

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A480-75 (ANSI)	Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip, Specifications for General Requirements for
A484-76 (ANSI)	Stainless and Heat-Resisting Wrought Steel Products (Except Wire), Specifications for General Requirements for
A485-75 (ANSI)	High Hardenability Bearing Steels, Specifications for
A487-78 (ANSI)	Steel Castings Suitable for Pressure Service, Specifications for
A488-77a (ANSI)	Qualification of Procedures and Personnel for the Welding of Steel Castings, Recommended Practice for
A489-72 (ANSI)	Carbon Steel Eyebolts, Specifications for
A490-78 (ANSI)	Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints, Specifications for
A491-74 (ANSI)	Aluminum-Coated Steel Chain-Link Fence Fabric, Specifications for
A494-76 (ANSI)	Nickel and Nickel Alloy Castings, Specifications for
A496-72 (ANSI)	Deformed Steel Wire for Concrete Reinforcement, Specifications for
A497-72 (ANSI)	Welded Deformed Steel Wire Fabric for Concrete Reinforcement, Specifications for
A498-68 (ANSI)	Seamless and Welded Carbon, Ferritic, and Austenitic Alloy Steel Heat-Exchanger Tubes with Integral Fins, Specifications for (1973)
A499-76 (ANSI)	Hot-Rolled Rail Carbon Steel Bars and Shapes, Specifications for
A500-78 (ANSI)	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Specifications for
A501-76 (ANSI)	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, Specifications for
A502-76 (ANSI)	Steel Structural Rivets, Specifications for
A505-78 (ANSI)	Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Specifications for General Requirements for
A506-73 (ANSI)	Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Regular Quality, Specifications for
A507-73 (ANSI)	Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Drawing Quality, Specifications for

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A508-78a (ANSI)	Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels, Specifications for
A511-77b (ANSI)	Seamless Stainless Steel Mechanical Tubing, Specifications for
A512-77a (ANSI)	Cold-Drawn Buttweld Carbon Steel Mechanical Tubing, Specifications for
A513-78 (ANSI)	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing, Specifications for
A514-77 (ANSI)	High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding, Specifications for
A515-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, Specifications for
A516-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service, Specifications for
A517-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered, Specifications for
A518-64 (ANSI)	Corrosion-Resistant High-Silicon Cast Iron, Specifications for (1974)
A519-77b (ANSI)	Seamless Carbon and Alloy Steel Mechanical Tubing, Specifications for
A520-72 (ANSI)	Seamless and Electric-Resistance-Welded Carbon Steel Tubular Products for High-Temperature Service Conforming to ISO Recommendations for Boiler Construction, Specifications for Supplementary Requirements for
A522-76 (ANSI)	Forged or Rolled 8% and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service, Specifications for
A523-78 (ANSI)	Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits, Specifications for
A524-78 (ANSI)	Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures, Specifications for
A525-78a (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements, Specifications for
A526-71 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality, Specifications for (1975)
A527-71 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality, Specifications for

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A528-71 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Drawing Quality, Specifications for (1975)
A529-75 (ANSI)	Structural Steel with 42,000 psi [1/2 in. (12.7 mm) Maximum Thickness], Specifications for
A530-78 (ANSI)	Specialized Carbon and Alloy Steel Pipe, Specifications for General Requirements for
A531-74 (ANSI)	Ultrasonic Inspection of Turbine-Generator Steel Retaining Rings, Recommended Practice for
A532-75a	Abrasion-Resistant Cast Irons, Specifications for
A533-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel, Specifications for
A536-77 (ANSI)	Ductile Iron Castings, Specifications for
A537-78 (ANSI)	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, Specifications for
A538-77 (ANSI)	Pressure Vessel Plates, Alloy Steel, Precipitation Hardening (Maraging), 18 Percent Nickel, Specifications for
A540-77a (ANSI)	Alloy-Steel Bolting Materials for Special Applications, Specifications for
A541-78 (ANSI)	Steel Forgings, Carbon and Alloy, Quenched and Tempered, for Pressure Vessel Components, Specifications for
A542-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Chromium-Molybdenum, Specifications for
A543-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum, Specifications for
A553-78 (ANSI)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel, Specifications for
A554-77 (ANSI)	Welded Stainless Steel Mechanical Tubing, Specifications for
A555-78 (ANSI)	Stainless and Heat-Resisting Steel Wire, Specifications for General Requirements for
A556-76 (ANSI)	Seamless and Cold-Drawn Carbon Steel Feedwater Heater Tubes, Specifications for
A557-76 (ANSI)	Electric-Resistance-Welded Carbon Steel Feedwater Heater Tubes, Specifications for

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A560-74 (ANSI)	Chromium-Nickel Alloy Castings, Specifications for
A562-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass of Diffused Metallic Coatings, Specifications for
A563-78a (ANSI)	Carbon and Alloy Steel Nuts, Specifications for
A564-74 (ANSI)	Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes, Specifications for
A565-74 (ANSI)	Martensitic Stainless Steel Bars, Forgings, and Forging Stock for High-Temperature Service, Specifications for
A567-74 (ANSI)	Iron, Cobalt, and Nickel-Base Alloy Castings for High Strength at Elevated Temperatures, Specifications for
A568-74 (ANSI)	Steel, Carbon and High-Strength, Low-Alloy Hot-Rolled Sheet, Hot-Rolled Strip, and Cold-Rolled Sheet, General Requirements, Specifications for
A569-72 (ANSI)	Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality, Specifications for
A570-78 (ANSI)	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality, Specifications for
A571-71 (ANSI)	Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service, Specifications for
A572-78 (ANSI)	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality, Specifications for
A573-77 (ANSI)	Structural Carbon Steel Plates of Improved Toughness, Specifications for
A574-77 (ANSI)	Alloy Steel Socket-Head Cap Screws, Specifications for
A575-73 (ANSI)	Merchant Quality Hot-Rolled Carbon Steel Bars, Specifications for
A576-74 (ANSI)	Steel Bars, Carbon, Hot-Rolled, Special Quality, Specifications for
A577-77 (ANSI)	Ultrasonic Angle-Beam Examination of Steel Plates, Specifications for
A578-77c (ANSI)	Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications, Specifications for
A579-77 (ANSI)	Superstrength Alloy Steel Forgings, Specifications for
A580-77 (ANSI)	Stainless and Heat-Resisting Steel Wire, Specifications for

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A582-78 (ANSI)	Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished, Specifications for
A585-71 (ANSI)	Aluminum-Coated Steel Barbed Wire, Specifications for (1975)
A586-68 (ANSI)	Zinc-Coated Steel Structural Strand, Specifications for (1976)
A588-77a (ANSI)	High-Strength Low-Alloy Structural Steel with 50,000 psi Minimum Yield Point to 4 in. Thick, Specifications for
A589-78 (ANSI)	Seamless and Welded Carbon Steel Water Well Pipe, Specifications for
A590-72a (ANSI)	Pressure Vessel Plates, Alloy Steel, Precipitation Hardening (Maraging), 12 Percent Nickel, Specifications for (1977)
A591-77 (ANSI)	Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated, Specifications for
A592-74 (ANSI)	High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels, Specifications for
A595-74 (ANSI)	Steel Tubes, Low-Carbon, Tapered for Structural Use, Specifications for
A599-77 (ANSI)	Steel Sheet, Cold-Rolled, Tin-Coated by Electrodeposition, Specifications for
A603-70 (ANSI)	Zinc-Coated Steel Structural Wire Rope, Specifications for (1974)
A605-72 (ANSI)	Pressure Vessel Plates, Alloy Steel Quenched and Tempered Nickel-Cobalt-Molybdenum-Chromium, Specifications for (1977)
A606-75 (ANSI)	Steel Sheet and Strip, Hot-Rolled and Cold-Rolled High-Strength, Low-Alloy, with Improved Corrosion Resistance, Specifications for
A607-75 (ANSI)	Steel Sheet and Strip, Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy Columbium and/or Vanadium, Specifications for
A608-70 (ANSI)	Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures, Specifications for (1976)
A609-78 (ANSI)	Longitudinal-Beam Ultrasonic Inspection for Carbon and Low-Alloy Steel Castings, Specifications for
A611-72 (ANSI)	Steel, Cold-Rolled Sheet, Carbon, Structural, Specifications for
A612-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, High-Strength, for Moderate and Lower Temperature Service, Specifications for

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A615-78 (ANSI)	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Specifications for
A616-76 (ANSI)	Rail-Steel Deformed and Plain Bars for Concrete Reinforcement, Specifications for
A617-76 (ANSI)	Axle-Steel Deformed and Plain Bars for Concrete Reinforcement, Specifications for
A618-74 (ANSI)	Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing, Specifications for
A619-75	Steel Sheet, Carbon, Cold-Rolled, Drawing Quality, Specifications for
A620-75	Steel Sheet, Carbon, Cold-Rolled, Drawing Quality, Special Killed, Specifications for
A621-75	Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality, Specifications for
A622-75	Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality, Special Killed, Specifications for
A628-74 (ANSI)	Tool-Resisting Composite Steel Plates for Security Applications, Specifications for
A629-77 (ANSI)	Tool-Resisting Steel Flat Bars and Shapes for Security Applications, Specifications for
A632-76 (ANSI)	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service, Specifications for
A633-78 (ANSI)	Normalized High-Strength Low-Alloy Structural Steel, Specifications for
A635-74 (ANSI)	Steel Sheet and Strip, Carbon, Hot-Rolled Commercial Quality, Heavy-Thickness Coils (formerly Plate), Specifications for
A637-70 (ANSI)	Precipitation Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service, Specifications for (1976)
A638-70 (ANSI)	Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service, Specifications for (1976)
A639-70 (ANSI)	Precipitation Hardening Cobalt-Containing Alloy Bars, Forgings, and Forging Stock for High-Temperature Service, Specifications for (1976)

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A641-71a (ANSI)	Zinc-Coated (Galvanized) Carbon Steel Wire, Specifications for (1975)
A642-71 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Drawing Quality, Special Killed, Specifications for (1975)
A643-78 (ANSI)	Steel Castings, Heavy-Walled, Carbon and Alloy, for Pressure Vessels, Specifications for
A644-78	Iron Castings, Definition of Terms Relating to
A645-78 (ANSI)	Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated, Specifications for
A648-73 (ANSI)	Steel Wire, Hard Drawn for Prestressing Concrete Pipe, Specifications for
A650-78 (ANSI)	Double-Reduced Black Plate, Specifications for
A656-75 (ANSI)	High-Strength Low-Alloy, Hot-Rolled, Structural Vanadium-Aluminum-Nitrogen and Titanium-Aluminum Steels, Specifications for
A657-74 (ANSI)	Steel, Cold-Rolled, Single- and Double-Reduced Tin Mill Black Plate Electrolytic Chromium Coated, Specifications for
A658-72 (ANSI)	Pressure Vessel Plates, Alloy Steel, 36 Percent Nickel, Specifications for (1977)
A659-72 (ANSI)	Steel, Carbon (0.16 to 0.25 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality, Specifications for
A660-76 (ANSI)	Centrifugally Cast Carbon Steel Pipe for High-Temperature Service, Specifications for
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A663-77 (ANSI)	Merchant Quality Hot-Rolled Carbon Steel Bars Subject to Mechanical Property Requirements, Specifications for
A666-72 (ANSI)	Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications, Specifications for (1979)
A668-77 (ANSI)	Steel Forgings, Carbon and Alloy, for General Industrial Use, Specifications for
A669-76 (ANSI)	Seamless Ferritic-Austenitic Alloy Steel Tubes, Specifications for
A671-77 (ANSI)	Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures, Specifications for

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A672-77 (ANSI)	Electric-Fusion-Welded Steel Pipe for High Pressure Service at Moderate Temperatures, Specifications for
A673-77 (ANSI)	Sampling Procedure for Impact Testing of Structural Steel, Specifications for
A676-72 (ANSI)	Hot-Dipped Aluminum Coatings on Ferrous Articles, Specifications for (1976)
A678-75 (ANSI)	Quenched and Tempered Carbon Steel Plates for Structural Applications, Specifications for
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A687-78 (ANSI)	High-Strength Nonheaded Steel Bolts and Studs, Specifications for
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A689-74	Carbon and Alloy Steel Bars for Springs, Specifications for
A691-77 (ANSI)	Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures, Specifications for
A692-74	Seamless Medium Strength Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes, Specifications for
A693-79 (ANSI)	Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip, Specifications for
A694-74	Forgings, Carbon and Alloy Steel for Pipe Flanges Fittings, Valves, and Parts for High-Pressure Transmission Service, Specifications for
A695-74	Steel Bars, Carbon, Hot-Rolled, Special Quality, for Fluid Power Applications, Specifications for
A696-77 (ANSI)	Steel Bars, Carbon, Hot-Rolled and Cold-Finished Special Quality, for Pressure Piping Components and Other Pressure Containing Parts, Specifications for
A699-77 (ANSI)	Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel Plates, Shapes, and Bars, Specifications for
A703-77 (ANSI)	Steel Castings for Pressure-Containing Parts, Specifications for General Requirements Applicable to
A704-74	Welded Steel Plain Bar or Rod Mats for Concrete Reinforced, Specifications for

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A707-76 (ANSI)	Flanges, Forged, Carbon and Alloy Steel for Low-Temperature Service, Specifications for
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A710-77 (ANSI)	Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Columbium Alloy Steels, Specifications for
A711-74	Carbon and Alloy Steel Blooms, Billets, and Slabs for Forging, Specifications for
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A715-75	Steel Sheet and Strip, Hot-Rolled, High-Strength, Low-Alloy, with Improved Formability, Specifications for
A716-78 (ANSI)	Ductile Iron Culvert Pipe, Specifications for
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A723-77 (ANSI)	Alloy Steel Forgings for High-Strength Pressure Component Application, Specifications for
A724-78 (ANSI)	Pressure Vessel Plates, Carbon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels, Specifications for
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A732-76 (ANSI)	Carbon and Low-Alloy Steel Investment Castings for General Application, Specifications for
A733-76 (ANSI)	Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples, Specifications for
A734-78 (ANSI)	Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched and Tempered, Specifications for

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A736-78 (ANSI)	Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Steel, Specifications for
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A738-78a (ANSI)	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service, Specifications for
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A742-77 (ANSI)	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Polymeric Precoated, for Sewer and Drainage Pipe, Specifications for
A743-77 (ANSI)	Corrosion-Resistant Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Alloy Castings for General Application, Specifications for
A744-77 (ANSI)	Corrosion-Resistant Iron-Chromium-Nickel and Nickel-Base Alloy Castings for Severe Service, Specifications for
A745-77 (ANSI)	Ultrasonic Examination of Austenitic Steel Forgings, Recommended Practice for
A746-77 (ANSI)	Ductile Iron Gravity Sewer Pipe, Specifications for
A747-77 (ANSI)	Precipitation Hardening Stainless Steel Castings, Specifications for (1979 Rev.)
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A749M-77	Steel, Carbon, and High-Strength, Low-Alloy, Hot-Rolled Strip, (Metric) Specifications for General Requirements for
A755-78 (ANSI)	Steel Sheet Zinc-Coated (Galvanized) by the Hot-Dip Process and Coil-Coated for Roofing and Siding, Specifications for General Requirements for
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B32-76 (ANSI)	Solder Metal, Specifications for
B33-74 (ANSI)	Tinned Soft or Annealed Copper Wire for Electrical Purposes, Specifications for
B42-78 (ANSI)	Seamless Copper Pipe, Standard Sizes, Specifications for
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B91-72 (ANSI)	Magnesium-Alloy Forgings, Specifications for (1978)
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B108-76 (ANSI)	Aluminum-Alloy Permanent Mold Castings, Specifications for
B111-79 (ANSI)	Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock, Specifications for
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B165-75 (ANSI)	Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube, Specifications for
B167-75 (ANSI)	Nickel-Chromium-Iron Alloy (UNS N06600) Seamless Pipe and Tube, Specifications for
B168-75 (ANSI)	Nickel-Chromium-Iron Alloy (UNS N06600) Plate, Sheet, and Strip, Specifications for
B177-68 (ANSI)	Chromium Electroplating on Steel and Engineering Use, Recommended Practice for (1978)
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B183-79 (ANSI)	Low-Carbon Steel for Electroplating, Practice for Preparation of
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B209-79 (ANSI)	Aluminum-Alloy Sheet and Plate, Specifications for
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B315-79 (ANSI)	Seamless Copper Alloy Pipe and Tube, Specifications for
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B338-78 (ANSI)	Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers, Specifications for
B359-79 (ANSI)	Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes with Integral Fins, Specifications for
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B395-79 (ANSI)	U-Bend Seamless Copper and Copper Alloy Heat-Exchanger and Condenser Tubes, Specifications for
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B646-78	Practice for Fracture Toughness Testing of Aluminum Alloys
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D1339-78 (ANSI)	Sulfite Ion in Water, Tests for
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D1752-67 (ANSI)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, Specifications for (1978)
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D1889-71 (ANSI)	Turbidity of Water, Tests for (1977)
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D2167-66 (ANSI)	Density of Soil in Place by the Rubber-Balloon Method, Test for (1977)
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D2216-71 (ANSI)	Moisture Content of Soil, Laboratory Determination of
D2293-69 (ANSI)	Creep Properties of Adhesives in Shear by Compression Loading (Metal-to-Metal), Test for (1975)
D2294-69 (ANSI)	Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal), Test for (1975)
D2295-72 (ANSI)	Strength Properties of Adhesives in Shear by Tension Loading at Elevated Temperatures (Metal-to-Metal), Test for (1978)
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D2465-73 (ANSI)	Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80, Specifications for
D2466-78 (ANSI)	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40, Specifications for
D2467-76a (ANSI)	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80, Specifications for
D2468-76 (ANSI)	Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40, Specifications for
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D2912-76 (ANSI)	Oxidant Content of the Atmosphere (Neutral KI), Test for
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D2990-77 (ANSI)	Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics, Test for
D2991-71 (ANSI)	Stress-Relaxation of Plastics, Recommended Practice for Testing (1978)
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D3208-76 (ANSI)	Manifold Papers for Permanent Records, Specifications for
D3223-73 (ANSI)	Total Mercury in Water, Test for (1979)

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

D3263-77	Corrosivity of Solvent Systems for Removing Water-Formed Deposits, Test for
D3284-73 (ANSI)	Combustible Gases in Electrical Apparatus in the Field, Test for (1978)
D3301-74 (ANSI)	File Folders for Storage of Permanent Records, Specifications for
D3305-74	Gas from a Transformer, Sampling
D3310-74	Corrosivity of Adhesive Materials, Recommended Practice for Determining (1979)
D3370-76	Water, Practices for Sampling
D3372-75	Molybdenum in Water, Test for
D3373-75	Vanadium in Water, Test for
D3397-75	Triaxial Classification of Base Materials, Soils, and Soil Mixtures
D3406-78	Joint Sealants, Hot-Poured, Elastomeric Type, for Portland Cement Concrete Pavement, Specifications for
D3407-78	Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements, Testing
D3408-78	Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Pavements, Testing
D3482-76 (ANSI)	Electrolyte Corrosion of Copper by Adhesives, Recommended Practice for Determining
D3483-75	Accumulated Deposition in a Steam Generator Tube, Test for
D3557-78	Cadmium in Water, Test for
D3558-77	Cobalt in Water, Test for
D3559-78	Lead in Water, Test for
D3632-77	Accelerated Aging of Adhesive Joints by the Oxygen-Pressure Method, Practice for
D3658-78	Determining the Strength of Ultra-Violet (UV) Light-Cured Glass/Metal Adhesive Joints, Practice for
D3667-78 (ANSI)	Rubber Seals Used in Flat-Plate Solar Collectors, Specifications for
D3697-78	Antimony in Water, Test for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

D3771-79 (ANSI)	Rubber Seals used in Concentrating Solar Collectors, Specifications for
E1-79 (ANSI)	ASTM Thermometers, Specifications for
E8-79 (ANSI)	Tension Testing of Metallic Materials
E9-77 (ANSI)	Compression Testing of Metallic Materials at Room Temperature
E21-70 (ANSI)	Elevated Temperature Tension Tests of Metallic Materials, Recommended Practice for (1978)
E23-72	Notched Bar Impact Testing of Metallic Materials (1978)
E94-77 (ANSI)	Radiographic Testing, Recommended Practice for
E109-63 (ANSI)	Dry Powder Magnetic Particle Inspection (1976)
E113-67 (ANSI)	Ultrasonic Testing by the Resonance Method, Recommended Practice for (1974)
E114-75 (ANSI)	Ultrasonic Pulse-Echo Straight-Beam Testing by the Contact Method, Recommended Practice for
E125-63 (ANSI)	Magnetic Particle Indications on Ferrous Castings, Reference Photographs for (1976)
E139-70 (ANSI)	Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials, Recommended Practice for Conducting (1978)
E142-77 (ANSI)	Radiographic Testing, Controlling Quality of
E150-64 (ANSI)	Creep and Creep-Rupture Tension Tests of Metallic Materials Under Conditions of Rapid Heating and Short Times, Recommended Practice for Conducting (1975)
E151-64 (ANSI)	Tension Tests of Metallic Materials at Elevated Temperatures with Rapid Heating and Conventional or Rapid Strain Rates, Recommended Practice for (1975)
E155-79 (ANSI)	Aluminum and Magnesium Castings, Reference Radiographs for Inspection of
E164-74 (ANSI)	Ultrasonic Contact Examination of Weldments, Recommended Practice for
E165-75 (ANSI)	Liquid Penetrant Inspection Method, Recommended Practice for
E179-73 (ANSI)	Geometric Conditions for Measurement of Reflectance and Transmittance, Recommended Practice for Selection of

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

E186-75 (ANSI)	Heavy-Walled [2- to 4-1/2-in. (51- to 114-mm)] Steel Castings, Reference Radiographs for
E206-72 (ANSI)	Fatigue Testing and the Statistical Analysis of Fatigue Data, Definition of Terms Relating to (1979)
E209-65 (ANSI)	Compression Tests of Metallic Materials at Elevated Temperatures with Conventional or Rapid Heating Rates and Strain Rates, Recommended Practice for (1975)
E213-79 (ANSI)	Ultrasonic Inspection of Metal Pipe and Tubing, Recommended Practice for
E214-68	Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves, Recommended Practice for (1979)
E220-72	Calibration of Thermocouples by Comparison Techniques
E229-70 (ANSI)	Shear Strength and Shear Modulus of Structural Adhesives, Test for (1976)
E242-68 (ANSI)	Appearances of Radiographic Images as Certain Parameters Are Changed, Reference Radiographs for
E243-74	Electromagnetic (Eddy-Current) Testing of Seamless Copper and Copper Alloy Tubes, Recommended Practice for
E251-67 (ANSI)	Performance Characteristics of Bonded Resistance Strain Gages, Tests for (1974)
E259-66 (ANSI)	Reference White Reflectance Standards, Recommended Practice for Preparation of (1973)
E268-76 (ANSI)	Electromagnetic Testing, Definition of Terms Relating to
E269-78 (ANSI)	Magnetic Particle Inspection, Definition of Terms Relating to
E270-78 (ANSI)	Liquid Penetrant Inspection, Definition of Terms Relating to
E273-68 (ANSI)	Ultrasonic Inspection of Longitudinal and Spiral Welds of Welded Pipe and Tubing (1974)
E280-75 (ANSI)	Heavy-Walled [4-1/2 to 12-in. (114- to 305-mm)] Steel Castings, Reference Radiographs for
E309-77 (ANSI)	Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation, Recommended Practice for
E376-69	Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods, Recommended Practice for Measuring (1979)

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

E424-71 (ANSI)	Solar Energy Transmittance and Reflectance (Terrestrial) of Sheet Materials, Test for
E426-76 (ANSI)	Electromagnetic (Eddy-Current) Testing of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys, Recommended Practice for
E429-78 (ANSI)	Reflecting Characteristics of Metallic Surfaces Using Integrating Sphere Instruments, Measurements, and Calculation of
E430-78 (ANSI)	Gloss of High Gloss Metal Surfaces Using Abridged Goniophotometer or Goniophotometer, Measurement of
E432-71 (ANSI)	Leak Testing Method, Recommended Guide for the Selection of a (1976)
E433-71 (ANSI)	Liquid Penetrant Inspection, Reference Photographs for (1976)
E434-71	Calorimetric Determination of Hemispherical Emittance and the Ratio of Solar Absorptance to Hemispherical Emittance Using Solar Simulation, Test for
E446-78 (ANSI)	Steel Castings up to 2 in. (51 mm) in Thickness, Reference Radiographs for
E466-76 (ANSI)	Constant Amplitude Axial Fatigue Tests of Metallic Materials, Recommended Practice for
E467-76 (ANSI)	Verification of Constant Amplitude Dynamic Loads in an Axial Load Fatigue Testing Machine, Recommended Practice for
E468-76 (ANSI)	Constant Amplitude Fatigue Test Results for Metallic Materials, Recommended Practice for Presentation of
E500-74	Ultrasonic Testing, Definition of Terms Relating to
E505-75 (ANSI)	Aluminum and Magnesium Die Castings, Reference Radiographs for Inspection of
E569-76 (ANSI)	Acoustic Emission Monitoring of Structures During Control Simulation, Recommended Practice for
E571-76 (ANSI)	Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products, Recommended Practice for
E606-77T	Constant-Amplitude Low-Cycle Fatigue Testing, Recommended Practice for
E608-78 (ANSI)	Metal-Sheathed Base-Metal Thermocouples, Specifications for
E610-77 (ANSI)	Acoustic Emission, Definition of Terms Relating to

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

E616-78 (ANSI)	Fracture Testing, Definition of Terms Relating to
E639-78 (ANSI)	Total-Radiance Temperature of Heated Surfaces Using a Radiation Pyrometer, Measuring
E650-78 (ANSI)	Mounting Piezoelectric Acoustic Emission Contact Sensors, Practice for
E689-79	Reference Radiograph for Ductile Iron Castings
E690-79	In-Situ Electromagnetic (Eddy-Current) Examination of Non-magnetic Heat Exchanger Tubes, Practice for
F24-65 (ANSI)	Particulate Contamination on Surfaces, Measuring and Counting (1976)
F64-69 (ANSI)	Corrosive and Adhesive Effects of Gasket Materials on Metal Surfaces, Test for (1975)
F218-68 (ANSI)	Stress in Glass, Analyzing (1978)
F320-78 (ANSI)	Hail Impact Resistance of Aerospace Transport Enclosures, Test for
F329-78 (ANSI)	Particulate Contamination in Liquids Using an In-Line Automatic Monitor, Sampling and Measurement of, Recommended Practice for
F437-77 (ANSI)	Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80, Specifications for
F438-77 (ANSI)	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40, Specifications for
F439-77 (ANSI)	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80, Specifications for
F441-77 (ANSI)	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80, Specifications for
F442-77 (ANSI)	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, (SDR-PR), Specifications for
F571-79 (ANSI)	Installation of Exit Devices in Security Areas, Practice for
G1-72 (ANSI)	Preparing, Cleaning, and Evaluating Corrosion Test Specimens, Recommended Practice for (1979)
G3-74	Conventions Applicable to Electrochemical Measurements in Corrosion Testing, Recommended Practice for

Table 12. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

G4-68	Plant Corrosion Tests, Recommended Practice for Conducting (1974)
G7-77a (ANSI)	Atmospheric Environmental Exposure Testing of Nonmetallic Materials, Recommended Practice for
G15-79	Corrosion and Corrosion Testing, Definition of Terms Relating to
G28-72 (ANSI)	Detecting Susceptibility to Intergranular Attack in Wrought Nickel-Rich, Chromium-Bearing Alloys (1979)
G29-75 (ANSI)	Algae Resistance of Plastic Films, Test for
G30-72	U-Bend Stress Corrosion Test Specimens, Recommended Practice for Making and Using (1979)
G31-72	Laboratory Immersion Corrosion Testing of Metals, Recommended Practice for (1979)
G33-72	Recording Data from Atmospheric Corrosion Tests of Metallic-Coated Steel Specimens, Recommended Practice for (1979)
G39-79	Bent-Beam Stress-Corrosion Specimens, Preparation and Use of
G40-77 (ANSI)	Erosion and Wear, Terminology Relating to
G41-74	Cracking Susceptibility of Titanium Alloys Exposed Under Stress to a Hot Salt Environment, Recommended Practice for Determining
G42-75T	Cathodic Disbonding of Pipeline Coatings Subjected to Elevated or Cyclic Temperatures
G46-76	Pitting Corrosion, Recommended Practice for Examination and Evaluation, of
G47-76 (ANSI)	Susceptibility to Stress-Corrosion Cracking of High-Strength 7XXX Aluminum Alloy Products, Recommended Practice for Determining
G48-76 (ANSI)	Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by the Use of Ferric Chloride Solution, Test for
G49-76 (ANSI)	Direct Tension Stress Corrosion Test Specimens, Recommended Practice for Preparation and Use of
G50-76 (ANSI)	Atmospheric Corrosion Tests on Metals, Recommended Practice for Conducting
G51-77 (ANSI)	pH of Soil for Use in Corrosion Testing, Test for
G52-76 (ANSI)	Surface Seawater Exposure Tests on Metals and Alloys, Recommended Practice for Conducting
G58-78 (ANSI)	Preparation of Stress Corrosion Test Specimen for Weldments, Practice for the

Table 13. AMERICAN WATER WORKS ASSOCIATION (AWWA)

C101-67 (ANSI)	Standard for Thickness Design of Cast-Iron Pipe
C104-74 (ANSI)	Standard for Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water
C110-77 (ANSI)	Standard for Gray-Iron and Ductile-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
C150-76 (ANSI)	Standard for the Thickness Design of Ductile-Iron Pipe
C200-75	Standard for Steel Water Pipe 6 Inches and Larger
C205-71	Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe — 4 in. and Larger — Shop Applied
C206-75	Standard for Field Welding of Steel Water Pipe
C207-78 (ANSI)	Standard for Steel Pipe Flanges
C208-59 (ANSI)	Standard for Dimensions for Steel Water Pipe Fittings
C300-74	Standard for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
C301-72	Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
C303-74	Standard for Reinforced-Concrete Water Pipe — Steel Cylinder Type, Pretensioned
C400-77	Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids
C402-77 (ANSI)	Standard for Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids
C900-75	Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water
D100-73	Standard for Welded Steel Elevated Tanks, Standpipes and Reservoirs for Water Storage
D101-R79	Standard for Inspecting and Repairing Steel Water Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage
D102-78 (ANSI)	Standard for Painting and Repainting Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks, for Water Storage

Table 14. AMERICAN WELDING SOCIETY

A5.1-78 (ANSI)	Specification for Carbon Steel Covered Arc Welding Electrodes
A5.2-69 (ANSI)	Specification for Iron and Steel Gas Welding Rods
A5.3-69 (ANSI)	Specification for Aluminum and Aluminum-Alloy Arc-Welding Electrodes
A5.4-78 (ANSI)	Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Electrodes
A5.5-69 (ANSI)	Specification for Low-Alloy Steel Covered Arc Welding Electrodes
A5.6-76 (ANSI)	Specification for Copper and Copper-Alloy Covered Electrodes
A5.7-77 (ANSI)	Specification for Copper and Copper-Alloy Bare Welding Rods and Electrodes
A5.8-76 (ANSI)	Specification for Brazing Filler Metal
A5.9-77 (ANSI)	Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Arc Welding Electrodes and Welding Rods
A5.10-69 (ANSI)	Specification for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes
A5.11-76 (ANSI)	Specification for Nickel and Nickel-Alloy Covered Welding Electrodes
A5.12-69 (ANSI)	Specification for Tungsten Arc Welding Electrodes
A5.13-70 (ANSI)	Specification for Surfacing Welding Rods and Electrodes
A5.14-76 (ANSI)	Specification for Nickel and Nickel-Alloy Bare Welding Rods and Electrodes
A5.17-76 (ANSI)	Specification for Bare Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
A5.18-79 (ANSI)	Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding
A5.19-69 (ANSI)	Specification for Magnesium-Alloy Welding Rods and Bare Electrodes
A5.20-79 (ANSI)	Specification for Carbon Steel Electrodes for Flux-Cored Arc Welding
A5.21-70 (ANSI)	Specification for Composite Surfacing Welding Rods and Electrodes

Table 14. AMERICAN WELDING SOCIETY (Concluded)

A5.22-74 (ANSI)	Specification for Flux-Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes
A5.23-76 (ANSI)	Specification for Bare Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
WI-68	Welding Inspection, Second Edition
B1.0-77	Guide for the Nondestructive Inspection of Welds
BRM-76	Brazing Manual, Third Edition
C3.2-63	Standard Method for Evaluating the Strength of Brazed Joints
D10.4-66	Welding of Austenitic Chromium-Nickel Steel Piping and Tubing
D1.1-79	Structural Welding Code—Steel
D1.3-78	Specification for Welding Sheet Steel in Structures
D1.4-79	Structural Welding Code — Reinforcing Steel

Table 15. COOLING TOWER INSTITUTE (CTI)

STD-103-78	Redwood Lumber Specifications Part I—CTI Grades of Redwood Lumber Part II—Framework Design Data
ATP-105-75	Acceptance Test Code
STD-114-78	Douglas Fir Lumber Specifications Part I—Grades of Douglas Fir Lumber Part II—Design Data
STD-115-71	Southern Pine Lumber Specifications Part I—Grades of Southern Pine Lumber Part II—Design Data
WMS-117-74	Recommendations for Maximum Life of Cooling Tower Lumber
STD-119-62	Timber Fastener Specifications
STD-127-66	Asbestos Cement Materials for Application on Industrial Water Cooling Towers
STD-201-77	Certification Standard for Commercial Water Cooling Towers
WMS-104-75	Wood Maintenance

Table 16. EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

Standards

4th Edition, Addenda 1975, 1976.

Table 17. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

4-1978 (ANSI)	Standard Techniques for High Voltage Testing
43-1974 (ANSI)	Recommended Practice for Testing Insulation Resistance of Rotating Machinery
48-1975	Test Procedures and Requirements for High-Voltage AC Cable Terminations
56-1977 (ANSI)	Guide for Insulation Maintenance of Large AC Rotating Machinery
62-1978	Guide for Field Testing Power Apparatus Insulation
67-1972	Guide for Operation and Maintenance of Turbine Generators
80-1976	Guide for Safety in AC Substation Grounding
82-1963	Test Procedure for Impulse Voltage Tests on Insulated Conductors
83-1963	Test Procedure for Radial Power Factor Tests on Insulating Tapes in Paper-Insulated Power Cable
95-1977 (ANSI)	Recommended Practice for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage
112-1978 (ANSI)	Standard Test Procedure for Polyphase Induction Motors and Generators
122-1959	Recommended Specification for Speed-Governing of Steam Turbines Intended to Drive Electric Generators 500 kW and Larger
141-1976	Recommended Practice for Electric Power Distribution for Industrial Plants
142-1972 (ANSI)	Recommended Practice for Grounding of Industrial and Commercial Power Systems
143-1954	Application Guides for Ground-Fault Neutralizers, Grounding of Synchronous Generator Systems, Neutral Grounding of Transmission Systems
271-1966	Switching Surge Testing of Extra-High-Voltage Switches
336-1977 (ANSI)	Standard Installation, Inspection and Testing Requirements for Instrumentation and Electrical Equipment During the Construction of Nuclear Power Generating Stations
344-1975 (ANSI)	Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Table 17. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
(Concluded)

352-1975 (ANSI)	Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Protection Systems
367-1979	Guide for Determining the Maximum Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault
386-1977	Separable Insulated Connectors for Power Distribution Systems Above 600 V
415-1976	Guide for Planning of Pre-Operational Testing Programs for Class 1E Power Systems for Nuclear Power Generating Stations
422-1977	Guide for the Design and Installation of Cable Systems in Power Generating Stations
446-1974	Recommended Practice for Emergency and Standby Power Systems
450-1975 (ANSI)	Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations
484-1975 (ANSI)	Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations
485-1978	Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
500-1977 (ANSI)	Guide to the Collection and Presentation of Electrical, Electronic, and Sensing Component Reliability Data for Nuclear Power Generating Stations
505-1977	Nomenclature for Generating Station Electric Power Systems
566-1977	Recommended Practice for the Design of Display and Control Facilities for Central Control Rooms of Nuclear Power Generating Stations
577-1976 (ANSI)	Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations
590-1977	Cable Plowing Guide
592-1977	Standard for Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors
634-1978 (ANSI)	Standard Cable Penetration Fire Stop Qualification Test

Table 18. INSTITUTE OF HYDRONICS (HI)

I B R

Baseboard and Finned Tube
(Commercial Ratings, Jan. 1979)

Table 19. INSTRUMENT SOCIETY OF AMERICA (ISA)

<u>Standards</u>	
S5.1 (ANSI)	Instrumentation Symbols and Identification
S5.2	Binary Logic Diagrams for Process Operations
S5.4	Instrument Loop Diagrams
S7.3 (ANSI)	Quality Standard for Instrument Air
S12.4	Instrument Purging for Reduction of Hazardous Area Classification
S12.10	Area Classification in Hazardous Dust Locations
S12.11	Electrical Instruments in Hazardous Dust Locations
S26 (ANSI)	Dynamic Response Testing of Process Control Instrumentation
S37.1 (ANSI)	Electrical Transducer Nomenclature and Terminology
S37.3 (ANSI)	Specifications and Tests for Strain Gage Pressure Transducers
S37.5 (ANSI)	Specifications and Tests for Strain Gage Linear Acceleration Transducers
S37.6 (ANSI)	Specifications and Tests of Potentiometric Pressure Transducers
S37.8 (ANSI)	Specifications and Tests for Strain Gage Force Transducers
S37.10 (ANSI)	Specifications and Tests for Piezoelectric Pressure and Sound-Pressure Transducers
S37.12 (ANSI)	Specifications and Tests for Potentiometric Displacement Transducers
S75.01 (ANSI)	ANSI/ISA Control Valve Sizing Equations
S61.1	Industrial Computer System FORTRAN Procedures for Executive Functions, Process Input-Output, and Bit Manipulation
S61.2	Industrial Computer System FORTRAN Procedures for File Access and the Control of File Contention
MC96.1	Temperature Measurement Thermocouples

Table 19. INSTRUMENT SOCIETY OF AMERICA (ISA) (Concluded)

Recommended Practices

RP4.1	Uniform Face to Face Dimensions for Flanged Control Valve Bodies
RP4.2	Standard Control Valve Manifold Designs (Carbon Steel Valves)
RP12.1	Electrical Instruments in Hazardous Atmospheres
RP55.1 (ANSI)	Hardware Testing of Digital Process Computers

Table 20. INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

UBC	Uniform Building Code
UMC	Uniform Mechanical Code
PC	ICBO Plumbing Code

Table 21. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVES AND FITTINGS INDUSTRY (MSS)

SP-58	Pipe Hangers and Supports—Materials Design and Manufacture (1975)
SP-69	Pipe Hangers and Supports—Selection and Application (1976)

Table 22. NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

RP-01-69	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
RP-01-72	Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recoating
RP-01-75	Control of Internal Corrosion in Steel Pipelines and Piping Systems
RP-02-75	Application of Organic Coatings to the External Surface of Steel Pipe for Underground Service
RP-03-75	Application and Handling of Wax-Type Protective Coatings and Wrapper Systems for Underground Pipelines
TM-01-70	Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive
TM-02-70	Method of Conducting Controlled Velocity Laboratory Corrosion Tests
TM-01-71	Autoclave Corrosion Testing of Metals in High Temperature Water
TM-92-74	Dynamic Corrosion Testing of Metals in High Temperature Water
TM-03-75	Abrasion Resistance Testing of Thin Film Baked Coatings and Linings Using the Falling Sand Method

Table 23. NATIONAL BUREAU OF STANDARDS (NBS)

NBSIR 76-1187	Interim Performance Criteria for Solar Heating and Cooling Systems in Commercial Buildings, November 1976
NBSIR 77-1314	Solar Energy Systems—Survey of Materials Performance, October 1977
NBSIR 78-1532	Environmental and Safety Considerations for Solar Heating and Cooling Applications, September 1978
NBSIR 78-1548	An Evaluation of ASHRAE Standard 94-77 for Testing Water Tanks for Thermal Storage
NBSIR 79-1908	Solar Energy Systems: Test Methods for Collector Insulations, August 1979
NBS TN 899	Development of Proposed Standards for Testing Solar Collectors and Thermal Storage Devices, February 1976
NBS BSS 117	Experimental Verification of a Standard Test Procedure for Solar Collectors, January 1979

Table 24. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

VE 1-79	Cable Tray Systems
SG 4-75	Alternating-Current High-Voltage Circuit Breakers
FB 1-77	Fittings and Supports for Conduit and Cable Assemblies
BC 1-79	Bituminous Fiber Duct for Underground Installation
TC 6-78	PVC and ABS Plastic Utilities Duct for Underground Installation
TC 8-78	Extra-Strength PVC Plastic Utilities Duct for Underground Installation
TC 9-78	Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
TC 10-78	PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
CC 3-73 (ANSI)	Connectors for Use Between Aluminum or Aluminum-Copper Overhead Conductors (1978)
ICS 1-78 (ANSI)	General Standards for Industrial Control and Systems
ICS 2-78 (ANSI)	Industrial Control Devices, Controllers, and Assemblies
ICS 4-77 (ANSI)	Terminal Blocks for Industrial Control Equipment and Systems
ICS 6-78 (ANSI)	Enclosures for Industrial Controls and Systems
250-79	Enclosures for Electrical Equipment (1000 Volts Maximum)
SG 2-76	High-Voltage Fuses
SG 2.1-79	Distribution Fuse Links
II 2-72	Electrical Indicating Instrument-Relays (1977)
II 1-76	Digital Panel Instruments
PB 1-77	Panelboards
PB 2-78	Deadfront Distribution Switchboards
KS 1-75	Enclosed Switches
ST 20-72 (ANSI)	Dry-Type Transformers for General Applications
TR 1-74	Transformers, Regulators, and Reactors

Table 25. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1-75	Fire Prevention Code
10-78 (ANSI)	Portable Fire Extinguishers
11-78 (ANSI)	Foam Extinguishing Systems
11A-76 (ANSI)	High Expansion Foam Systems
11B-77 (ANSI)	Synthetic Foam and Combined Agent Systems
12-77 (ANSI)	Carbon Dioxide Extinguishing Systems
12A-77 (ANSI)	Halogenated Extinguishing Agent Systems—Halon 1301
12B-77 (ANSI)	Halogenated Fire Extinguishing Agent Systems—Halon 1211
13-78 (ANSI)	Installation of Sprinkler Systems
13A-78 (ANSI)	Care and Maintenance of Sprinkler Systems
13E-78	Fire Department Operations in Protected Properties
14-78 (ANSI)	Standpipe and Hose Systems
15-79 (ANSI)	Water Spray Fixed Systems
16-74 (ANSI)	Foam-Water Sprinkler and Spray Systems
17-75 (ANSI)	Dry Chemical Extinguishing Systems
18-79 (ANSI)	Wetting Agents
19B-71	Respiratory Protective Equipment for Fire Fighters
20-78 (ANSI)	Centrifugal Fire Pumps
21-75	Operation and Maintenance of Steam Fire Pumps
22-78 (ANSI)	Water Tanks for Private Fire Protection
24-77	Outside Protection
26-76	Supervision of Water Supply Valves
27-75	Private Fire Brigades
30-77 (ANSI)	Flammable and Combustible Liquids Code
31-78 (ANSI)	Installation of Oil Burning Equipment
43A-75 (ANSI)	Oxidizing Materials, Storage of Liquid and Solid

Table 25. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) (Continued)

43C-75	Code for Storage of Gaseous Oxidizing Material
50A-78 (ANSI)	Gaseous Hydrogen Systems at Consumer Sites
50B-78 (ANSI)	Liquefied Hydrogen Systems at Consumer Sites
51-77 (ANSI)	Oxygen-Fuel Gas Systems for Welding and Cutting
51B-77 (ANSI)	Fire Prevention in Use of Cutting and Welding Processes
58-79 (ANSI)	Liquefied Petroleum Gases, Storage and Handling
63-75 (ANSI)	Prevention of Dust Explosions in Industrial Plants
69-78 (ANSI)	Explosion Prevention Systems
70-78 (ANSI)	National Electrical Code
70B-77 (ANSI)	Electrical Equipment Maintenance
70C-74	Hazardous Locations Classification for Electrical Equipment and Wiring Methods
70E-79	Electrical Safety Requirements for Employee Work Places
71-77 (ANSI)	Central Station Signaling Systems
72A-79 (ANSI)	Local Protective Signaling Systems
72B-79 (ANSI)	Auxiliary Protective Signaling Systems
72C-75 (ANSI)	Remote Station Protective Signaling Systems
72D-79 (ANSI)	Proprietary Protective Signaling Systems
72E-78 (ANSI)	Automatic Fire Detectors
75-76 (ANSI)	Protection of Electronic Computer/Data Processing Equipment
77-77 (ANSI)	Recommended Practice on Static Electricity
78-77 (ANSI)	Lightning Protection Code
80A-75 (ANSI)	Protection from Exposure Fires
90A-78 (ANSI)	Air Conditioning and Ventilating Systems
90B-78 (ANSI)	Warm Air Heating and Air Conditioning Systems
91-73 (ANSI)	Blower and Exhaust Systems, Dust, Stock, and Vapor Removal or Conveying

Table 25. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) (Concluded)

101-76 (ANSI)	Life Safety Code
203M-70	Roof Coverings
204-68	Smoke and Heat Venting
206-76	Guide on Building Areas and Heights
214-77 (ANSI)	Water-Cooling Towers
231-79 (ANSI)	Indoor General Storage
231A-75	Outdoor General Storage
231C-75 (ANSI)	Rack Storage of Materials
232-75 (ANSI)	Protection of Records
241-75 (ANSI)	Safeguarding Building Construction and Demolition Operations
292M-74	Water Charges for Private Fire Protection
321-76	Basic Classification of Flammable and Combustible Liquids
325M-77	Fire Hazard Properties of Flammable Liquids, Gases, Volatile Solids
327-75	Cleaning or Safeguarding Small Tanks and Containers
329-77 (ANSI)	Underground Leakage of Flammable and Combustible Liquids
496-74 (ANSI)	Purged and Pressurized Enclosures for Electrical Equipment
704-75	Identification of the Fire Hazards of Materials
901-76	Uniform Coding for Fire Protection
1921-75 (ANSI)	Standard for Fire Department Portable Pumping Units (Formerly 191)
1961-79	Fire Hose
1962-79	Care, Maintenance and Use of Fire Hose
1963-79	Screw Threads and Gaskets for Fire Hose Connections (Formerly 194)

Table 26. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACCNA)

Low Pressure Duct Construction Standards (1976)

Table 27. UNDERWRITERS LABORATORIES, INC. (UL)

UL-1 (ANSI)	Flexible Metal Electrical Conduit
UL-4 (ANSI)	Armored Cable
UL-6	Rigid Metal Electrical Conduit
UL-19	Woven-Jacketed Rubber-Lined Fire Hose
UL-33	Fusible Links for Fire Protection Service
UL-38 (ANSI)	Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
UL-44 (ANSI)	Rubber-Insulated Wires and Cables
UL-47	Fire Hose Storage Devices
UL-50 (ANSI)	Electrical Cabinets and Boxes
UL-57	Electric Lighting Fixtures
UL-58 (ANSI)	Steel Underground Tanks for Flammable and Combustible Liquids
UL-65 (ANSI)	Electric Wired Cabinets
UL-67 (ANSI)	Electric Panelboards
UL-83 (ANSI)	Thermoplastic-Insulated Wires
UL-92 (ANSI)	Fire Extinguisher and Booster Hose
UL-96	Lightning Protection Components
UL-96A	Master Labeled Lightning Protection Systems
UL-107	Asbestos-Cement Pipe and Couplings
UL-109	Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service and Marine Use
UL-142	Steel Aboveground Tanks for Flammable and Combustible Liquids
UL-154	Carbon Dioxide Fire Extinguishers
UL-193 (ANSI)	Alarm Valves for Fire Protection Service
UL-194	Gasketed Joints for Cast Iron Pressure Pipe and Fittings
UL-199	Automatic Sprinklers for Fire Protection Service
UL-203	Pipe Hanger Equipment for Fire Protection Service

Table 27. UNDERWRITERS LABORATORIES, INC. (UL) (Continued)

UL-213	Rubber Gasketed Fittings for Fire Protection Service
UL-214	Tests for Flame Propagation of Fabrics and Films (1976)
UL-217	Single and Multiple Station Smoke Detectors
UL-231 (ANSI)	Electrical Power Outlets
UL-236	Couplings for Fire Hose
UL-260	Dry Pipe, and Deluge Valves for Fire Protection Service
UL-262	Gate Valves for Fire Protection Service
UL-268	Smoke Detectors for Fire Protective Signaling Systems
UL-299	Dry Chemical Fire Extinguishers
UL-312	Check Valves for Fire Protection Service
UL-346	Waterflow Indicators for Fire Protective Signaling Systems
UL-353 (ANSI)	Limit Controls
UL-393 (ANSI)	Indicating Pressure Gauges for Fire Protection Service
UL-401	Portable Spray Hose Nozzles for Fire Protection Service
UL-448 (ANSI)	Pumps for Fire Protection Service
UL-486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL-486B	Wire Connectors for Use with Aluminum Conductors
UL-489	Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL-493 (ANSI)	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables
UL-514 (ANSI)	Electrical Outlet Boxes and Fittings
UL-521 (ANSI)	Heat Detectors for Fire Protective Signaling Systems
UL-539	Single and Multiple Station Heat Detectors
UL-547 (ANSI)	Thermal Protectors for Electric Motors
UL-555 (ANSI)	Fire Dampers and Ceiling Dampers
UL-873 (ANSI)	Electrical Temperature-Indicating and Regulating Equipment

Table 27. UNDERWRITERS LABORATORIES, INC. (UL) (Concluded)

UL-943	Ground-Fault Circuit Interrupters
UL-1418 (ANSI)	Implosion-Protected-Cathode Ray Tubes for Television-Type Appliances
UL-1480	Speakers and Amplifiers for Fire Protective Signaling Systems
UL-1481	Power Supplies for Fire Protective Signaling Systems

Table 28. U.S. DEPARTMENT OF ENERGY (DOE)

ERDAM	DOE (ERDA) Manual
	Part 0820—Quality Assurance
	Part 6300—Design Criteria

Table 29. U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

930.2 HUD Intermediate Minimum Property Standard Supplement, Solar Heating and Domestic Hot Water Systems

Form for
 Additional Information and Comments on
 Matrix Overview of Potential Standards Application Areas and
 Availability of Acceptable and Modifiable Standards

VED	Subject	Applicable HED (\$)
Solar Thermal Program Needs:		

Available Standard		
Title:	Date:	Responsible Organization:
Assessment of Available Standard Versus Solar Thermal Program Needs:		

Recommended Action

Commentor: Affiliation:



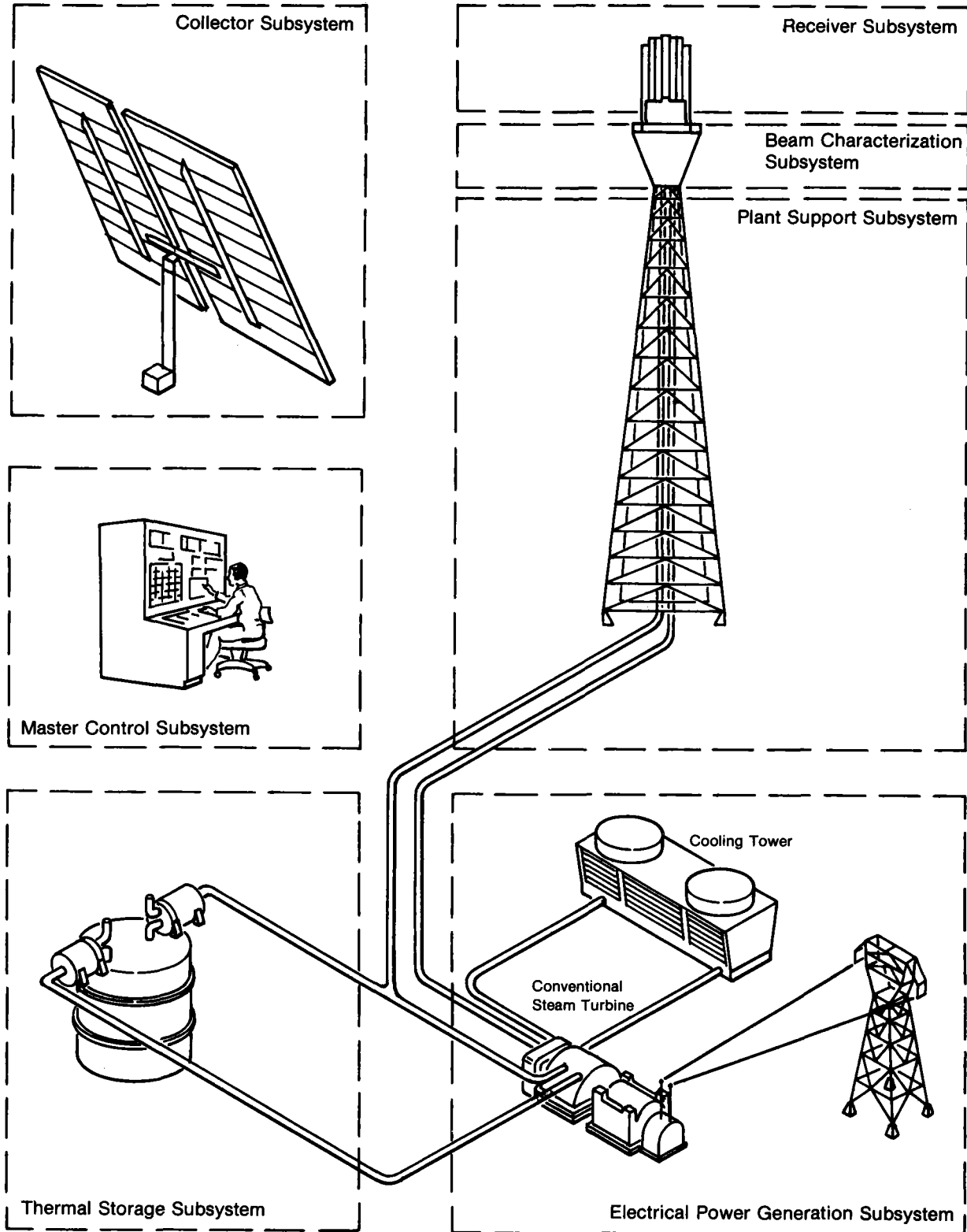


Figure 1-1. Stand-Alone Central Receiver Concept

Source: SAN/0499-24, MDCG8220.

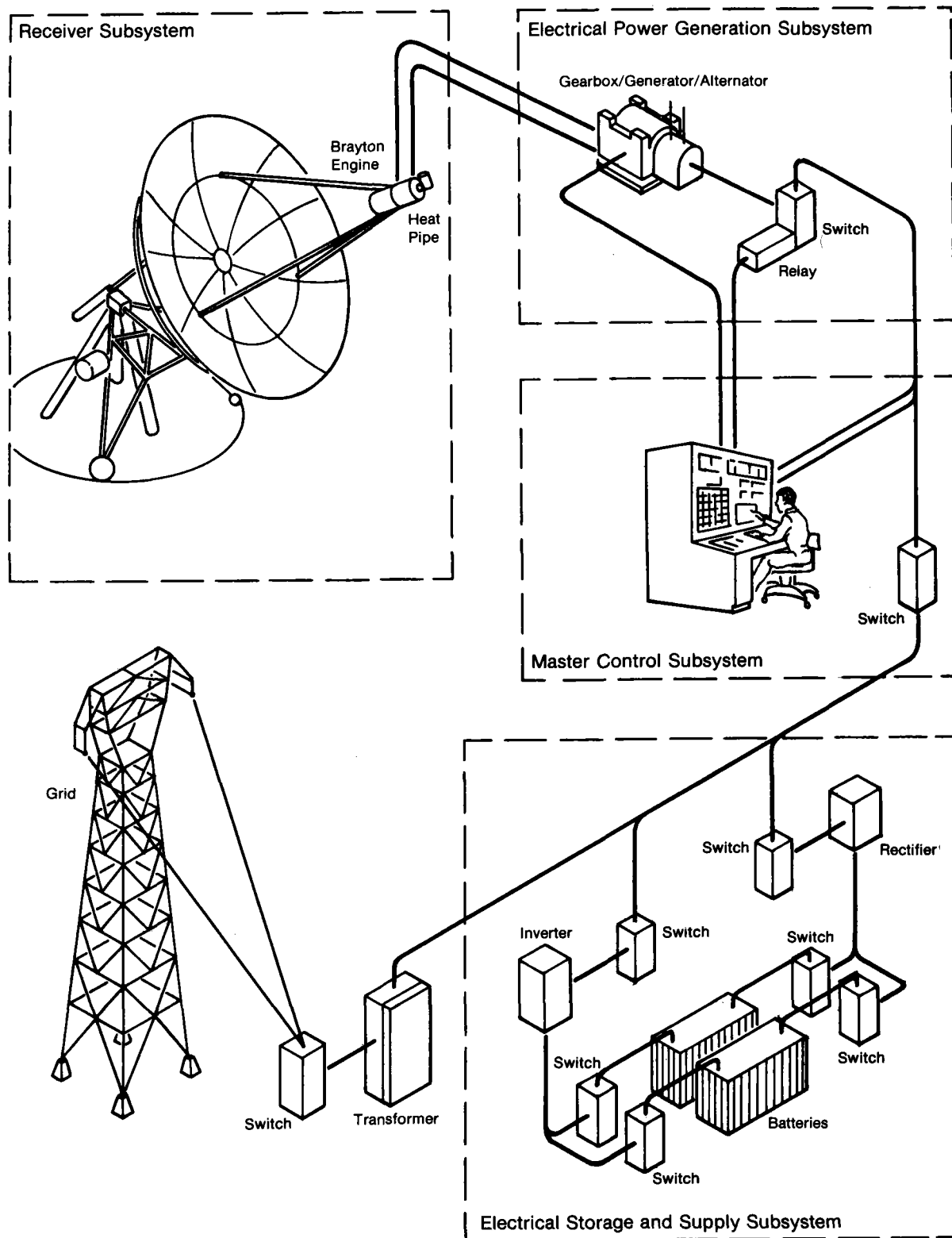


Figure 1-2. Point Focus Distributed Systems

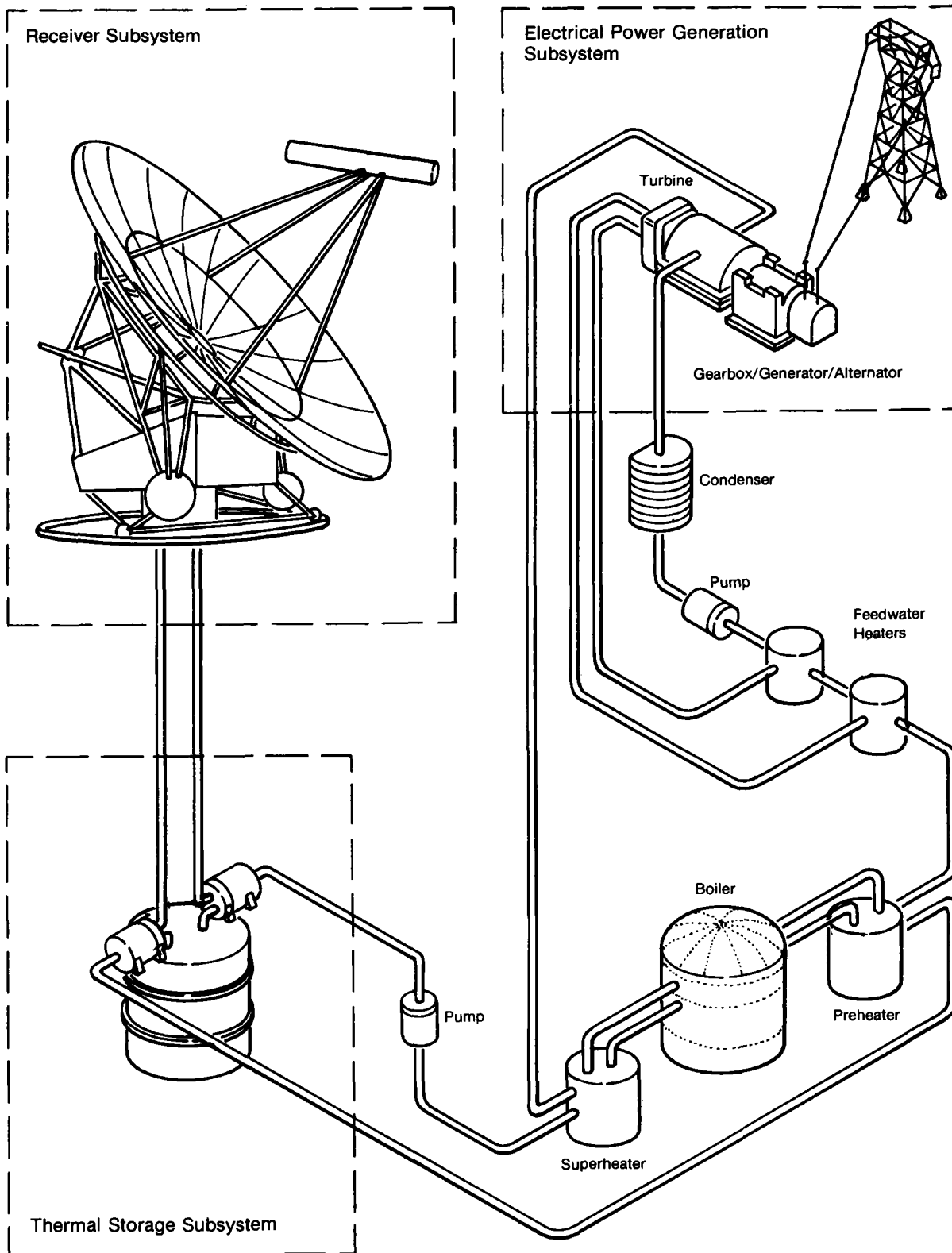


Figure 1-3. Hemispherical Bowl (Line-Focus) System

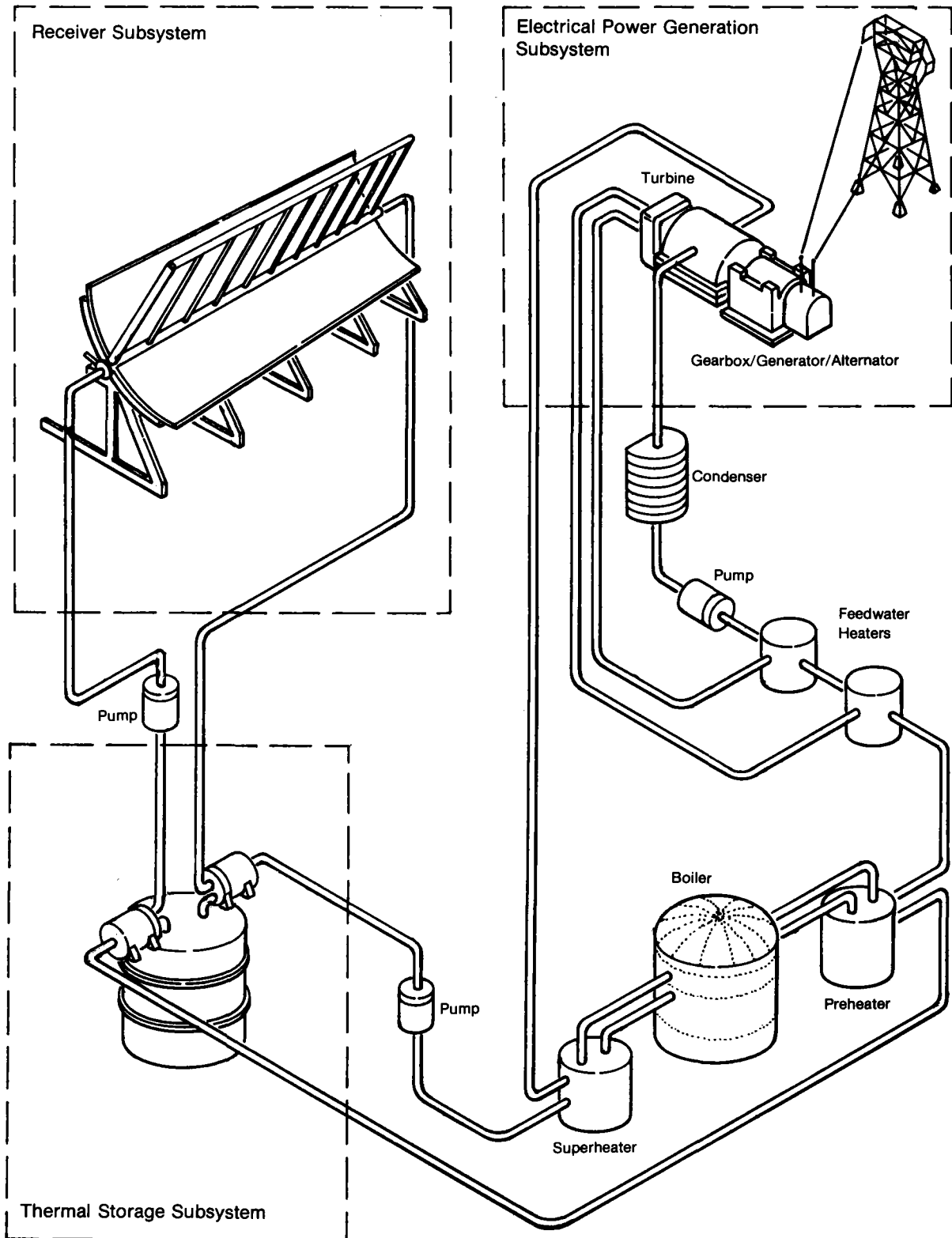


Figure 1-4. Line Focus Distributed System

Subject	Matrix Element Designation		System (HA.00)	Type	Use																							
	HEO	VED																										
A. Definition of Functional Characteristics: 1. Function/Classification 2. Operating/Design Conditions a. Definition of System and Site b. Hazard Events c. Natural Phenomena d. Human Errors e. Site Characteristics f. Climate, Including Insolation and Solar Exposure g. Meteorology h. Seismicity i. Magnitude of Event j. Type of Load from Each Event k. Load Combinations l. Performance or Operating/Design Requirements m. Operational Behavior n. Structural o. Thermal/Hydraulic p. Electrical q. Steam Subsystem r. Assembly and Component Efficiencies/Reliability/Performances VA.00 VA.01 VA.02 VA.03 VA.04 VA.05 VA.06 VA.07 VA.08 VA.09 VA.10 VA.11 VA.12 VA.13 VA.14 VA.15 VA.16 VA.17 VA.18 VA.19 VA.20 VA.21	HA.00	HA.01	HA.02	Central Distributed																								
	HA.03	HA.04	HA.05	HA.06	Stand Alone Repowering Cogeneration Industrial Process Heat																							
	HB.00	HB.01	HB.02	HB.03	HB.04	HB.05	HB.06	HB.07	HB.08	HB.09	HB.10	HB.11	HB.12	HB.13	HB.14	HB.15	HB.16	HB.17	HB.18	Collector Subsystem (CS)								
	HB.01	HB.02	HB.03	HB.04	HB.05	HB.06	HB.07	HB.08	HB.09	HB.10	HB.11	HB.12	HB.13	HB.14	HB.15	HB.16	HB.17	HB.18										
	HC.00	HC.01	HC.02	HC.03	HC.04	HC.05	HC.06	HC.07	HC.08	HC.09	HC.10	HC.11	HC.12	HC.13	HC.14	HC.15	HC.16	HC.17	HC.18	HC.19	HC.20	HC.21	HC.22	HC.23	HC.24	HC.25	Receiver Subsystem (RS)	
	HC.01	HC.02	HC.03	HC.04	HC.05	HC.06	HC.07	HC.08	HC.09	HC.10	HC.11	HC.12	HC.13	HC.14	HC.15	HC.16	HC.17	HC.18	HC.19	HC.20	HC.21	HC.22	HC.23	HC.24	HC.25			
	HD.00	HD.01	HD.02	HD.03	HD.04	HD.05	HD.06	HD.07	HD.08	HD.09	HD.10	HD.11	HD.12	HD.13	HD.14	HD.15	HD.16	HD.17	HD.18	HD.19	HD.20	Thermal Storage Subsystem (TSS)						
	HD.01	HD.02	HD.03	HD.04	HD.05	HD.06	HD.07	HD.08	HD.09	HD.10	HD.11	HD.12	HD.13	HD.14	HD.15	HD.16	HD.17	HD.18	HD.19	HD.20								
	HE.00	HE.01	HE.02	HE.03	HE.04	HE.05	HE.06	HE.07	HE.08	HE.09	HE.10	HE.11	HE.12	HE.13	HE.14	HE.15	HE.16	HE.17	HE.18	HE.19	HE.20	HE.21	HE.22	HE.23	HE.24	HE.25	Electrical Power Generation Subsystem (EPGS)	
	HE.01	HE.02	HE.03	HE.04	HE.05	HE.06	HE.07	HE.08	HE.09	HE.10	HE.11	HE.12	HE.13	HE.14	HE.15	HE.16	HE.17	HE.18	HE.19	HE.20	HE.21	HE.22	HE.23	HE.24	HE.25			

Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems



Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems (continued)

Subject	Matrix Element Designation		Subsystem/Assembly/Component				
	VED	VED	VED	VED			
A. Definition of Functional Characteristics 1. Function/Classification 2. Operating/Design Conditions a. Technical Data b. Natural Phenomena c. Site Characteristics d. Climate, including Insolation and Solar Exposure e. Meteorology f. Seismology g. Wind h. Type of Load from Each Event i. Load Combinations j. Performance vs Operating/Design Conditions (Design Criteria) k. Operational Behavior l. Mechanical m. Structural n. Thermohydraulic o. Electrical p. Optical q. System, Subsystem, Assembly and Component Efficiency/Ratings/Performance	VA.00	HA.00	Master Control Subsystem (MCS) HF.00 - Operations Control System HF.01 - Console & Displays HF.02 - Console/Software HF.03 - Data Storage/Printers HF.04 - Data Storage/Printers HF.05 - Control Room/Equipm HF.06 - Loop Flow Controllers HF.07 - Pump Controller HF.08 - Vaporizer/Lower Controller HF.09 - Valve Controller HF.10 - Heat Source Monitor HF.11 - Tracker Controller HF.12 - Pressure Controller HF.13 - Leak Monitor HF.14 - Toxic Vapor Monitor HF.15 - Data Acquisition System HF.16 - Console Display/Keys HF.17 - Computer/Software HF.18 - Data Storage/Printers HF.19 - Sensors HF.20 - Peripheral Control System HF.21 - Console Display/Keys HF.22 - Computer/Software HF.23 - Data Storage/Printers HF.24 - Processors HF.25 - Position Encoders HF.26 - Microprocessors	Beam Characterization Subsystem (BCS) HG.00 - Video Assembly HG.01 - Video Camera System HG.02 - Digital Image Field Transfer HG.03 - Environmental Housing HG.04 - Pedestal HG.05 - BCS Controller HG.06 - Console Display HG.07 - Data Processor/Storage HG.08 - Target HG.09 - Screen HG.10 - Mounting Structure HG.11 - Target Radiometer	Plant Support Subsystem (PSS) HH.00 - Site Development HH.01 - Roads and Parking HH.02 - Grading HH.03 - Fencing HH.04 - Landscaping HH.05 - Ditch Structures HH.06 - Guard House HH.07 - Administration Bldg HH.08 - Warehouse HH.09 - Receiver Tower HH.10 - Collector Field/Receiver Foundations HH.11 - Turbine/Gen Bldg HH.12 - Meteorological Stations HH.13 - Off Site Facilities HH.14 - Visitor Center HH.15 - Helipad HH.16 - Water Supply HH.17 - Electrical Transmission Network HH.18 - Facility Services HH.19 - Sewer/Service Water and Waste System HH.20 - Fire Protection System HH.21 - Distribution System HH.22 - DI Supply System HH.23 - Lighting Protection HH.24 - Lights HH.25 - Power Distribution HH.26 - Instrumentation HH.27 - Control Wiring Distribution HH.28 - Collector Washer Equipment HH.29 - Electrical Interface HH.30 - Fuel Interface HH.31 - Structural Interface HH.32 - Soil HH.33 - Concrete HH.34 - Foundation	Electrical Storage and Supply Subsystem (ESS) HI.00 - Power (Electrical) Components HI.01 - Inverter HI.02 - Rectifier HI.03 - Batteries HI.04 - Switch Gear HI.05 - Switch Controller HI.06 -	
	VA.01	HA.01					HI.00
	VA.02	HA.02					HI.01
	VA.03	HA.03					HI.02
	VA.04	HA.04					HI.03
	VA.05	HA.05					HI.04
	VA.06	HA.06					HI.05
	VA.07	HA.07					HI.06
	VA.08	HA.08					HI.00
	VA.09	HA.09					HI.00
	VA.10	HA.10					HI.00
	VA.11	HA.11					HI.00
	VA.12	HA.12					HI.00
	VA.13	HA.13					HI.00
	VA.14	HA.14					HI.00
	VA.15	HA.15					HI.00
	VA.16	HA.16					HI.00
	VA.17	HA.17					HI.00
	VA.18	HA.18					HI.00
	VA.19	HA.19					HI.00
	VA.20	HA.20					HI.00
VA.21	HA.21	HI.00					

▲ - First Priority
 ▼ - Second Priority
 ● - Specific Application Areas



Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems (continued)

Subject	Matrix Element Designation	System (HA 00)		Subsystem/Assembly/Component																									
		Type	Use	Subsystem/Assembly/Component																									
		HA 01	HA 02	HA 03	HA 04	HA 05	HA 06	HA 07	HA 08	HA 09	HA 10	HA 11	HA 12	HA 13	HA 14	HA 15	HA 16	HA 17	HA 18	HA 19	HA 20	HA 21	HA 22	HA 23	HA 24	HA 25			
B. Provisions to Achieve Function																													
1. Design/Analysis																													
a. Mechanical																													
(1) Thermal Stress																													
(2) Vibration Frequencies																													
(3) Wind Load Displacements																													
(4) Stress Allowables																													
b. Thermal/Hydraulic																													
(1) Thermal Storage Capacity																													
(2) Thermal Response																													
(3) Flow Characteristics																													
(4) Degradation From Nuclear Boiling																													
d. Electrical/Instrumentation																													
(1) Control Stability																													
(2) Reliability																													
(3) Redundancy																													
(4) Reliability																													
(5) Beam Control Pointing																													
(6) Beam Quality																													
(7) Reliability																													
(8) Specificity																													
2. Mechanical Applications																													
a. Properties and Tests																													
(1) Metals																													
(2) Concrete/Rebar																													
(3) Glass (Including Sealing)																													
(4) Composites																													
(5) Plastics																													
(6) Ceramics																													
(7) Coatings																													
(8) Insulation																													
b. Heat Transfer Mediums																													
(1) Water																													
(2) Oil																													
(3) Molten Salt																													
(4) Sodium																													
(5) Molten Salt																													
(6) Performance																													
(7) Fatigue and Shock																													
(8) Creep																													
3. Construction																													
a. Forming, Fitting and Alignment																													
b. Welding																													
c. Brazing																													
d. Heat Treatment																													
e. Mechanical Joints																													
f. Electrical Connections																													

▲ — First Priority ▼ — Second Priority ● — Specific Application Areas

Subject	Matrix Element Designation		System (HA 90)	Type	Use
	HA 00	HA 01			
C. Quality Assurance 1. Design Control a. Design Review b. Design Change c. Material Certification d. Material Compatibility e. Acceptability for Maintenance and Inspection Procedures f. Control of Design Changes g. Handling Issues in Field h. Control of Design Changes i. Control of Design Changes j. Control of Design Changes k. Control of Design Changes l. Control of Design Changes m. Control of Design Changes n. Control of Design Changes o. Control of Design Changes p. Control of Design Changes q. Control of Design Changes r. Control of Design Changes s. Control of Design Changes t. Control of Design Changes u. Control of Design Changes v. Control of Design Changes w. Control of Design Changes x. Control of Design Changes y. Control of Design Changes z. Control of Design Changes	VC 00	VC 01	HA 00	HA 01	HA 02
	VC 02	VC 03	HA 03	HA 04	HA 05
	VC 04	VC 05	HA 06	HA 07	HA 08
	VC 06	VC 07	HA 09	HA 10	HA 11
	VC 08	VC 09	HA 12	HA 13	HA 14
	VC 10	VC 11	HA 15	HA 16	HA 17
	VC 12	VC 13	HA 18	HA 19	HA 20
	VC 14	VC 15	HA 21	HA 22	HA 23
	VC 16	VC 17	HA 24	HA 25	HA 26
	VC 18	VC 19	HA 27	HA 28	HA 29
D. Health and Safety 1. Field Personnel 2. Beam Safety 3. Environmental 4. Environmental 5. Environmental 6. Environmental 7. Environmental 8. Environmental 9. Environmental 10. Environmental 11. Environmental 12. Environmental 13. Environmental 14. Environmental 15. Environmental 16. Environmental 17. Environmental 18. Environmental 19. Environmental 20. Environmental 21. Environmental 22. Environmental 23. Environmental 24. Environmental 25. Environmental 26. Environmental 27. Environmental 28. Environmental 29. Environmental 30. Environmental 31. Environmental 32. Environmental 33. Environmental 34. Environmental 35. Environmental 36. Environmental 37. Environmental 38. Environmental 39. Environmental 40. Environmental 41. Environmental 42. Environmental 43. Environmental 44. Environmental 45. Environmental 46. Environmental 47. Environmental 48. Environmental 49. Environmental 50. Environmental 51. Environmental 52. Environmental 53. Environmental 54. Environmental 55. Environmental 56. Environmental 57. Environmental 58. Environmental 59. Environmental 60. Environmental 61. Environmental 62. Environmental 63. Environmental 64. Environmental 65. Environmental 66. Environmental 67. Environmental 68. Environmental 69. Environmental 70. Environmental 71. Environmental 72. Environmental 73. Environmental 74. Environmental 75. Environmental 76. Environmental 77. Environmental 78. Environmental 79. Environmental 80. Environmental 81. Environmental 82. Environmental 83. Environmental 84. Environmental 85. Environmental 86. Environmental 87. Environmental 88. Environmental 89. Environmental 90. Environmental 91. Environmental 92. Environmental 93. Environmental 94. Environmental 95. Environmental 96. Environmental 97. Environmental 98. Environmental 99. Environmental 100. Environmental	VC 20	VC 21	HA 30	HA 31	HA 32
	VC 22	VC 23	HA 33	HA 34	HA 35
	VC 24	VC 25	HA 36	HA 37	HA 38
	VC 26	VC 27	HA 39	HA 40	HA 41
	VC 28	VC 29	HA 42	HA 43	HA 44
	VC 30	VC 31	HA 45	HA 46	HA 47
	VC 32	VC 33	HA 48	HA 49	HA 50
	VC 34	VC 35	HA 51	HA 52	HA 53
	VC 36	VC 37	HA 54	HA 55	HA 56
	VC 38	VC 39	HA 57	HA 58	HA 59
E. Environmental 1. Environmental 2. Environmental 3. Environmental 4. Environmental 5. Environmental 6. Environmental 7. Environmental 8. Environmental 9. Environmental 10. Environmental 11. Environmental 12. Environmental 13. Environmental 14. Environmental 15. Environmental 16. Environmental 17. Environmental 18. Environmental 19. Environmental 20. Environmental 21. Environmental 22. Environmental 23. Environmental 24. Environmental 25. Environmental 26. Environmental 27. Environmental 28. Environmental 29. Environmental 30. Environmental 31. Environmental 32. Environmental 33. Environmental 34. Environmental 35. Environmental 36. Environmental 37. Environmental 38. Environmental 39. Environmental 40. Environmental 41. Environmental 42. Environmental 43. Environmental 44. Environmental 45. Environmental 46. Environmental 47. Environmental 48. Environmental 49. Environmental 50. Environmental 51. Environmental 52. Environmental 53. Environmental 54. Environmental 55. Environmental 56. Environmental 57. Environmental 58. Environmental 59. Environmental 60. Environmental 61. Environmental 62. Environmental 63. Environmental 64. Environmental 65. Environmental 66. Environmental 67. Environmental 68. Environmental 69. Environmental 70. Environmental 71. Environmental 72. Environmental 73. Environmental 74. Environmental 75. Environmental 76. Environmental 77. Environmental 78. Environmental 79. Environmental 80. Environmental 81. Environmental 82. Environmental 83. Environmental 84. Environmental 85. Environmental 86. Environmental 87. Environmental 88. Environmental 89. Environmental 90. Environmental 91. Environmental 92. Environmental 93. Environmental 94. Environmental 95. Environmental 96. Environmental 97. Environmental 98. Environmental 99. Environmental 100. Environmental	VC 40	VC 41	HA 60	HA 61	HA 62
	VC 42	VC 43	HA 63	HA 64	HA 65
	VC 44	VC 45	HA 66	HA 67	HA 68
	VC 46	VC 47	HA 69	HA 70	HA 71
	VC 48	VC 49	HA 72	HA 73	HA 74
	VC 50	VC 51	HA 75	HA 76	HA 77
	VC 52	VC 53	HA 78	HA 79	HA 80
	VC 54	VC 55	HA 81	HA 82	HA 83
	VC 56	VC 57	HA 84	HA 85	HA 86
	VC 58	VC 59	HA 87	HA 88	HA 89

Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems (continued)



Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems (continued)

Subject	Subsystem/Assembly/Component			
	Master Control Subsystem (MCS)	Beam Characterization Subsystem (BCS)	Plant Support Subsystem (PSS)	Electrical Storage and Supply Subsystem (ESSS)
VED	VE.00	HG.00	HM.00	HM.00
B. Provisions to Achieve Function	HF.01	HG.01	HM.01	HM.01
1. Design/Analysis	HF.02	HG.02	HM.02	HM.02
a. Mechanical	HF.03	HG.03	HM.03	HM.03
(1) Thermal Stresses	HF.04	HG.04	HM.04	HM.04
(2) Vibration Frequencies	HF.05	HG.05	HM.05	HM.05
b. Structural	HF.06	HG.06	HM.06	HM.06
(1) Load Displacements	HF.07	HG.07	HM.07	HM.07
(2) Soil Allowables	HF.08	HG.08	HM.08	HM.08
c. Thermal-Hydraulic	HF.09	HG.09	HM.09	HM.09
(1) Thermal Storage Capacity	HF.10	HG.10	HM.10	HM.10
(2) Thermal Response	HF.11	HG.11	HM.11	HM.11
(3) Flow Stability	HF.12	HG.12	HM.12	HM.12
(4) Departure From Nucleate Boiling	HF.13	HG.13	HM.13	HM.13
d. Electrical/Instrumentation	HF.14	HG.14	HM.14	HM.14
(1) Control Stability	HF.15	HG.15	HM.15	HM.15
(2) Redundancy	HF.16	HG.16	HM.16	HM.16
e. Optical	HF.17	HG.17	HM.17	HM.17
(1) Reflectance	HF.18	HG.18	HM.18	HM.18
(2) Beam Quality	HF.19	HG.19	HM.19	HM.19
(3) Beam Uniformity	HF.20	HG.20	HM.20	HM.20
(4) Specificity	HF.21	HG.21	HM.21	HM.21
f. Reliability	HF.22	HG.22	HM.22	HM.22
2. Material Specifications	HF.23	HG.23	HM.23	HM.23
a. Structural/Mechanical	HF.24	HG.24	HM.24	HM.24
(1) Metals	HF.25	HG.25	HM.25	HM.25
(2) Concrete/Fiber	HF.26	HG.26	HM.26	HM.26
(3) Glass (Bonding String)	HF.27	HG.27	HM.27	HM.27
(4) Ceramics	HF.28	HG.28	HM.28	HM.28
(5) Adhesives	HF.29	HG.29	HM.29	HM.29
(6) Plastics	HF.30	HG.30	HM.30	HM.30
(7) Coatings	HF.31	HG.31	HM.31	HM.31
(8) Insulation	HF.32	HG.32	HM.32	HM.32
b. Heat Transfer Mediums	HF.33	HG.33	HM.33	HM.33
(1) Air	HF.34	HG.34	HM.34	HM.34
(2) Water	HF.35	HG.35	HM.35	HM.35
(3) Oil	HF.36	HG.36	HM.36	HM.36
(4) Sodium	HF.37	HG.37	HM.37	HM.37
(5) Molten Salt	HF.38	HG.38	HM.38	HM.38
c. Performance Considerations	HF.39	HG.39	HM.39	HM.39
(1) Thermal/Mechanical	HF.40	HG.40	HM.40	HM.40
(2) Fatigue and Shock	HF.41	HG.41	HM.41	HM.41
(3) Creep	HF.42	HG.42	HM.42	HM.42
(4) Erosion	HF.43	HG.43	HM.43	HM.43
(5) Corrosion	HF.44	HG.44	HM.44	HM.44
(6) Creep	HF.45	HG.45	HM.45	HM.45
3. Construction	HF.46	HG.46	HM.46	HM.46
a. Forming, Fitting, and Alkipping	HF.47	HG.47	HM.47	HM.47
b. Welding	HF.48	HG.48	HM.48	HM.48
c. Brazing	HF.49	HG.49	HM.49	HM.49
d. Heat Treatment	HF.50	HG.50	HM.50	HM.50
e. Mechanical Joints	HF.51	HG.51	HM.51	HM.51
f. Electrical Connectors	HF.52	HG.52	HM.52	HM.52
Matrix Element Designation	VE.00	HG.00	HM.00	HM.00
Operations Control System	HF.01	HG.01	HM.01	HM.01
Console Displays	HF.02	HG.02	HM.02	HM.02
Computer/Software	HF.03	HG.03	HM.03	HM.03
Data Storage/Printers	HF.04	HG.04	HM.04	HM.04
Control Room/Equipment	HF.05	HG.05	HM.05	HM.05
Loop Flow Controllers	HF.06	HG.06	HM.06	HM.06
Vaporizer Level Controller	HF.07	HG.07	HM.07	HM.07
Pump Controller	HF.08	HG.08	HM.08	HM.08
Valve Controller	HF.09	HG.09	HM.09	HM.09
Heat Source Monitor	HF.10	HG.10	HM.10	HM.10
Tracker Controller	HF.11	HG.11	HM.11	HM.11
Pressure Controller	HF.12	HG.12	HM.12	HM.12
Leak Monitor	HF.13	HG.13	HM.13	HM.13
Toxic Vapor Monitor	HF.14	HG.14	HM.14	HM.14
Data Acquisition System	HF.15	HG.15	HM.15	HM.15
Console Display/Keybds	HF.16	HG.16	HM.16	HM.16
Computer/Software	HF.17	HG.17	HM.17	HM.17
Data Storage/Printers	HF.18	HG.18	HM.18	HM.18
Sensors	HF.19	HG.19	HM.19	HM.19
Peripheral Control System	HF.20	HG.20	HM.20	HM.20
Console Display/Keybds	HF.21	HG.21	HM.21	HM.21
Computer/Software	HF.22	HG.22	HM.22	HM.22
Data Storage/Printers	HF.23	HG.23	HM.23	HM.23
Microprocessors	HF.24	HG.24	HM.24	HM.24
Position Encoders	HF.25	HG.25	HM.25	HM.25
Processors	HF.26	HG.26	HM.26	HM.26
Video Assembly	HG.00	HG.00	HM.00	HM.00
Video Camera System	HG.01	HG.01	HM.01	HM.01
Digital Image Field Grabber	HG.02	HG.02	HM.02	HM.02
Environmental Housing	HG.03	HG.03	HM.03	HM.03
pedestal	HG.04	HG.04	HM.04	HM.04
BCS Controller	HG.05	HG.05	HM.05	HM.05
Console Display	HG.06	HG.06	HM.06	HM.06
Data Processor/Storage	HG.07	HG.07	HM.07	HM.07
Target	HG.08	HG.08	HM.08	HM.08
Mounting Structure	HG.09	HG.09	HM.09	HM.09
Screen	HG.10	HG.10	HM.10	HM.10
Target Reflector	HG.11	HG.11	HM.11	HM.11
Beam Characterization Subsystem (BCS)	HG.00	HG.00	HM.00	HM.00
Site Development	HM.00	HM.00	HM.00	HM.00
Roads and Parking	HM.01	HM.01	HM.01	HM.01
Grading	HM.02	HM.02	HM.02	HM.02
Fencing	HM.03	HM.03	HM.03	HM.03
Landscaping	HM.04	HM.04	HM.04	HM.04
Dustie Structures	HM.05	HM.05	HM.05	HM.05
Guard House	HM.06	HM.06	HM.06	HM.06
Administration Bldg	HM.07	HM.07	HM.07	HM.07
Warehouse	HM.08	HM.08	HM.08	HM.08
Receiver Tower	HM.09	HM.09	HM.09	HM.09
Turbine/Gen Bldg	HM.10	HM.10	HM.10	HM.10
Collector Field/Receiver Foundations	HM.11	HM.11	HM.11	HM.11
Meteorological Stations	HM.12	HM.12	HM.12	HM.12
Off-Site Facilities	HM.13	HM.13	HM.13	HM.13
Visitor Center	HM.14	HM.14	HM.14	HM.14
Water Supply	HM.15	HM.15	HM.15	HM.15
Waste Treatment	HM.16	HM.16	HM.16	HM.16
Electrical Transmission Network	HM.17	HM.17	HM.17	HM.17
Facility Services	HM.18	HM.18	HM.18	HM.18
Raw/Service Water and Waste System	HM.19	HM.19	HM.19	HM.19
Fire Protection System	HM.20	HM.20	HM.20	HM.20
Demeritalization System	HM.21	HM.21	HM.21	HM.21
Oil Supply System	HM.22	HM.22	HM.22	HM.22
Lighting Protection Equipment	HM.23	HM.23	HM.23	HM.23
Lights	HM.24	HM.24	HM.24	HM.24
Power Distribution	HM.25	HM.25	HM.25	HM.25
Instrumentation	HM.26	HM.26	HM.26	HM.26
Control Wiring Distribution	HM.27	HM.27	HM.27	HM.27
Control Wiring Equipment	HM.28	HM.28	HM.28	HM.28
Electrical Interface	HM.29	HM.29	HM.29	HM.29
Structural Interface	HM.30	HM.30	HM.30	HM.30
Fluid Interface	HM.31	HM.31	HM.31	HM.31
Concrete	HM.32	HM.32	HM.32	HM.32
Soils	HM.33	HM.33	HM.33	HM.33
Pre-tension	HM.34	HM.34	HM.34	HM.34
Power (Electrical) Components	HM.35	HM.35	HM.35	HM.35
Batteries	HM.36	HM.36	HM.36	HM.36
Inverters	HM.37	HM.37	HM.37	HM.37
Rectifiers	HM.38	HM.38	HM.38	HM.38
Switch Gear	HM.39	HM.39	HM.39	HM.39
Switch Controller	HM.40	HM.40	HM.40	HM.40
Electrical Storage and Supply Subsystem (ESSS)	HM.00	HM.00	HM.00	HM.00

▲ — First Priority ▼ — Second Priority ● — Specific Application Areas

Figure 2. Overview of Potential Standards Application Areas for Solar Thermal Systems (concluded)

Subject	Matrix Element Designation		VED	VED	Subsystem/Assembly/Component		VED	VED																																								
	VED	VED			VED	VED																																										
C. Quality Assurance 1. Design Control a. Design Review (1) Analyze Criticalities (2) Analyze Feasibility (3) Material Compatibility (4) Accessibility for Maintenance and Inspection Procedures b. Control of Design Interfaces c. Computer Code Verification d. Implementation of Appropriate Quality Standards Changes e. Including Those in Field 2. Process and Configuration Qualification a. Preparational Testing b. Alternative Analytical Methods c. Manufacturing Testing d. Manufacturing Methods 3. Construction Control a. Control of Purchased Material, Equipment and Services b. Inspection to Confirm Use of Proper Fabrication and Erection c. Control of Special Processes (1) Welding and Brazing (2) Heat Treating (3) Nondestructive Testing d. Control of Nonconforming Materials and Equipment 4. Operational Control a. Personnel Training b. Inspection and On-Line Monitoring c. Maintenance d. Repair e. Operations f. Testing g. Conduct of Operations (1) Training (2) Plant Procedures D. Health and Safety 1. Fire Protection 2. Electrical and Lightning Protection 3. Beam Safety 4. Security 5. Environmental	VC.00	VC.01	VC.02	VC.03	VC.04	VC.05	VC.06	VC.07	VC.08	VC.09	VC.10	VC.11	VC.12	VC.13	VC.14	VC.15	VC.16	VC.17	VC.18	VC.19	VC.20	VC.21	VC.22	VC.23	VC.24	VC.25	VC.26	VC.27	VC.28	VC.29	VC.30	VC.31	VC.32	VC.33	VC.34	VD.00	VD.01	VD.02	VD.03	VD.04	VD.05							
	H.00	H.01	H.02	H.03	H.04	H.05	H.06	H.07	H.08	H.09	H.10	H.11	H.12	H.13	H.14	H.15	H.16	H.17	H.18	H.19	H.20	H.21	H.22	H.23	H.24	H.25	H.26	H.27	H.28	H.29	H.30	H.31	H.32	H.33	H.34	H.35	H.36	H.37	H.38	H.39	H.40							
	Operations Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers	
	Master Control Subsystem (MCS)		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers			
	Beam Characterization Subsystem (BCS)		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers			
	Plant Support Subsystem (PSS)		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers			
	Electrical Storage and Supply Subsystem (ESS)		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Sensors		Peripheral Control System		Data Storage/Printers		Computer/Software		Console Display/Keyboards		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers		Data Storage/Printers					

▲ -- First Priority ▼ -- Second Priority ● -- Specific Application Areas

Subject	Matrix Element Designation		System (HA.00)	Collector Subsystem (CS)	Receiver Subsystem (RS)	Thermal Storage Subsystem (TSS)	Essential Power Generation Subsystem (EPGS)
	HE.01	HE.02					
A. Definition of Functional Characteristics B. Operation/Design Conditions C. Definition of System and Site D. Industrial Effects E. Material Phenomena F. System Transients G. Design/Industry Modification and Safety Exposure H. Meteorology I. Hydrology J. Seismology K. Magnitude of Events L. Level of Consequences M. Performance vs Operating/Design Conditions (Design Critical) N. Operational Behavior O. Mechanical P. Electrical Q. Thermal/Hydraulic R. Optical S. System, Subsystem, Assembly and Component Efficiency/Reliability/Performance	HA.00	HA.01	Central				
	HA.02	HA.03	Distributed	Stand Alone			
	HA.04	HA.05	Repowering	Cogeneration			
	HA.06	HA.07	Industrial Process Heat				
	HB.00	HB.01	Reflector Assembly				
	HB.02	HB.03	Reflector Panel				
	HB.04	HB.05	• Heliiostat (Reflector Central) • Parabolic Dish (Point Focus, Distributed)				
	HB.06	HB.07	• Trough (Line Focus, Distributed)				
	HB.08	HB.09	• Reflector (Support)				
	HB.10	HB.11	Drive Unit				
	HB.12	HB.13	Pedestal				
	HB.14	HB.15	Electrical System/Instr.				
	HB.16	HB.17	Field Electronics				
	HB.18	HB.19	Protective Housing				
	HB.20	HB.21	Control Assembly				
	HB.22	HB.23	Array Controller				
	HB.24	HB.25	Field Controller				
	HB.26	HB.27	Collector Controller				
	HB.28	HB.29	Tracking Drive				
	HB.30	HB.31	Insulation				
	HC.00	HC.01	Receiver Unit				
	HC.02	HC.03	Preheater Panel				
	HC.04	HC.05	Boiler Panel				
	HC.06	HC.07	• Cavity				
	HC.08	HC.09	• External				
HC.10	HC.11	Steam Outlet Piping					
HC.12	HC.13	Downcomer Manifold					
HC.14	HC.15	Flash Tank					
HC.16	HC.17	Feedwater Inlet Piping					
HC.18	HC.19	Feedwater Pump					
HC.20	HC.21	Insulation					
HC.22	HC.23	Cans					
HC.24	HC.25	Heat Transfer Medium					
HC.26	HC.27	Control Assembly					
HC.28	HC.29	Instrumentation					
HC.30	HC.31	Control Electronics					
HC.32	HC.33	Valves and Actuators					
HC.34	HC.35	Ceramic Assembly					
HC.36	HC.37	Inlet Manifold					
HC.38	HC.39	Outlet Manifold					
HC.40	HC.41	Outer Shell					
HC.42	HC.43	Absorber Unit					
HC.44	HC.45	Reflector					
HC.46	HC.47	Heat Pipes					
HC.48	HC.49	Flexible Piping					
HD.00	HD.01	Thermal Storage Unit					
HD.02	HD.03	Tank and Manifolds					
HD.04	HD.05	Heat Storage Media					
HD.06	HD.07	Heat Transfer Media					
HD.08	HD.09	Charging Loop					
HD.10	HD.11	Discharger					
HD.12	HD.13	Thermal Storage Heater					
HD.14	HD.15	Piping					
HD.16	HD.17	Pump					
HD.18	HD.19	Usage Maintenance Unit					
HD.20	HD.21	Fluid Maintenance Unit					
HD.22	HD.23	Extraction Loop					
HD.24	HD.25	Steam Generator (Super Heater, Boiler, Preheater)					
HD.26	HD.27	Piping					
HD.28	HD.29	Pump					
HD.30	HD.31	Control Assembly					
HD.32	HD.33	Instrumentation					
HD.34	HD.35	Control Electronics					
HD.36	HD.37	Control Valves and Actuators					
HD.38	HD.39	Auxiliary Thermal Storage					
HE.00	HE.01	Power Conversion					
HE.02	HE.03	Turbine					
HE.04	HE.05	Generator/Alternator					
HE.06	HE.07	Support Systems					
HE.08	HE.09	Controls/Instr					
HE.10	HE.11	Heat Engine (Rankine, Brayton, Stirling Cycle)/Alternator					
HE.12	HE.13	Heat Rejection					
HE.14	HE.15	Cooling Tower					
HE.16	HE.17	Circulation System					
HE.18	HE.19	Controls/Instr					
HE.20	HE.21	Feedwater Loop					
HE.22	HE.23	Condenser					
HE.24	HE.25	Circulation System					
HE.26	HE.27	Heaters/Depositor					
HE.28	HE.29	Controls/Instr					
HE.30	HE.31	Aux Steam Network					
HE.32	HE.33	Electric Boiler					
HE.34	HE.35	Circulation System					
HE.36	HE.37	Controls/Instr					
HE.38	HE.39	Electr Distribution					
HE.40	HE.41	Transformers					
HE.42	HE.43	Switchgear/Relays					
HE.44	HE.45	Cables/Connectors					
HE.46	HE.47	Controls/Instr					
HE.48	HE.49	Gear Box					

Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems

Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems (continued)

Subject	Matrix Element Designation		Subsystem/Assembly/Component					
	VED	VED	VED	VED				
A. Definition of Functional Characteristics 1. Function/Classification 2. Operating Design Conditions a. Location/Climate System and Site i. Natural Events ii. Induced Events iii. System Transients (1) Natural Phenomena (2) Manmade Phenomena b. Site Characteristics (1) Climate, including insulation and solar exposure (2) Topography (3) Hydrology (4) Seismology (5) Wind c. Magnitude of Event d. Type of Load from Each Event e. Load Combinations 3. Performance vs. Operating/Design Conditions (e.g., efficiency, reliability) a. Operational Behavior (1) Mechanical (2) Structural (3) Thermal-Hydraulic (4) Electrical (5) Optical b. Assembly/Component Efficiency/Ratings/Performance	VA.00	HA.00	Mass Control Subsystem (MCS) HF.01 - Operations Control System HF.02 - Console Displays HF.03 - Computer/Software HF.04 - Data Storage/Printers HF.05 - Control Room/Equipment HF.06 - Loop Controllers HF.07 - Pump Controller HF.08 - Vaporizer Level Controller HF.09 - Valve Controller HF.10 - Heat Source Monitor HF.11 - Tracker Controller HF.12 - Pressure Controller HF.13 - Leak Monitor HF.14 - Tank Vapor Monitor HF.15 - Data Acquisition System HF.16 - Console Display/Keybds HF.17 - Computer/Software HF.18 - Data Storage/Printers HF.19 - Sensors HF.20 - Peripheral Control System HF.21 - Console Display/Keybds HF.22 - Computer/Software HF.23 - Data Storage/Printers HF.24 - Processors HF.25 - Position Encoders HF.26 - Microprocessors	Beam Characterization Subsystem (BCS) HG.01 - Video Camera System HG.02 - Digital Image Field Grabber HG.03 - Environmental Housing HG.04 - Pedestal HG.05 - BCS Controller HG.06 - Control Display HG.07 - Beam Display HG.08 - Data Processor/Storage HG.09 - Target HG.10 - Mounting Structure HG.11 - Screen HG.12 - Target Radiometer	Plant Support Subsystem (PSS) HH.00 - Site Development HH.01 - Roads and Parking HH.02 - Grading HH.03 - Fencing HH.04 - Landscaping HH.05 - Office Buildings HH.06 - Guard House HH.07 - Warehouse HH.08 - Administration Bldg HH.09 - Receiver Tower HH.10 - Turbine/Gen Bldg HH.11 - Collector Field/Receiver Foundations HH.12 - Meteorological Stations HH.13 - Off-Site Facilities HH.14 - Visitor Center HH.15 - Helipad HH.16 - Water Supply HH.17 - Electrical Transmission Network HH.18 - Facility Services HH.19 - Fire Protection and Waste System HH.20 - Demolition System HH.21 - Oil Supply System HH.22 - Lighting Protection HH.23 - Lights HH.24 - Power Distribution HH.25 - Interconnection HH.26 - Collector/Washer Equipment HH.27 - Structural Interface HH.28 - Field Interface HH.29 - Soils HH.30 - Concrete HH.31 - Fire Tension	Electrical Storage and Supply Subsystem (ESS) HI.00 - Power (Electrical) Components HI.01 - Inverters HI.02 - Rectifiers HI.03 - Batteries HI.04 - Switch Gear HI.05 - Switch Controller HI.06 -		
	HA.00	HA.01					HA.02	HA.03
		HA.04					HA.05	HA.06
		HA.07					HA.08	HA.09
		HA.10					HA.11	HA.12
		HA.13					HA.14	HA.15
		HA.16					HA.17	HA.18
		HA.19					HA.20	HA.21
		HA.22					HA.23	HA.24
		HA.25					HA.26	HA.27
		HA.28					HA.29	HA.30
		HA.31					HA.32	HA.33
		HA.34					HA.35	HA.36
		HA.37					HA.38	HA.39
		HA.40					HA.41	HA.42
		HA.43					HA.44	HA.45
		HA.46					HA.47	HA.48
		HA.49					HA.50	HA.51
		HA.52					HA.53	HA.54
		HA.55					HA.56	HA.57
		HA.58					HA.59	HA.60
	HA.61	HA.62	HA.63					
	HA.64	HA.65	HA.66					
	HA.67	HA.68	HA.69					
	HA.70	HA.71	HA.72					
	HA.73	HA.74	HA.75					
	HA.76	HA.77	HA.78					
	HA.79	HA.80	HA.81					
	HA.82	HA.83	HA.84					
	HA.85	HA.86	HA.87					
	HA.88	HA.89	HA.90					
	HA.91	HA.92	HA.93					
	HA.94	HA.95	HA.96					
	HA.97	HA.98	HA.99					
	HA.100	HA.101	HA.102					
	HA.103	HA.104	HA.105					
	HA.106	HA.107	HA.108					
	HA.109	HA.110	HA.111					
	HA.112	HA.113	HA.114					
	HA.115	HA.116	HA.117					
	HA.118	HA.119	HA.120					
	HA.121	HA.122	HA.123					
	HA.124	HA.125	HA.126					
	HA.127	HA.128	HA.129					
	HA.130	HA.131	HA.132					
	HA.133	HA.134	HA.135					
	HA.136	HA.137	HA.138					
	HA.139	HA.140	HA.141					
	HA.142	HA.143	HA.144					
	HA.145	HA.146	HA.147					
	HA.148	HA.149	HA.150					
	HA.151	HA.152	HA.153					
	HA.154	HA.155	HA.156					
	HA.157	HA.158	HA.159					
	HA.160	HA.161	HA.162					
	HA.163	HA.164	HA.165					
	HA.166	HA.167	HA.168					
	HA.169	HA.170	HA.171					
	HA.172	HA.173	HA.174					
	HA.175	HA.176	HA.177					
	HA.178	HA.179	HA.180					
	HA.181	HA.182	HA.183					
	HA.184	HA.185	HA.186					
	HA.187	HA.188	HA.189					
	HA.190	HA.191	HA.192					
	HA.193	HA.194	HA.195					
	HA.196	HA.197	HA.198					
	HA.199	HA.200	HA.201					
	HA.202	HA.203	HA.204					
	HA.205	HA.206	HA.207					
	HA.208	HA.209	HA.210					
	HA.211	HA.212	HA.213					
	HA.214	HA.215	HA.216					
	HA.217	HA.218	HA.219					
	HA.220	HA.221	HA.222					
	HA.223	HA.224	HA.225					
	HA.226	HA.227	HA.228					
	HA.229	HA.230	HA.231					
	HA.232	HA.233	HA.234					
	HA.235	HA.236	HA.237					
	HA.238	HA.239	HA.240					
	HA.241	HA.242	HA.243					
	HA.244	HA.245	HA.246					
	HA.247	HA.248	HA.249					
	HA.250	HA.251	HA.252					
	HA.253	HA.254	HA.255					
	HA.256	HA.257	HA.258					
	HA.259	HA.260	HA.261					
	HA.262	HA.263	HA.264					
	HA.265	HA.266	HA.267					
	HA.268	HA.269	HA.270					
	HA.271	HA.272	HA.273					
	HA.274	HA.275	HA.276					
	HA.277	HA.278	HA.279					
	HA.280	HA.281	HA.282					
	HA.283	HA.284	HA.285					
	HA.286	HA.287	HA.288					
	HA.289	HA.290	HA.291					
	HA.292	HA.293	HA.294					
	HA.295	HA.296	HA.297					
	HA.298	HA.299	HA.300					

Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems (continued)

Subject	System (HA.00)		Collector Subsystem (CS)		Receiver Subsystem (RS)		Thermal Storage Subsystem (TSS)		Electrical Power Generation Subsystem (EPGS)	
	Type	Use								
B. Provisions to Achieve Function	HA.00	Direct								
	HA.01	Direct								
1. Design/Analysis	HA.02	Direct								
	HA.03	Stand Alone								
a. Mechanical	HA.04	Supporting								
	HA.05	Industrial Process Heat								
b. Thermal Stress	HA.06	Industrial Process Heat								
	HA.07	Industrial Process Heat								
c. Thermal-Hydraulic	HA.08	Industrial Process Heat								
	HA.09	Industrial Process Heat								
d. Electrical/Instrumentation	HA.10	Industrial Process Heat								
	HA.11	Industrial Process Heat								
e. Control	HA.12	Industrial Process Heat								
	HA.13	Industrial Process Heat								
f. Structural	HA.14	Industrial Process Heat								
	HA.15	Industrial Process Heat								
g. Material Specifications	HA.16	Industrial Process Heat								
	HA.17	Industrial Process Heat								
h. Performance	HA.18	Industrial Process Heat								
	HA.19	Industrial Process Heat								
i. Manufacturing	HA.20	Industrial Process Heat								
	HA.21	Industrial Process Heat								
j. Safety	HA.22	Industrial Process Heat								
	HA.23	Industrial Process Heat								
k. Environmental	HA.24	Industrial Process Heat								
	HA.25	Industrial Process Heat								
l. Reliability	HA.26	Industrial Process Heat								
	HA.27	Industrial Process Heat								
m. Maintenance	HA.28	Industrial Process Heat								
	HA.29	Industrial Process Heat								
n. Cost	HA.30	Industrial Process Heat								
	HA.31	Industrial Process Heat								
o. Other	HA.32	Industrial Process Heat								
	HA.33	Industrial Process Heat								
p. Mechanical Joints	HA.34	Industrial Process Heat								
	HA.35	Industrial Process Heat								
q. Electrical Connections	HA.36	Industrial Process Heat								
	HA.37	Industrial Process Heat								
r. Other	HA.38	Industrial Process Heat								
	HA.39	Industrial Process Heat								
s. Other	HA.40	Industrial Process Heat								
	HA.41	Industrial Process Heat								
t. Other	HA.42	Industrial Process Heat								
	HA.43	Industrial Process Heat								
u. Other	HA.44	Industrial Process Heat								
	HA.45	Industrial Process Heat								
v. Other	HA.46	Industrial Process Heat								
	HA.47	Industrial Process Heat								
w. Other	HA.48	Industrial Process Heat								
	HA.49	Industrial Process Heat								
x. Other	HA.50	Industrial Process Heat								
	HA.51	Industrial Process Heat								
y. Other	HA.52	Industrial Process Heat								
	HA.53	Industrial Process Heat								
z. Other	HA.54	Industrial Process Heat								
	HA.55	Industrial Process Heat								

Subject	Matrix Element Designation	B. Procedures to Achieve Function		
		1. Design/Analysis	2. Construction	
a. Mechanical (1) Wind Load Displacements (2) Stress Allowables b. Structural (1) Thermal Hydraulic (2) Thermal Response (3) Thermal Stability (4) Radiant Heat From Hardware c. Thermal Response (1) Thermal Response (2) Thermal Stability (3) Radiant Heat From Hardware d. Electrical/Instrumentation (1) Control Stability (2) Redundancy e. Optical (1) Reference (2) Beam Control Pointing (3) Scan Accuracy (4) Scan Stability f. Reliability g. Material Specifications h. Properties and Tests (1) Metals (2) Composites (3) Concrete/Rebar (4) Cast (Including Sealing) (5) Adhesives (6) Plastics (7) Coatings (8) Insulation (9) Heat Transfer Mediums (10) Air (11) Water (12) Soil (13) Sealing (14) Lubricants (15) Bolts/Shafts (16) Springs (17) Performance Considerations (18) Fatigue and Shock (19) Corrosion (20) Creep (21) Creep	HF.00 HF.01 HF.02 HF.03 HF.04 HF.05 HF.06 HF.07 HF.08 HF.09 HF.10 HF.11 HF.12 HF.13 HF.14 HF.15 HF.16 HF.17 HF.18 HF.19 HF.20 HF.21 HF.22 HF.23 HF.24 HF.25 HF.26	HG.00 HG.01 HG.02 HG.03 HG.04 HG.05 HG.06 HG.07 HG.08 HG.09 HG.10 HG.11 HG.12	HH.00 HH.01 HH.02 HH.03 HH.04 HH.05 HH.06 HH.07 HH.08 HH.09 HH.10 HH.11 HH.12 HH.13 HH.14 HH.15 HH.16 HH.17 HH.18 HH.19 HH.20 HH.21 HH.22 HH.23 HH.24 HH.25 HH.26 HH.27 HH.28 HH.29 HH.30 HH.31 HH.32 HH.33 HH.34 HH.35	HI.00 HI.01 HI.02 HI.03 HI.04 HI.05 HI.06
	Master Control Subsystem (MCS) Operations Control System - Console Displays - Computer/Software - Data Storage/Printers - Control Room/Equipment Loop Flow Controllers Pump Controller Vaporizer Level Controller Valve Controller Heat Source Monitor Tracker Controller Pressure Controller Leak Monitor Toxic Vapor Monitor Data Acquisition System - Console Display/Keybds - Computer/Software - Data Storage/Printers - Sensors Peripheral Control System - Console Display/Keybds - Computer/Software - Data Storage/Printers Processors - Position Encoders - Microprocessors	Beam Characterization Subsystem (BCS) Video Assembly - Video Camera System - Digital Image Field Grabber - Environmental Housing - Pedestal BCS Controller - Console Display - Data Processor/Storage Target - Screen - Mounting Structure - Target Radiometer	Site Development - Roads and Parking - Grading - Fencing - Landscaping Onsite Structures - Guard House - Administration Bldg - Warehouse - Receiver Tower - Turbine/Gen Bldg - Collector Field/Receiver Foundations - Meteorological Stations Off-Site Facilities - Visitor Center - Helipad - Water Supply - Electrical Transmission Network Facility Services - Raw/Service Water and Waste System - Fire Protection System - Demineralization System - Oil Supply System - Lightning Protection Equipment - Lights - Power Distribution - Instrumentation - Control Wiring Distribution - Collector Washer Equipment Electrical Interface Structural Interface Fluid Interface Soils Concrete - Pre-tension	Power (Electrical) Components - Inverter - Rectifier - Batteries - Switch Gear - Switch Controller

Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems (continued)



Subject	Matrix Element Designation		System (HA.00)	Type	Use
	HE0	VE0			
C. Quality Assurance 1. Design Review (1) Analyses (2) Material Certification (3) Materials Compatibility and Inspection Procedures b. Control of Design Changes c. Computer-Aided Verification d. Implementation of Appropriate Quality Standards e. Control of Design Changes Including Those in Field 2. Process and Configuration a. Process Control b. Alternative Analytical Methods c. Qualification Testing d. Material Test Methods 3. Construction Control a. Control of Purchased Material, Equipment and Services b. Inspection and Control of Construction c. Inspection and Control of Erection d. Inspection and Control of Final Assembly e. Control of Special Processes (1) Welding and Brazing (2) Heat Treating (3) Nondestructive Testing d. Control of Material and Equipment 4. Operational Plus Control a. Preventive Maintenance b. Inspection and On-Line Monitoring c. Maintenance d. Repairs e. Modifications f. Testing g. Control of Operations (1) Training (2) Repair Procedures D. Health and Safety 1. Fire Protection 2. Electrical and Lightning Protection 3. Security 4. Security 5. Environmental	HA.00 HA.01 HA.02 HA.03 HA.04 HA.05 HA.06 HB.00 HB.01 HB.02 HB.03 HB.04 HB.05 HB.06 HB.07 HB.08 HB.09 HB.10 HB.11 HB.12 HB.13 HB.14 HB.15 HB.16 HB.17 HB.18 HC.00 HC.01 HC.02 HC.03 HC.04 HC.05 HC.06 HC.07 HC.08 HC.09 HC.10 HC.11 HC.12 HC.13 HC.14 HC.15 HC.16 HC.17 HC.18 HC.19 HC.20 HC.21 HC.22 HC.23 HC.24 HC.25 HD.00 HD.01 HD.02 HD.03 HD.04 HD.05 HD.06 HD.07 HD.08 HD.09 HD.10 HD.11 HD.12 HD.13 HD.14 HD.15 HD.16 HD.17 HD.18 HD.19 HD.20 HE.00 HE.01 HE.02 HE.03 HE.04 HE.05 HE.06 HE.07 HE.08 HE.09 HE.10 HE.11 HE.12 HE.13 HE.14 HE.15 HE.16 HE.17 HE.18 HE.19 HE.20 HE.21 HE.22 HE.23 HE.24 HE.25	HA.00 HA.01 HA.02 HA.03 HA.04 HA.05 HA.06 HB.00 HB.01 HB.02 HB.03 HB.04 HB.05 HB.06 HB.07 HB.08 HB.09 HB.10 HB.11 HB.12 HB.13 HB.14 HB.15 HB.16 HB.17 HB.18 HC.00 HC.01 HC.02 HC.03 HC.04 HC.05 HC.06 HC.07 HC.08 HC.09 HC.10 HC.11 HC.12 HC.13 HC.14 HC.15 HC.16 HC.17 HC.18 HC.19 HC.20 HC.21 HC.22 HC.23 HC.24 HC.25 HD.00 HD.01 HD.02 HD.03 HD.04 HD.05 HD.06 HD.07 HD.08 HD.09 HD.10 HD.11 HD.12 HD.13 HD.14 HD.15 HD.16 HD.17 HD.18 HD.19 HD.20 HE.00 HE.01 HE.02 HE.03 HE.04 HE.05 HE.06 HE.07 HE.08 HE.09 HE.10 HE.11 HE.12 HE.13 HE.14 HE.15 HE.16 HE.17 HE.18 HE.19 HE.20 HE.21 HE.22 HE.23 HE.24 HE.25	System (HA.00) Collector Subsystem (CS) Receiver Subsystem (RS) Thermal Storage Subsystem (TSS) Electrical Power Generation Subsystem (EPGS)	Central Distributed Stand Alone Repowering Cogeneration Industrial Process Heat Reflector Assembly - Reflector Panel - Heliosat (Reflector Central) - Parabolic Dish (Point Focus, Distributed) - Hemispheric Bowl (Line Focus, Distributed) - Trough (Line Focus, Distributed) - Reflector Support - Drive Unit - Pedestal - Electrical System - Field Electronics - Protective Housing Control Assembly - Array Controller - Field Controller - Collector Controller Tracking Drive Insulation Receiver Unit - Preheater Panel - Boiler Panel - Cavity - External - Steam Outlet Piping - Downcomer Manifold - Flash Tank - Feedwater Inlet Piping - Feedwater Pump - Insulation - Crane - Heat Transfer Medium Control Assembly - Instrumentation - Control Electronics - Valves and Actuators Ceramic Assembly - Inlet Manifold - Outlet Manifold - Outer Shell - Absorber Unit - Reflector Heat Pipes Flexible Piping Thermal Storage Unit - Tank and Manifolds - Heat Storage Media - Heat Transfer Media Charging Loop - Desuperheater - Thermal Storage Heater - Pump - Usage Maintenance Unit - Fluid Maintenance Unit Extraction Loop - Steam Generator (Super Heater, Boiler, Preheater) - Pump Control Assembly - Instrumentation - Control Electronics - Control Valves and Actuators Auxiliary Thermal Storage Power Conversion - Turbine - Generator/Alternator - Support Systems - Controls/Instr - Heat Engine (Rankine, Brayton, Stirling Cycle)/Alternator Heat Rejection - Cooling Tower - Circulation System - Controls/Instr Feedwater Loop - Condenser - Circulation System - Heaters/Deaerator - Controls/Instr Aux Steam Network - Electric Boiler - Circulation System - Controls/Instr Electr Distribution - Transformers - Switchgear/Relays - Cables/Connectors - Controls/Instr Gear Box	

Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems (continued)



Figure 3. Overview of Areas Where Acceptable and/or Modifiable Standards Exist for Solar Thermal Systems (concluded)

Subject	Matrix Element Designation	System/Assembly/Component		
		MEC	VED	
C. Quality Assurance 1. Design Control a. Design Review (1) Analyses (2) Materials Certification (3) Acceptability for Maintenance and Inspection Procedures b. Control of Design Interfaces c. Computer Code Verification d. Implementation of Appropriate Quality Standards e. Control of Design Changes f. Control of Design in Field 2. Process and Configuration Qualification 3. Preoperational Testing a. Qualification Analytical Methods b. Alternative Analytical Methods c. Qualification Testing d. Material Test Methods 3. Construction Control a. Control of Purchased Material, Equipment and Services b. Inspection to Confirm Use of Proper Fabrication and Erection c. Control of Special Processes (1) Welding and Brazing (2) Heat Treating (3) Nondestructive Testing d. Control of Nonconforming Materials and Equipment 4. Operational Press Control a. Preoperational Testing b. Inspection and On-Line Monitoring c. Maintenance Cleaning (1) Repairs d. Modifications e. Testing f. Control of Operators 9. Training (1) Training Procedures (2) Plant Procedures D. Health and Safety 1. Fire Protection 2. Electrical and Lightning Protection 3. Beam Safety 4. Security 5. Environmental	HF.00 HF.01 HF.02 HF.03 HF.04 HF.05 HF.06 HF.07 HF.08 HF.09 HF.10 HF.11 HF.12 HF.13 HF.14 HF.15 HF.16 HF.17 HF.18 HF.19 HF.20 HF.21 HF.22 HF.23 HF.24 HF.25 HF.26	HG.00 HG.01 HG.02 HG.03 HG.04 HG.05 HG.06 HG.07 HG.08 HG.09 HG.10 HG.11 HG.12	HH.00 HH.01 HH.02 HH.03 HH.04 HH.05 HH.06 HH.07 HH.08 HH.09 HH.10 HH.11 HH.12 HH.13 HH.14 HH.15 HH.16 HH.17 HH.18 HH.19 HH.20 HH.21 HH.22 HH.23 HH.24 HH.25 HH.26 HH.27 HH.28 HH.29 HH.30 HH.31 HH.32 HH.33 HH.34 HH.35	HI.00 HI.01 HI.02 HI.03 HI.04 HI.05 HI.06
	Operations Control System - Console Displays - Computer/Software - Data Storage/Printers - Control Room/Equipm Loop Flow Controllers Pump Controller Vaporizer Lever Controller Valve Controller Heat Source Monitor Tracker Controller Pressure Controller Leak Monitor Toxic Vapor Monitor Data Acquisition System - Console Display/Keybds - Computer/Software - Data Storage/Printers - Sensors Peripheral Control System - Console Display/Keybds - Computer/Software - Data Storage/Printers Processes - Position Encoders - Microprocessors	Video Assembly - Video Camera System - Digital Image Field Grabber - Environmental Housing Pedestal BCS Controller - Console Display - Data Processor/Storage Target - Screen - Mounting Structure - Target Radiometer	Site Development - Roads and Parking - Grading - Fencing - Landscaping Onsite Structures - Guard House - Administration Bldg - Warehouse - Receiver Tower - Turbine/Gen Bldg - Collector Field/Receiver Foundations - Meteorological Stations Off-Site Facilities - Visitor Center - Mailport - Water Supply - Electrical Transmission Network Facility Services - Raw/Service Water and Waste System - Fire Protection System - Demineralization System - Oil Supply System - Lightning Protection Equipment - Lights - Power Distribution - Instrumentation - Control Wiring Distribution - Collector Washer Equipment Electrical Interface Structural Interface Fluid Interface Soils Concrete - Pre-tension	Power (Electrical) Components - Inverter - Rectifier - Batteries - Switch Gear - Switch Controller



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16. Abstract (Limit: 200 words) The Solar Energy Research Institute, at the request of DOE, is developing a Quality Assurance and Standards (QA&S) Plan for solar thermal technologies. Unlike the legislative directives concerning standards for the Photovoltaic (PV) and Solar Heating and Cooling of Buildings (SHAC) programs, which required prior development of criteria, relevant legal requirements for ST involved developing sound commercial practices. Since standards development and implementation of PV and SHAC technologies were begun earlier, a lessons-learned approach is used to develop a QA&S plan for ST. Thus, the keystone of the plan is a series of functional and standards matrices, contained in this report, developed from input from ST users and from the industry that will be continually reviewed and updated as commercial aspects develop. The matrices highlight codes, standards, test methods, functions and definitions that need to be developed. They will be submitted through ANSI for development by national consensus bodies. A contingency action is proposed for standards development if specific input is lacking at the committee level or if early development of a standard would hasten commercialization or gain needed jurisdictional acceptance. Agency funding will be sought before consensus review to support development of draft standards by specialists, laboratories, and consultants where qualifying requirements apply.			
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