UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

APPLICATION OF TEXAS UTILITIES GENERATING COMPANY, ET AL. FOR AN OPERATING LICENSE FOR COMANCHE PEAK STEAM ELECTRIC STATION UNITS #1 AND #2 (CPSES)

Docket Nos. 50-445
and 50-446

CASE'S RESPONSE TO
BOARD'S 9/22/82 MEMORANDUM AND ORDER
FOR BRIEFS RE: NECESSARY DOCUMENTS AND INFORMATION

On September 22, 1982, the Board filed its Memorandum and Order confirming and detailing its September 17, 1982, verbal Order during the hearings. CASE hereby files this, its Response to the Board's 9/22/82 Memorandum and Order for Briefs re: Necessary Documents and Information which the Board needs in order to close the evidentiary record.

(1)

The following items were referred to and discussed in the transcript, but were not offered into evidence; we believe they should be in the record in order for it to be complete:

1. Mr. Tolson indicated that CASE Exhibit 495 (already admitted into evidence) was not complete and that there were other pages which should be included. The complete document should be in the record. (tr. 1994/12-1995/1; 1996/13-15)

2. AWS (American Welding Society) Code D1.1 (whatever year is applicable to Comanche Peak). This is referenced many times in the transcript and the document should be in the record. (tr. 2141/5; 4564/6-9; 4412/4-7; 4515/22; 4602/8-9; 4632/7-8; 4633/22-4634/11; 4840/23) (NOTE: CASE Exhibit 719 is pages 156, 157, 158, and 159 of AWS D1.1-80; however, we do not believe this is the portion referred to in the transcript and that those portions should also be included.)

3. The Status Report on inspection and repairs to the Polar Crane (Applicants' Exhibit 122, 7/82, Mr. Tolson's Testimony, page 6, answer 16; tr. 2268/21; 2274/3-4; 2280/11-13)

4. NRC Guidance that purports to be an interpretation of 10 CFR 50.55(e). (This may be the same as CASE Exhibit 300, already admitted into evidence, tr. 5360; if not, it should be in the record. Tr. 2341/2-3.)

D803

(Discussed but not introduced into evidence - continued):

5. Brown & Root Welding Procedures 11032, 11065, and 10046 (Henry Stiner's testimony; tr. 4585/20-4587; 4593/1; 4594/7-9; 4074/5-7)

6. ASME (American Society of Mechanical Engineers) Section 9 (Tr. 4272/20; 4273/25; 4364/6-9; 4411/24-4412/3; 4412/4-7; 4412/11-13; 4413/17; 4522/24; 4526/21; 4591/8; 4591/20; 4591/25; 4602/8-9; 4633/22-4634/11.) This document is referred to and discussed in many places in the transcript and those portions should be in the record.

7. ASME Section 3, Subsection NF) (Tr. 4628/23-4629/11; 4633/22-4634/11.) This document is referred to and discussed several times in the transcript and those portions should be in the record.

8. Brown & Root Procedure re: stops and starts, cleaning of welds, referred to by Mr. Brandt. (tr. 4431/15-4432/4). The portion referred to should be in record.

9. The procedure for inspection of concrete expansion anchors, referred to by Mr. Brandt. (tr. 4532/9-10)

10. Inspection instructions for ASME Classes 1, 2, and 3 Hangers, and inspection instructions for Class 5 Hangers, referred to by Mr. Brandt. (tr. 4565/4-6).

11. ANSI N45.2.9, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants," referred to by Mr. Brandt. (tr. 4557/2; 4563/22) Portion referred to should be in record.

12. ANSI 13.31.1, governing code for Class 5 hangers, referred to by Mr. Brandt (tr. 4565/8-10; 4628/23-4629/11).

13. Procedure re: final record review for Hilti bolt torquing, referred to by Tolson (tr. 4601/2-4).

14. Procedures or documentation of verification program for welding (tr. 4646/17-4648/3).

15. Final s[illegible] analysis on each piping system as it relates to minimum wall thickn[illegible]r. 2102/1-14).

16. Docu[illegible]on of final approval of pipe supports (tr. 4715/21-25).

17. D[illegible] procedure re: as-built design verification program (tr. 4835/1-13).

18. Gib[illegible] and Westinghouse piping analysis (tr. 5281/13-15).

19. As-built survey (tr. 5283/25).

20. Final design reviews by PSE, NPSI, ITT Grinnel of pipe supports to as-built piping analysis loads (tr. 5291/11-14).

(Discussed but not introduced into evidence - continued):

21. AISC document referred to by Mr. Reedy which was the basis for Class 2 and 3 linear supports in the ASME Code (tr. 5219/1-12).

22. Paragraph NCA-1140 (or whatever applicable paragraph number is) of ASME Code which allows mixing of Codes, referred to by Mr. Reedy (tr. 5220/1-8).

23. Paragraph in NF 3100 or 3200 (whichever is applicable) which describes thermal stress, referred to by Mr. Reedy (tr. 5224/11).

24. The "editorial revision" in the ASME code which "made clearer statements that thermal stress is not to be evaluated for any component supports," referred to by Mr. Reedy (tr. 5224/22-5225/15).

ASME Section 3, Sub-Section NF Criteria

25. NS.46-A and the NF code/which Mr. Finneran stated PSE, NPSI, and ITT Grinnel all design basically to same requirements of (tr. 5279/17-24; 5014/8-15; 5044/21-22; 5052/15-16; 5060/4-6; 5088/4-10; 5074/1-11). (May be MS.46-A???)

26. Results and report re: NRC special inspection to address Mr. Doyle's concerns, referred to by Mr. Tapia (tr. 5353/2-6) (to be done in addition to Applicants' response to IE Bulletin 79-14, tr. 5353/9-15).

27. Results and report re: NRC special inspection to evaluate Applicants' response to IE Bulletin 79-14 (tr. 5353/9-15), referred to by Mr. Tapia; (see also tr. 5561/14-17). According to Mr. Burwell, the evaluation by the NRC will be reported in an inspection report to be issued by Region IV, rather than being included in SSER 5 as previously stated. (tr. 5561/9-25)

28. All documentation re: corrective actions and verification of corrective actions taken as a result of problems found during item 27 above. (tr. 5353/16-20; 5354/4).

29. NRC Staff's supplementary confirmatory analysis for Comanche Peak, referred to by Dr. Chen (tr. 5354/5-5355/23); this should include the final report and all criteria to be relied on, including Sections of ASME 3231.1A, B and C.

30. NRC Staff's review of the Applicants' as-built design verification program, referred to by Mr. Mizuno (tr. 5408/1-4; 5385/24)

31. Applicants' final report in response to IE Bulletin 79-14 (5395/25-5396/1).

32. All procedures for approving the drawings at Comanche Peak (for PSE, NPSI, and ITT Grinnel). (tr. 4980/4-8).

33. The procedures at Comanche Peak that comply with ANSI N45.2.11 (CASE Exhibit 690), External Design Interface, Page 1. (Tr. 5024/4-5025/3).

34. The code case which permits the use of A500 Grade B tube steel (referred to by Mr. Reedy) (Tr. 5072/4-5076/4; 5079/11-5080/20; 5090/1-5). (May be the same as CASE Exhibits 730, 731, and/or 732 = ASME Code Cases 1644, 1644-3, and N-71-11, respectively; if not, should be provided for the record.)

35. The paragraph in the ASME Code that addresses cold-forming, which Mr. Reedy stated he authored (tr. 5082/21-5083/10).

36. ASME Section 3, Sub-section NA, Appendix F (of applicable year[1]), which Dr. Chang stated is the basis for Code-allowable stress under faulted conditions (tr. 5088/15-23).

37. The "special calculation in the design criteria file" referred to by Dr. Chang regarding the 400 supports that were looked at for their seismic acceleration problems (tr. 5109/13-5110/21).

38. The NPSI Design Criteria for pipe supports at Comanche Peak (the official one in use, which we believe was issued in May, 1981[2], allegedly proprietary (tr. 5032/4-10; 5060/7-5061/8; Mark Walsh testimony, CASE Exhibits 659 and 659H; Jack Doyle testimony, CASE Exhibits 669 and 669B).

39. The ITT Grinnel Design Criteria for pipe supports at Comanche Peak (the one currently in use at Comanche Peak)[2], allegedly proprietary (tr. 5032/4-10; 5060/7-5061/8; Mark Walsh testimony, CASE Exhibits 659 and 659H; Jack Doyle testimony, CASE Exhibits 669 and 669B).

40. FUB II and the instructions of how to use the FUB II and the instructions of how to use the FUB II information (i.e., the entire procedure for using all of the information off of FUB II) to determine the capacity of the Hilti bolt[2] (Mark Walsh testimony, CASE Exhibits 659 and 659H; Jack Doyle testimony, CASE Exhibits 669 and 669B).

41. A copy of the Hilti (bolt) allowables and the procedures for the analysis[2] (Mark Walsh testimony, CASE Exhibits 659 and 659H; Jack Doyle testimony, CASE Exhibits 669 and 669B).

42. All documents (in the broad sense of the word, including but not limited to: internal memoranda, papers, letters, handwritten notes, etc.) which were used to define the method used to determine the tensile force in the Richmond Inserts.[2] (Mark Walsh testimony, CASE Exhibits 659 and 659H; Jack Doyle testimony, CASE Exhibits 669 and 669B).

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[1] Code of record for Comanche Peak pipe supports is 1974 edition through the Winter of 1974 addenda, per Mr. Finneran (tr. 5144/20-22).

[2] Items 38 through 42 were requested in CASE's 12th Set of Interrogatories to Applicants and Requests to Produce; Applicants referred CASE to NPSI and Grinnel for responses.

CASE contacted NPSI regarding items 38, 41 and 42 above by letter and by phone, most recently by phone on 10/8/82. During that conversation, we were told that: "We're evaluating your request...going through management internally here, trying to come up with a reply to you...probably the latter part of next week I could get some kind of reply back to you or get back to you on the phone, and make you aware of what our position is and what direction we're heading. Right now, we're looking into it. Of course, we have to pursue it with TUSI also to -- you know, whether it would be O.K. with them to -- you know, we're working for them as a vendor, so it's you know, their place to direct us whether we can, so we are doing the different things." CASE stated that "it's our

(continued on page 5)

Other necessary documents and information:

43. SSER #3, #4, and #5 (tr. 5393/14-15, 5422; 5423; 5424/5425.)

44. The Public Health Region's functional statement regarding emergency planning, which is yet to be developed and is anticipated to be completed sometime within the next two or three months. (Tr. 5601/22-5602/7).

45. The problems with the emergency plan as detailed in CASE Exhibits 728B-K should be resolved and documented prior to the granting of the operating license, and the Board should have such documentation in hand. (Tr. 5607/15-5613/14).

46. Specific documents or procedures as to how Squaw Creek Park would be evacuated, how the park visitors would be accounted for, who would be doing this, and what liaison there would be between them and the people in the county and the cities. (Tr. 5625/20-5626/10).

47. Documentation of cooperative arrangements with people in the area or local agencies detailing arrangements for sheltering and decontamination and medical

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2 (continued)
understanding that some of the information, according to what TUSI had said, may be proprietary information?" NPSI response: "Yeah, that's some of the stuff that we are looking into within our organization, you know, which information can be let out and which can't and then also, see if, uh, you know, also pursuing it with TUSI to see if it's O.K. if we do so. We know that they did release to you some of the manuals earlier, they did give you information, right?" CASE: "On some things." NPSI: "On some things -- uh huh. O.K. But, yes, we have received your letter...I would say probably the latter part of next week I should have some kind of answers for you..."

CASE also contacted ITT Grinnel regarding items 39, 40, 41 and 42 preceding by letter and by phone, most recently by phone on 10/7/82. At that time we were advised that the gentleman we needed to talk to was out until Monday, 10/11/82, and that he woudl return our call.

We will, of course, keep the Board informed regarding these matters. It is CASE's position that this information is of vital importance to the Board's being able to make an informed decision in these proceedings, to CASE's case, and to the public interest. These matters go to the very heart of the testimony of Mark Walsh and Jack Doyle and are obviously necessary to the resolution of the concerns raised by them. Further, as CASE has indicated earlier in its Motion to Add New Contention 26, the idea of building secret pipe supports at Comanche Peak is completely contrary to the whole idea and intent of having public hearings about whether or not to grant an operating license for Comanche Peak. The information should have been available prior to CASE's cross-examination of Applicant's rebuttal witnesses to Mark Walsh's and Jack Doyle's testimony in order to make the record complete. It should most certainly be made available prior to CASE's cross-examination of the NRC Staff's panel rebutting Mark Walsh's and Jack Doyle's testimony.

47. (continued):
attention, etc. (tr. 5633/16-5635/4). Mr. Skiles stated "there would be no need for cooperative arrangements." (tr. 5634/24).

48. Documentation that arrangements have been made to take care of sheltering people who voluntarily choose to evacuate (who live either in or out of the 10-mile EPZ); this has not been done, according to Mr. Skiles. (tr. 5636/22-5637/22).

49. Responses to all of the RAC comments, which Mr. Born expected that state and local agencies will have completed "in approximately two weeks." (tr. 5653/12-5653/24)

50. Documentation that the utility's public information package has been adequately developed to provide information to the public; is currently being developed. (tr. 5656/8):

51. Documentation that the emergency warning system is completed and working properly; expected to be by November 1982. (tr. 5663/19-5663/24).

52. Documentation that drills have been successfully carried out to demonstrate that emergency plan works. (tr. 5658/10-5660/12, State people have only participated in national nuclear war emergency tests.)

53. NRC Staff reviews of the Emergency Planning for Comanche Peak, expected to be done over the next 18 months according to Staff Witness Mr. Rohrer on onsite planning. (tr. 5671/24-5672/11).

54. FEMA preliminary findings which were to be sent to NRC headquarters in Washington, D.C. on 9/17/82. (tr. 5718/11-5719/10; 5729/5-5729/17).

55. Documentation of FEMA conclusions regarding revision of the plans, exercises, meetings, etc. (tr. 5722/18-5723/11).

56. Memorandum of Understanding (tr. 5726/22-5726/25).

57. Documentation that an integrated emergency plan actually exists. (tr. 5729/19-5732/23).

58. Documentation that adequate consideration has been given to predominant Spring thunderstorm winds which might necessitate an additional sub-area (tr. 5732/25-5734/15)

59. Documentation that an exercise has been successfully conducted. (Note: Although it is our understanding that new regulations allow up to 5% operation without full evaluation of the emergency planning having been done, the Board in these proceedings does not presently have before it a request for a low-power operating license from the Applicants; therefore, it is not appropriate to proceed as though such a request had been officially filed. Unless and until such a request is filed, the Board, in CASE's opinion, should address itself to the full power license request only.) (tr. 5734/16-5735/8; 5742/16-22).

60. All of the testimony on emergency planning indicates that most of the things are yet to be done. The Board should require documentation that the necessary requirements have been met not only on paper, but in actuality as well.

61. There are some portions of the depositions CASE sought to put into evidence which are needed to make the record complete and accurate. See Motion to follow. (CASE Exhibits 670 through 682.)

62. The comments of Jack Doyle on drawings contained in CASE Exhibit 669B are needed to make the record complete and accurate. See Motion to follow.

63. Documents listed by CASE which have not yet been accepted into evidence are needed to make the record complete and accurate. See pleading to follow in one week (tr. 5773/1-7).

64. Documents handed out by CASE for cross-examination of NRC Staff witnesses but not accepted into evidence yet are needed to make the record complete and accurate. (CASE Exhibits 694, 695, 701, 703, 705, 714 through 726.)

65. Documents to be used by CASE for cross-examination of NRC Staff witnesses rebutting testimony of Mark Walsh and Jack Doyle are needed to make the record complete and accurate. (See CASE Exhibits 729 through 733 attached; further, since we have not yet received the NRC Staff's additional rebuttal testimony, there may be additional documents to be used in cross-examination.)

66. Pre-filed testimony of NRC Staff rebuttal witnesses to Mark Walsh's and Jack Doyle's testimony. (tr. 5409/2-3; 5411/9).

67. CASE has never had the opportunity to cross-examine the NRC investigators (Messrs. Driskill and Herr) regarding I&E Report 81-12 (Staff Exhibit 178) since we received the back-up "sanitized" notes regarding it (this was the investigation of the Stiners' allegations). We should be able to do this to make the record complete; we should not be denied this opportunity because the NRC Staff chose not to file rebuttal testimony to the Stiners' testimony in this regard. See Motion to follow.

(2)

Significance of remaining SSER's 3, 4, and 5:

SSER 3: obviously, since the Applicants' emergency preparedness plans and programs are involved directly in CASE's Contention 22, SSER 3 is needed prior to making a determination regarding this contention.

SSER 4 and 5: It is not clear from the wording of what will be contained in these two SSER's (Board's Memorandum and Order of September 22, 1982, page 2) which will be pertinent to the concerns raised by Mark Walsh and Jack Doyle; however, if any of the items contained in the SSER's pertains to those concerns, the SSER's should certainly be available prior to making a determination regarding those concerns.

Further, it might be beneficial to the record if some limited discovery were allowed regarding these SSER's as they pertain to CASE's Contentions 5 and 22 and the concerns raised by Mark Walsh and Jack Doyle, as well as some cross-examination should it be necessary to complete the record, especially in regard to the bases for the Staff's positions.

(3)

Regulatory and procedural requirements which the Board must find are satisfied if it is to authorize the issuance of operating licenses for the Comanche Peak plant:

1. Many of these have been listed on pages 1 through 7, item (1) of this pleading.

2. Applicants' construction permits.

3. All site procedures which are applicable to any of the concerns raised by CASE's witnesses.

4. All ANSI/ASME regulations which are applicable to any of the concerns raised by CASE's witnesses.

5. All applicable NRC regulations, including but not limited to:
   10 CFR, Part 50, Appendix B, entire Appendix
   10 CFR, Part 50, Appendix A, especially Criteria 1, 2, 4
   10 CFR, Part 50, Appendix E
   10 CFR, Part 21
   10 CFR, 50.55(e)
   10 CFR, 50.100
   10 CFR, 50.109
   10 CFR, 50.57

6. The Atomic Energy Act of 1954, as amended, 42 U.S.C.

7. Houston Lighting & Power Company (South Texas Project, Units 1 and 2), CLI-80-32, 12NRC281, 291-92 (1980).

Regulatory and procedural requirements (continued):

8. NUREG-0885, published January 1982, "U. S. Nuclear Regulatory Commission Policy and Planning Guidance 1982," especially "Quality Assurance."

9. NRC Final Rule, "Protection of Employees Who Provide Information," effective October 12, 1982, FEDERAL REGISTER, Vol. 27, No. 135, July 14, 1982, 30452-30459.

10. All applicable requirements and regulations regarding emergency planning, including:

    a. NUREG-0654, Rev. 1, November 1980, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants"
    b. NRC Final Rule, "Emergency Planning and Preparedness," effective July 13, 1982, FEDERAL REGISTER, Vol. 47, No. 134, July 13, 1982, 30232-30236.

    c. Federal Emergency Management Agency National Radiological Emergency Preparedness/ Response Plan for Commercial Nuclear Power Plant Accidents (the Master Plan), FEDERAL REGISTER, 12/23/80, pages 84910 through 84917.

    d. In the Matter of The Cincinnati Gas & Electric Company, et al. (Wm. H. Zimmer Nuclear Power Station, Unit 1), Docket No. 50-358, June 21, 1982, LBP-82-48, especially pages 24 through 96.

    e. NRC/FEMA Memorandum of Understanding, FEDERAL REGISTER, January 24, 1980, 45FR17.

    f. NRC final Emergency Planning Regulations (10 CFR 50, 50.47), August 19, 1980, 45FR162.

CASE urges that the Board take whatever measures are necessary to assure that there is adequate time between the receiving of documents and the time motions or other pleadings are required to be received. For example, CASE notes that the results and report of the NRC special inspection to evaluate Applicants' response to IE Bulletin 79-14 is to be in an inspection report to be issued by Region IV, rather than in an SSER (see item 27, page 3 of this pleading). Normally CASE does not receive such documents from the NRC regional office until the 20-day waiting period for Applicants' review for proprietary information is up. This procedure would place CASE at an unfair disadvantage and also possibly delay these proceedings unless the Board orders that CASE receive this promptly and that Applicants waive the usual waiting period (at least in part).

There have also been lag times between the time the Board and other parties receive their copies of the SER's and SSER's and the time CASE receives its copy. We ask that the Board order that the SSER's be forwarded to CASE by overnight expedited delivery so that we will be on an equal footing with other parties in these proceedings.

Respectfully submitted,

Juanita Ellis

(Mrs.) Juanita Ellis, President
CASE (Citizens Association for Sound Energy)
1426 S. Polk
Dallas, TX 75224
214/946-9446

(NOTE: All parties should change their records to reflect that the work number indicated on previous pleadings should be removed - 214/941-1211. The writer quit her job 5/11/82 to work full-time on these proceedings.)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

APPLICATION OF TEXAS UTILITIES GENERATING COMPANY, ET AL. FOR AN OPERATING LICENSE FOR COMANCHE PEAK STEAM ELECTRIC STATION UNITS #1 AND #2 (CPSES)

Docket Nos. 50-445 and 50-446

CERTIFICATE OF SERVICE

By my signature below, I hereby certify that true and correct copies of CASE'S RESPONSE TO BOARD'S 9/22/82 MEMORANDUM AND ORDER FOR BRIEFS RE: NECESSARY DOCUMENTS AND INFORMATION have been sent to the names listed below this 9th day of October, 1982, by: Express Mail where indicated by * and First Class Mail elsewhere.

* Administrative Judge Marshall E. Miller
U. S. Nuclear Regulatory Commission
Atomic Safety and Licensing Board Panel
Washington, D. C. 20555

* Dr. Kenneth A. McCollom, Dean
Division of Engineering, Architecture, and Technology
Oklahoma State University
Stillwater, Oklahoma 74074

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Docketing and Service Section
Office of the Secretary
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Juanita Ellis

(Mrs.) Juanita Ellis, President
CASE (Citizens Association for Sound Energy)

NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TEXAS 76011

Juanita Ellis

Rcd. 9/20/82

August 31, 1982

Dockets: 50-445/82-13
50-446/82-07

CASE EXHIBIT 729

Texas Utilities Generating Company
ATTN: Mr. R. J. Gary, Executive Vice
President and General Manager
2001 Bryan Tower
Dallas, Texas 75201

Gentlemen:

This refers to the inspection conducted by Mr. D. P. Tomlinson, Ms. M. J. Roberds, and Ms. K. A. Whittlesey of our staff on July 9, 12, 20, 21, 26 through 29, August 2, and August 5, 1982, of activities authorized by NRC Construction Permits CPPR-126 and CPPR-127 for the Comanche Peak facility, Units 1 and 2, and to the discussion of our finding with Mr. R. G. Tolson of your staff at the conclusion of the inspection.

Areas examined during the inspection and our findings are documented in the enclosed inspection report. Within these areas, the inspection consisted of selective examination of procedures and representative records, interviews with personnel, and observations by the inspectors.

Within the scope of the inspection, no violations or deviations were identified.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room unless you notify this office, by telephone, within 10 days of the date of this letter and submit written application to withold information contained therein within 30 days of the date of this letter. Such application must be consistent with the requirements of 2.790(b)(1).

Should you have any questions concerning this inspection, we will be pleased to discuss them with you.

Sincerely,

G. L. Madsen, Chief
Reactor Project Branch 1

Enclosure:
Appendix - NRC Inspection Report 50-445/82-13
50-446/82-07

cc w/enclosure:
Texas Utilities Generating Company
ATTN: H. C. Schmidt, Project Manager
2001 Bryan Tower
Dallas, Texas 75201

APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-445/82-13
50-446/82-07

Docket: 50-445
50-446

Category A2

Licensee: Texas Utilities Generating Company
2001 Bryan Tower
Dallas, Texas 75201

Facility Name: Comahche Peak, Units 1 and 2

Inspection at: Comanche Peak Steam Electric Station

Inspection conducted: July 9, 12, 20, 21, 26 through 29, August 2, and August 5, 1982

Inspectors:

D. P. Tomlinson, Reactor Inspector, Engineering Section (para. 1, 2, 3, 4, 5, 6, 7, 8, & 9) — 8-26-82 Date

for L M Hammett

M. J. Roberds, Engineering Technician, Engineering Section (para. 2, 4, 5, 6, 7, 8, & 9) — 8/26/82 Date

K. A. Whittlesey, Reactor Inspector, Engineering Section (para. 2, 3, & 7) — 8/26/82 Date

Reviewed:

T. F. Westerman, Chief, Reactor Project Section A — 8-27-82 Date

Approved: D. M. Hunnicutt, Chief, Engineering Section — 8/26/82 Date

Inspection Summary

Inspection Conducted July 9, 12, 20, and 21, 1982 (Report 50-445/82-13)

Areas Inspected: Routine, unannounced inspection of construction activities including a site tour, review of procedures, review of quality records, observation of work in progress, and review of isometric drawings of components and piping to be examined during the Unit 1 preservice inspection. This inspection involved 48 inspector-hours by two NRC inspectors.

Results: Within the areas inspected, no violations or deviations were identified.

Inspection conducted July 26 through 29, August 2, and August 5, 1982 (Report 50-446/82-07)

Areas Inspected: Routine, unannounced inspection of construction activities including a site tour, review of procedures, review of quality records, examination of completed work, and observation of work in progress. This inspection involved 72 inspector-hours by two NRC inspectors.

Results: Within the areas inspected, no violations or deviations were identified.

DETAILS

1. Persons Contacted

Principal Licensee Employees

*R. G. Tolson, Site Quality Assurance Supervisor, TUGCO
B. G. Scott, Quality Engineering Supervisor, TUGCO
C. T. Brandt, QA/QC Supervisor - Mechanical/Civil, TUGCO
R. A. Perry, Quality Engineer, Preservice Inspection, TUGCO
W. Hartshorn, Quality Engineer, TUGCO

Other Personnel

D. A. Gulling, Preservice Inspection Coordinator, Westinghouse

*Denotes those attending exit interview on August 5, 1982

The NRC inspectors also contacted other licensee and contractor employees during the course of the inspection.

2. Site Tour

The NRC inspectors toured the Units 1 and 2 reactor buildings, auxiliary buildings, and three weld rod issue stations to observe construction in progress, inspect completed work, and observe general housekeeping conditions.

Within the areas inspected, no violations or deviations were identified.

3. Unit 1 Preservice Inspection

The NRC inspectors reviewed the examination program plan for the preservice inspection of Unit 1. This plan, prepared by Westinghouse Electric Corporation, Water Reactor Division, describes the type and extent of examination to be performed on each item during this inspection. ASME Class I and Class II components such as the reactor vessel, steam generators, pressurizer, reactor coolant pumps, valves, piping, and associated hardware are included in the program. The NRC inspector reviewed a series of isometric drawings of the components and piping to be inspected and noted that each weld has been assigned a unique number to assure positive identification for this and subsequent examinations.

At the time of this inspection the Westinghouse procedures for ultrasonic inspection had not received final approval and were not available for review. Westinghouse ISI-11, Revision 10, for liquid penetrant examination

was available and was reviewed. The essential elements for a meaningful inspection and the requirements for inspection personnel were included. The visual and liquid penetrant inspections had been completed on all of the Class I piping welds, but the NRC inspectors opted not to review the records of these until the ultrasonic inspection is in progress or completed and the total inspection record packages for the welds can be reviewed and inspection results compared.

No violations or deviations were identified.

4. Safety-Related Structures - Unit 1

The NRC inspectors toured the Unit 1 auxiliary building and selected nine welds, three on each of three piping supports, for observation of welding operations. The NRC inspectors, by reviewing the traveler packages with each support, verified the identification and location of each weld. The welding procedures in use and the individual welder's identification symbols were compared to the current site qualification matrix to assure that each welder was qualified to perform these operations. The weld filler material being used was found to be as specified in the instructions and on each of the filler material request sheets. No uncontrolled filler material or rod stubs were noted in the area.

No violations or deviations were noted.

5. Safety-Related Structures - Unit 2

The NRC inspectors toured the Unit 2 reactor building and auxiliary building and selected 16 welds, 2 on each of 8 piping supports, for observation of welding operations. Traveler packages for each support were at the job sites, and the work in progress was in accordance with the written instructions. The welds were noted to be identified and located per the attendant drawing for each support. The weld filler material was of the type specified. No uncontrolled rods or rod stubs were observed. The procedure numbers and welder symbols were compared to the qualification matrix. Each welder was found to be qualified to the procedure to which he was working.

The NRC inspectors selected eight completed welds on these same supports for visual examination. The size, shape, length, location, and reinforcement were found to be in accordance with the attendant drawing requirements and notes. No visible surface defects such as excessive undercut, laps,

lack of penetration, cracks or porosity were noted. The quality records for these eight welds were reviewed and found to be complete and adequate for the operations performed.

No violations or deviations were noted.

6. Safety-Related Structures Record Review - Unit 1

The NRC inspectors selected the final record packages for 10 completed piping supports for review. These record packages were retrieved from the record vault files in a timely manner and each package was found to contain an inspection report, as-built drawings, weld filler material sheets, warehouse requests, material identification log, and modification sheets, if applicable. Modification sheets and drawing revisions all contained the required signatures and approvals prior to the date of issuance. All records examined were complete, each entry agreed with available back-up documentation.

No violations or deviations were noted.

7. Personnel Qualification Units 1 and 2

During previous inspections, the NRC inspectors recorded the names of all inspectors and the symbols for all welders involved as well as the dates on which they performed their operations. A total of 7 inspection personnel and 22 welders were noted. These names and dates were compared to qualification records in the vault and each was found to be properly qualified at the time the welding or inspection was performed. Each inspector's file contained the results of a current eye examination for visual acuity and for color discrimination. In the case of one inspector, it was noted that he failed the color discrimination portion of the test but a waiver for this was included as color discrimination was not necessary for the visual inspections he was performing.

No violations or deviations were noted.

8. Weld Filler Material Control Units 1 and 2

The NRC inspectors visited the receiving inspection warehouse and "walked-through" an imaginary lot of weld filler material. This included the isolation of the material in the warehouse, the review of shipping documentation and test reports, verification of chemical content and physical properties data, and QC acceptance of the material. The NRC inspectors toured the locked storage area reserved for accepted material prior to issuance and noted that each lot and type was separated from others

and that each container was clearly marked. No opened or damaged containers were in evidence. The NRC inspectors toured all three onsite rod issue rooms and conducted informal interviews with the attendants. All appeared to have good knowledge of the procedural requirements and the importance of proper material control. In the 3 issue rooms, the NRC inspectors noted that all 10 rod ovens were operational, were equipped with thermometers, and were within the required temperature range. All 10 thermometers displayed stickers indicating current calibration. The doors on each rod oven were marked to indicate the material type and lot number contained in each. Isolated areas in each oven were noted to be reserved for returned material to prevent reissuance prior to the required rebake cycle. Returned rod stubs were placed in a special container and all partially-used rods were destroyed. Several containers of bare wire were inspected and individual rods were all found to have identifying tags that agreed with the identification on the containers. Warehouse release tags were noted on all containers in the rod issue rooms and no uncontrolled filler material was found during this inspection.

No violations or deviations were noted.

9. Exit Interview

An exit interview was conducted August 5, 1982, with those persons listed in paragraph 1. At this interview, the NRC inspectors discussed the scope of this inspection and the findings indicated in the previous paragraphs.

Approved by Council, August 12, 1974

Case 1644
Additional Materials for Component Supports
Section III Subsection NF Class 1 2, 3, and MC Construction

Inquiry: What materials, in addition to those listed in Tables I-11.0, I-12.0, and I-13.0 of Appendix I of Section III, may be used for Class 1, 2, 3, or MC component supports constructed to the requirements of Subsection NF of Section III?

Reply: It is the opinion of the Committee that the additional materials, design stress intensity and allowable stress values, and the yield strength values listed in Tables 1, 2, 3, and 4 may be used in the construction of Class 1, 2, 3, and MC Component supports for Section III in addition to those listed in Table NF-2121(a)-1 of Section III.

The following additional requirements shall apply:

(1) All other requirements of Subsection NF shall be met.

(2) Until rules are added, welding is not permitted on carbon and low alloy steels containing more than 0.35 percent carbon, nor on PH[1] or age-hardened[1] steels, nor on materials to Specifications ASTM A514-70 and SA-592.

(3) When the Nominal Composition column references AISI grades, only materials meeting the chemical composition requirements of the specific AISI grades listed shall be used, with the exception that 0.60 maximum silicon is permitted for castings.

(4) When welding on A487-72 Grade 10Q, SA-508 Class 4, A508-69 Class 4a and A543-72a Class 1 and 2, the following additional requirements shall apply:

(a) Welding procedure qualification and welder and welding operator qualification shall be made in accordance with Section IX of the Code as modified by Section III and as given herein.

(b) Separate welding procedure qualification of Section IX of the Code shall be required for these materials and combinations of other materials with these materials. When joints are made between two different types or grades of base material, a procedure qualification must be made for applicable combinations of materials even though procedure qualification tests have been made for each of the two base materials welded to itself. (Materials of the same nominal chemical analysis and mechanical properties range even though of different product form may be considered as the same type or grade.)

(c) The following, in addition to the variables in Sec. IX, QW-250, shall be considered as essential variables requiring re-qualification of the welding process.

1. A change in filler metal SFA classification or to a weld metal not covered by an SFA specification.

2. An increase in the maximum or a decrease in the minimum specified preheat or interpass temperatures. The specified range of preheat temperatures shall not exceed 150 F.

3. A change in the heat treatment (procedure qualification tests shall be subjected to heat-treatment essentially equivalent to that encountered in fabrication of the vessel or vessel parts including the maximum total aggregate time at temperature or temperatures and cooling rates).

4. A change in the types of current (AC or DC) polarity, or a change in the specified range for amperage, volt, or travel speed.

5. A change in the thickness (T) of the welding procedure qualification test plate as follows:

(a) For welded joints which are Q and T after welding, any increase in thickness (the minimum thickness qualified in all cases is ½ in.).

(b) For welded joints which are not Q and T after welding, any change as follows:

T	
less than 5/8 in.	Any decrease in thickness (The maximum thickness qualified is $2T$)
5/8 in and over	Any departure from the range of 5/8 in. to $2T$.

[1] The designer shall consider the effects of temperature, environment and applied stress on the material properties of precipitation or age hardening alloys, or on other high strength heat-treated alloys.

Meeting of June 21, 1974

(d) Welding filler metal containing more than 0.06 percent vanadium shall not be used.

(e) In addition to the requirements of NB-4410 of Section III of the Code, the materials may require rebaking in order to minimize moisture. The procedures for doing this for covered arc welding electrodes are given in Specifications SFA-5.1 and SFA-5.5.

(f) The radius of the mandrel or die used in the guided bend tests of Section IX, Figs. QW-466.1, QW-466.2, and QW-466.3 shall be:

Thickness of Specimen, in.	A in.	B in.	C in.	D in.
3/8	$2\frac{1}{2}$	$1\frac{1}{4}$	$3\frac{3}{8}$	$1\frac{11}{16}$
t	$6\frac{2}{3}t$	$3\frac{1}{3}t$	$8\frac{2}{3}t$	$4\frac{1}{4}t$
			$+\frac{1}{8}$	$+\frac{1}{16}$

(g) The final postweld heat treatment shall be at a minimum temperature of 1075 F and a maximum temperature limited only by the ability to meet the specified mechanical properties. Minimum holding time at the final postweld heat treating temperature shall be one hour per inch of weld thickness, one hour minimum.

(5) Design of Bolted Connections shall be in accordance with Appendix XVII-2460, using yield strength given in Table 4, multiplied by 0.40 and 0.15 to obtain allowable tension and shear stresses, respectively. When the shear plane does not cross the threaded portion of that bolt, a factor of 0.25 may be used for the allowable shear stress.

(6) All supports and component standard supports used under the provisions of this Case shall be marked with this Case number.

TABLE 1

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Stress, ksi	Min Ultimate Tensile Stress, ksi	Design Stress Intensity, ksi (multiply by 1000 to obtain psi) For metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Low Alloy Steels																			
AISI 4140, 4130, 4330, 4340			Casting	A148-71	105-85	–	2	85	105	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	–	–
AISI 4140, 4130, 4330, 4340			Casting	A148-71	120-95	–	1,2	95	120	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	–	–
AISI 4140, 4130, 4330, 4340			Casting	A148-71	150-125	–	1,2	125	150	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	–	–
9Cr-1Mo	5	2	Casting	SA-217	C1.2	–	–	60	90	30.0	29.8	28.3	28.3	28.3	28.3	28.0	27.4	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	28.3	28.3	28.3	28.3	28.3	27.8	27.2	26.7	–	–
Mn-¼ Mo	10F	6	Casting	SA-487	2N	–	–	53	85	28.3	28.3	28.3	28.2	28.2	27.3	26.9	26.5	–	–
Ni-Cr-Mo			Casting	A487-72	10Q	–	1	100	125	41.7	41.7	41.7	41.7	41.7	41.7	41.7	41.7	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105	35.0	35.0	35.0	34.6	34.4	33.9	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
			Plate	A514-70	all	–	1,2,3	100	115	38.3	38.3	38.3	38.3	38.3	38.1	37.2	36.4	–	–
			Plate	A514-70	all	–	1,2,4	90	105	35.0	35.0	35.0	35.0	35.0	34.8	34.0	33.2	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	35.0	35.0	35.0	34.6	34.4	33.9	–	–	–	–
Ni-Cr-Mo			Plate,	A543-72a	–	2	–	100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
			Plate, Shapes	A572-73	–	42	–	42	60	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	–	–
			Plates, Shapes	A572-73	–	50	–	50	65	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	–	–
			Plate, Shapes	A588-71	A,B	–	–	42	63	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	–	–
			Plate, Shapes	A588-71	A,B	–	–	46	67	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	–	–
			Plate, Shapes	A588-71	A,B	–	–	50	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	–	–

Notes

1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined from the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ in. to 4 in.

TABLE 2

Allowable Stress Values, S, for Ferritic Steels for Classes 1, 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) For metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
AISI 4130 4140,4330, 4340			Casting	A148-71	105-85	–	2	85	105	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	–	–
AISI 4130, 4140,4330, 4340			Casting	A148-71	120-95	–	1,2	95	120	30.0	30.0	30.0	30.0		30.0	30.0	30.0	–	–
AISI 4130, 4140,4330, 4340			Casting	A148-71	150-125	–	1,2	125	150	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	–	–
9 Cr-1 Mo	5	2	Casting	SA-217	C1.2	–	–	60	90	22.5	22.4	21.2	21.2	21.2	21.2	21.0	20.6	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	21.2	20.1	19.6	19.6	19.6	19.2	18.8	18.3	–	–
Mn-Mo	10F	6	Casting	SA-487	2N	–	–	53	85	21.2	21.2	21.2	21.2	21.1	21.1	21.1	21.1	–	–
Ni-Cr-Mo			Casting	A487-72	10Q	–	1	100	125	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105	26.2	26.2	26.2	26.0	25.8	25.4	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	28.7	28.7	28.7	28.4	28.2	27.8	–	–	–	–
			Plate	A514-70	all	–	1,2,3	100	115	28.7	27.7	26.7	26.0	26.0	26.0	25.0	23.6	–	–
			Plate	A514-70	all	–	1,2,4	90	105	26.2	25.2	24.4	23.7	23.7	23.7	22.8	21.6	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	26.2	26.2	26.2	26.0	25.8	25.4	25.1	24.7	–	–
Ni-Cr-Mo			Plate	A543-72a	–	2	1	100	115	28.7	28.7	28.7	28.4	28.2	27.8	27.5	27.0	–	–
			Plate, Shapes	A572-73	–	42	–	42	60	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	–	–
			Plate, Shapes	A572-73	–	50	–	50	65	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	–	–
			Plate, Shapes	A588-71	A,B	–	–	42	63	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	–	–
			Plate, Shapes	A588-71	A,B	–	–	46	67	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
			Plate, Shapes	A588-71	A,B	–	–	50	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5

Notes

1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ in. to 4 in.

TABLE 3

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength ksi (Multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
			Pipe	A381-73	–	Y35	–	35	60	35.0	31.9	31.0	30.0	28.3	25.4	25.4	25.2	–	–
	1	1	Bar	SA-306	65	–	–	32.5	65	32.5	29.6	28.8	27.9	26.1	24.0	23.7	23.4	–	–
	1	1	Bar	SA-306	70	–	–	35	70	35.0	31.9	31.0	30.0	28.3	25.9	25.4	25.2	–	–
	1	1	Pipe	SA-524	I	–	–	35	60	35.0	31.9	31.0	30.0	28.3	25.9	25.4	25.2	–	–
	1	1	Pipe	SA-524	II	–	–	30	55	30.0	27.3	26.6	25.7	24.2	22.2	21.8	21.6	–	–
AISI 1020,1030			Forging	A668-72	–	C	–	33	66	33.0	30.1	29.2	28.3	26.5	24.4	24.1	23.8	–	–
AISI 1020,1030			Forging	A668-72	–	D	–	37.5	75	37.5	34.2	33.2	32.1	30.3	27.7	27.2	27.0	–	–
Low Alloy Steels																			
AISI 4130,4140 4330,4340			Casting	A148-71	105-85	–	2	85	105	85.0	82.5	79.2	74.8	71.0	70.5	70.5	70.5	–	–
AISI 4130,4140 4330,4340			Casting	A148-71	120-95	–	1,2	95	120	95.0	92.1	88.5	83.5	79.3	78.9	78.9	78.9	–	–
AISI 4130,4140, 4330,4340			Casting	A148-71	150-125	–	1,2	125	150	125.0	121.1	116.5	110.0	104.3	103.9	103.9	103.9	–	–
9 Cr-1 Mo	5	2	Casting	SA-217	C12	–	–	60	90	60.0	54.0	51.3	51.3	51.3	51.3	51.3	50.5	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	55.0	52.1	49.9	46.6	43.5	41.7	40.8	40.0	–	–
Mn-¼ Mo	10F	6	Casting	SA-487	2N	–	–	53	85	53.0	50.4	48.1	45.2	42.3	41.0	40.4	39.8	–	–
Ni-Cr-Mo			Casting	A-487-72	10Q	–	1	100	125	100.0	97.0	93.2	88.0	83.5	83.0	83.0	83.0	–	–
Ni-Cr-Mo	3	3	Forging	SA-508	–	2	–	50	80	50.0	47.1	45.2	44.5	43.2	42.0	41.4	40.6	–	–
Ni-Cr-Mo	3	3	Forging	SA-508	–	3	–	50	80	50.0	47.1	45.2	44.5	43.2	42.0	41.4	40.6	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105	85.0	80.0	77.5	75.8	74.5	73.2	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	100.0	94.2	91.2	89.2	87.7	86.1	–	–	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	85.0	80.0	77.5	75.8	74.5	73.2	–	–	–	–
Ni-Cr-Mo			Plate	A543-72a	–	2	1	100	115	100.0	94.2	91.2	89.2	87.7	86.1	–	–	–	–
			Plate	A514-70	all	–	1,2,3	100	115	100.0	95.8	93.0	90.2	89.5	87.5	86.0	84.4	–	–

TABLE 3 (Cont'd)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
			Plate	A514-70	all	–	1,2,4	90	105	90.0	86.1	83.6	81.1	80.5	78.8	77.4	75.4	–	–
			Forging	SA-592	A,E,F	–	1,2	100	115	100.0	95.8	93.0	90.2	89.5	87.5	86.0	84.4	–	–
			Forging	SA-592	A,E,F	–	1,2	90	105	90.0	86.1	83.6	81.1	80.5	78.8	77.4	75.4	–	–
AISI 4140 4145,4340			Bar	A434-64	–	BB	1,2	90	110	90.0	84.1	81.3	79.0	76.6	73.3	71.0	68.4	–	–
			Bar	A434-64	–	BB	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
			Bar	A434-64	–	BB	2	75	100	75.0	70.1	67.7	65.8	63.8	61.0	59.1	57.0	–	–
			Bar	A434-64	–	BB	2	75	95	75.0	70.1	67.7	65.8	63.8	61.0	59.0	57.0	–	–
			Bar	A434-64	–	BB	2	65	90	65.0	60.7	58.6	57.1	55.3	52.9	51.2	49.4	–	–
AISI 4140, 4145, 4340			Bar	A434-64	–	BC	1,2	110	130	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
			Bar	A434-64	–	BC	1,2	105	125	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Bar	A434-64	–	BC	1,2	95	115	95.0	88.5	85.4	83.0	80.6	77.0	74.6	72.0	–	–
			Bar	A434-64	–	BC	2	85	110	85.0	79.5	76.8	74.6	72.4	69.1	67.0	64.6	–	–
			Bar	A434-64	–	BC	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
AISI 4140, 4145, 4340			Bar	A434-64	–	BD	1,2	130	155	130.0	121.5	117.2	114.1	110.7	105.7	102.5	98.8	–	–
			Bar	A434-64	–	BD	1,2	120	150	120.0	112.1	108.4	105.2	102.1	97.6	94.6	91.1	–	–
			Bar	A434-64	–	BD	1,2	110	140	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
			Bar	A434-64	–	BD	1,2	105	135	105.0	98.1	94.8	92.2	89.4	88.5	82.9	79.8	–	–
			Bar	A434-64	–	BD	1,2	100	130	100.0	93.5	90.3	87.8	85.1	81.4	78.9	76.0	–	–
			Bar	SA-540	B21,B22, B23,B24	1	1,2	150	165	150.0	140.1	135.3	131.7	127.7	122.6	118.2	114.0	–	–
			Bar	SA-540	B21,B22, B23,B24	2	1,2	140	155	140.0	131.0	126.3	123.0	119.1	114.0	110.4	106.3	–	–
			Bar	SA-540	B21,B22, B23,B24	3	1,2	130	145	130.0	121.5	117.2	114.1	110.7	103.7	102.5	98.8	–	–
			Bar	SA-540	B21,B22, B23,B24	1	1,2	120	135	120.0	112.1	108.4	103.2	102.1	97.6	94.6	91.1	–	–
			Bar	SA-540	B21,B22, B23,B24	5	1,2	100	115	100.0	93.5	90.3	87.8	85.1	81.4	78.9	76.0	–	–
			Bar	SA-540	B21,B22, B23,B24	5	1,2	105	120	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Plate,Bar Shapes	A572-73	42	–		42	60	42.0	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
			Plate,Bar Shapes	A572-73	50	–		50	65	50.0	47.5	45.6	43.8	41.8	39.9	38.9	37.9	–	–

TABLE 3 (Cont'd)

Yield Strength Values, S_Y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength	Min Ultimate Tensile Strength	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
			Plate,Bar Shapes	A588-71	A,B	–		42	63	42.0	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
			Plate,Bar Shapes	A588-71	A,B	–		46	67	46.0	43.8	41.9	40.3	38.6	36.7	35.8	34.8	–	–
			Plate,Bar Shapes	A588-71	A,B	–		50	70	50.0	47.5	45.6	43.0	41.8	39.9	38.9	37.9	–	–
			Tube	A618-73	II	–		50	70	50.0	–	–	–	–	–	–	–	–	–
			Tube	A618-73	III	–		50	65	50.0	–	–	–	–	–	–	–	–	–
			Forging	A471-70	–	6	1,2	125	140	125.0	117.8	114.9	111.5	109.7	107.8	106.2	104.8	–	–
			Forging	A471-70	–	7	1,2	135	150	135.0	127.1	123.0	120.3	118.3	116.2	114.8	113.1	–	–
			Forging	A471-70	–	8	1,2	145	160	145.0	136.6	132.2	129.3	127.1	124.9	123.2	121.8	–	–
			Forging	A471-70	–	9	1,2	155	170	155.0	146.0	141.2	138.1	136.0	133.5	131.8	130.0	–	–
AISI 4140, 4340,8620			Forging	A668-72	K	–	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
			Forging	A668-72	K	–	2	75	100	75.0	70.1	67.7	65.8	63.8	61.0	59.0	57.0	–	–
AISI 4140, 4340			Forging	A668-72	L	–	1,2	105	125	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Forging	A668-72	L	–	1,2	95	115	95.0	88.5	85.4	83.0	80.6	77.0	74.6	72.0	–	–
			Forging	A668-72	L	–	1,2	85	110	85.0	79.5	76.8	74.6	72.4	69.1	67.0	64.6	–	–
AISI 4340			Forging	A668-72	M	–	1,2	120	145	120.0	112.1	108.4	105.2	102.1	97.6	94.6	91.1	–	–
AISI 4340			Forging	A668-72	M	–	1,2	115	140	115.0	107.5	103.8	101.0	98.0	93.6	90.0	87.5	–	–
AISI 4340			Forging	A668-72	M	–	1,2	110	135	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
AISI 4340			Forging	A668-72	N	–	1,2	140	170	140.0	131.0	126.3	123.0	119.1	114.0	110.4	106.3	–	–
AISI 4340			Fogeing	A668-72	N	–	1,2	135	165	135.0	126.1	121.9	118.5	115.0	108.9	106.5	102.7	–	–
AISI 4340			Forging	A668-72	N	–	1,2	130	160	130.0	121.5	117.2	114.1	110.7	105.7	102.5	98.8	–	–
High Alloy Steels																			
Precipitation Hardened Steels																			
			Bar,Forg.	SA-564	630	–	1,2	105	135	105.0	97.1	93.0	89.8	87.6	84.7	83.6	82.6	–	–
			Bar,Forg.	SA-564	630	–	1,2	115	140	115.0	106.3	101.9	98.3	95.2	92.8	91.5	90.5	–	–
			Bar,Forg.	SA-564	630	–	1,2	125	145	125.0	115.6	110.7	106.9	103.5	100.9	99.5	98.5	–	–
			Bar,Forg.	A564-72	XM12	–	1,2	145	155	145.0	136.0	130.7	125.8	121.7	117.2	115.2	112.9	–	–
			Bar,Forg.	A564-72	XM12	–	1,2	125	145	125.0	117.1	112.6	108.3	104.8	101.0	99.5	97.2	–	–
			Bar,Forg.	A564-72	XM13	–	1,2,5	165	175	165.0	154.6	148.5	143.0	138.1	133.8	131.1	128.4	–	–

Notes

1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ to 4 in.
5. A564 Type XM-13 shall be modified so that age hardening shall be at 1050 F, only.

TABLE 4

Yield Strength Values, S_y, for Bolting Materials for Classes 1, 2, 3, and MC Supports[5]

Nominal Composition	P-No.	Group No.	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength ksi (multiply by 1000 to obtain psi). For metal temperatures, F, not to exceed									
									100	200	300	400	500	600	650	700	750	800
Carbon Steels																		
	1	1	SA-307	B	–	1	36	58	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
Low Alloy Steels																		
AISI 4140,4340			SA-354	BB	–	2	83	105	83.0	77.5	74.9	72.8	70.6	67.5	65.5	63.0	–	–
AISI 4340			SA-354	BB	–	2	78	100	78.0	72.9	70.4	68.5	66.4	63.5	61.5	59.3	–	–
AISI 4340			SA-354	BC	–	2,6	109	125	109.0	102.0	98.5	95.6	92.8	88.7	86.0	82.9	–	–
AISI 4340			SA-354	BC	–	2,6	99	115	99.0	92.5	89.4	86.9	84.3	80.5	78.1	75.3	–	–
AISI 4340			SA-354	BD	–	2,6	125	150	125.0	116.9	112.9	109.8	106.5	101.8	98.6	95.0	–	–
AISI 4135, 4140,4340			A490-71	–	–	2,4,6	130	150	130.0	121.5	117.2	114.1	110.7	108.7	102.5	98.8	–	–
Precipitation Hardened Steels																		
			A564-72	XM-13	–	2,3,6	165	175	165.0	154.6	148.5	143.0	138.1	133.3	131.1	128.4		

Notes
1. All A307 bolts shall, in addition, meet both the chemical and mechanical requirements for SA-36 bar material. Welding is permitted.
2. No welding permitted.
3. A564, Type XM-13, shall be modified so that age hardening shall be at 1050 F, only.
4. Minimum Tempering Temperature shall be 850 F.
5. Allowable tension and shear stresses may be obtained by multiplying these yield strength values by 0.40 and 0.15 respectively. When the shear plane does not cross the threading, a factor of 0.25 may be used for allowable shear stress.
6. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the applicable Tables in SA-370.

CASE 1644-3

Approved by Council, November 3, 1975

Case 1644-3
Additional Materials for Component Supports
Section III Subsection NF Class, 1 2, 3, and MC Construction

Inquiry: What materials, in addition to those listed in Tables I-11.0, I-12.0, and I-13.0 of Appendix I of Section III, may be used for Class 1, 2, 3, or MC component supports constructed to the requirements of Subsection NF of Section III?

Reply: It is the opinion of the Committee that the additional materials, design stress intensity and allowable stress values, and the yield strength values listed in Tables 1, 2, 3, and 4 may be used in the construction of Class 1, 2, 3, and MC Component supports for Section III in addition to those listed in Table NF-2121(a)-1 of Section III.

The following additional requirements shall apply:

(1) All other requirements of Subsection NF shall be met including NF-2585, where applicable.

(2) Until rules are added, welding is not permitted on carbon and low alloy steels containing more than 0.35 percent carbon, nor on PH[1] or age-hardened[1] steels, nor on materials to Specifications ASTM A514-70 and SA-592, nor on the free machining[1] steels permitted in (3) below.

(3) When the Nominal Composition column references AISI grades, only materials meeting the chemical composition requirements of the specific AISI grades listed shall be used, with the exception that 0.60 maximum silicon is permitted for castings. Free machining[1] modifications of the specific AISI grades listed may be used at the same design stress intensities, allowable stresses and yield strengths of the reference grades but their use is limited to 400 F maximum temperature.

(4) When welding on A487-72 Grade 10Q, SA-508 Class 4, A508-69 Class 4a and A543-72a Class 1 and 2, the following additional requirements shall apply:

(a) Welding procedure qualification and welder and welding operator qualification shall be made in accordance with Section IX as modified by Section III and as given herein.

(b) Separate welding procedure qualification of Section IX shall be required for these materials and combinations of other materials with these materials. When joints are made between two different types or grades of base material, a procedure qualification must be made for applicable combinations of materials even though procedure qualification tests have been made for each of the two base materials welded to itself. (Materials of the same nominal chemical analysis and mechanical properties range even though of different product form may be considered as the same type or grade.)

(c) The following, in addition to the variables in Sec. IX, QW-250, shall be considered as essential variables requiring re-qualification of the welding process.

1. A change in filler metal SFA classification or to a weld metal not covered by an SFA specification.

2. An increase in the maximum or a decrease in the minimum specified preheat or interpass temperatures. The specified range of preheat temperatures shall not exceed 150 F.

3. A change in the heat treatment (procedure qualification tests shall be subjected to heat-treatment essentially equivalent to that encountered in fabrication of the vessel or vessel parts including the maximum total aggregate time at temperature or temperatures and cooling rates).

4. A change in the types of current (AC or DC) polarity, or a change in the specified range for amperage, volt, or travel speed.

5. A change in the thickness (T) of the welding procedure qualification test plate as follows:

(a) For welded joints which are Q and T after welding, any increase in thickness (the minimum thickness qualified in all cases is ½ in.).

(b) For welded joints which are not Q and T after welding, any change as follows:

[1]The designer shall consider the effects of temperature, environment and applied stress on the material properties of precipitation or age hardening alloys, on other high strength heat treated alloys, or on freemachining steels.

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T	
less than 5/8 in.	Any decrease in thickness (The maximum thickness qualified is $2T$)
5/8 in and over	Any departure from the range of 5/8 in. to $2T$.

(d) Welding filler metal containing more than 0.06 percent vanadium shall not be used.

(e) In addition to the requirements of NB-4410 of Section III, the materials may require rebaking in order to minimize moisture. The procedures for doing this for covered arc welding electrodes are given in Specifications SFA-5.1 and SFA-5.5.

(f) The radius of the mandrel or die used in the guided bend tests of Section IX, Figs. QW-466.1, QW-466.2, and QW-466.3 shall be:

Thickness of Specimen, in.	A in.	B in.	C in.	D in.
3/8	$2\frac{1}{2}$	$1\frac{1}{4}$	$3\frac{3}{8}$	$1\frac{11}{16}$
t	$6\frac{2}{3}t$	$3\frac{1}{3}t$	$8\frac{2}{3}t$	$4\frac{1}{4}t$
			$+\frac{1}{8}$	$+\frac{1}{16}$

(g) The final postweld heat treatment shall be at a minimum temperature of 1075 F and a maximum temperature limited only by the ability to meet the specified mechanical properties. Minimum holding time at the final postweld heat treating temperature shall be one hour per inch of weld thickness, one hour minimum.

(5) Design of bolted connections shall be in accordance with Appendix XVII-2460, using yield strength given in Table 4, multiplied by 0.40 and 0.15 to obtain allowable tension and shear stresses, respectively. When the shear plane does not cross the threaded portion of that bolt, a factor of 0.25 may be used for the allowable shear stress.

(6) When the ASTM specification referenced in Tables 1 through 4 does not specify minimum tensile and yield strengths, the values listed under the appropriate columns shall be met by the material.

(7) Materials in Tables 1 through 4 whose nominal composition is referenced as an AISI composition may be accepted as satisfying the requirements of the ASTM specification provided the chemical requirements of the AISI specification are within the specified range of the designated ASTM specification, and certification of the material shall be in accordance with the requirements of NA-3767.4(e) or (f). The term "each piece of stock material" in NA-3767.4(e) may be taken to refer to that portion of the material of the same heat and lot which has traceability established by the Manufacturer through his program. Where Certificates of Compliance are acceptable under Subsection NF, testing of each piece is not required.

(8) All supports and component standard supports used under the provisions of this Case shall be marked with this Case number.

TABLE 1

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Stress, ksi	Min Ultimate Tensile Stress, ksi	Design Stress Intensity, ksi (multiply by 1000 to obtain psi) For metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Low Alloy Steels																			
AISI 4140, 4130, 4330, 4340			Casting	A148-71	90-60	–	2	60	90	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	–	–
			Casting	A148-71	105-85	–	2	85	105	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	–	–
			Casting	A148-71	120-95	–	1,2	95	120	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	–	–
			Casting	A148-71	150-125	–	1,2	125	150	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	–	–
9Cr-1Mo	5	2	Casting	SA-217	C12	–	–	60	90	30.0	29.8	28.3	28.3	28.3	28.3	28.0	27.4	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	28.3	28.3	28.3	28.3	28.3	27.8	27.2	26.7	–	–
Mn-¼Mo	10F	6	Casting	SA-487	2N	–	–	53	85	28.3	28.3	28.3	28.2	28.2	27.3	26.9	26.5	–	–
Ni-Cr-Mo			Casting	A487-72	10Q	–	1	100	125	41.7	41.7	41.7	41.7	41.7	41.7	41.7	41.7	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105	35.0	35.0	35.0	34.6	34.4	33.9	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
			Plate	A514-70	All	–	1,2,3	100	115	38.3	38.3	38.3	38.3	38.3	38.1	37.2	36.4	–	–
			Plate	A514-70	All	–	1,2,4	90	105	35.0	35.0	35.0	35.0	35.0	34.8	34.0	33.2	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	35.0	35.0	35.0	34.6	34.4	33.9	–	–	–	–
Ni-Cr-Mo			Plate	A543-72a	–	2	–	100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
5Ni-Cr-Mo-V			Forging	A579	12a	–	1,2	140	150	50.0	49.5	48.0	47.0	47.0	47.0	46.0	46.0	–	–
			Plate, Shapes	A572-73	–	42	–	42	60	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	–	–
			Plates, Shapes	A572-73	–	50	–	50	65	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	–	–
			Plate, Shapes	A588-71	A,B	–	–	42	63	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	–	–
			Plate, Shapes	A588-71	A,B	–	–	46	67	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	–	–
			Plate, Shapes	A588-71	A,B	–	–	50	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	–	–

TABLE 1 (Cont'd)

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Stress, ksi	Min Ultimate Tensile Stress, ksi	Design Stress Intensity, ksi (multiply by 1000 to obtain psi) For metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
V-N			Plate	A633	E	–	5	60	80	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.4	–	–
AISI 1018			Bar	A108	1018	–	5,6	40	60	20.0	20.0	20.0	–	–	–	–	–	–	–
			Tube	A519	1018	–	5,7	50	70	23.3	23.3	23.3	–	–	–	–	–	–	–
Copper and Copper Alloys																			
80-10-10			Casting	B584	937	–	–	12	30	8.0	7.8	7.0	6.8	–	–	–	–	–	–

Notes
1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined from the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ in. to 4 in.
5. These materials are limited to non-welded construction and for use only for snubbers.
6. Max BHN 175.
7. Max BHN 197.

TABLE 2

Allowable Stress Values, S, for Ferritic Steels for Classes 1, 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) For metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Low Alloy Steels																			
			Casting	A148-71	90-60	–	2	60	90	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	–	–
AISI 4130, 4140, 4330, 4340			Casting	A148-71	105-85	–	2	85	105	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	–	–
			Casting	A148-71	120-95	–	1,2	95	120	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	–	–
			Casting	A148-71	150-125	–	1,2	125	150	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	–	–
9Cr-1Mo	5	2	Casting	SA-217	C12	–	–	60	90	22.5	22.4	21.2	21.2	21.2	21.2	21.0	20.6	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	21.2	20.1	19.6	19.6	19.6	19.2	18.8	18.3	–	–
Mn-Mo	10F	6	Casting	SA-487	2N	–	–	53	85	21.2	21.2	21.2	21.2	21.1	21.1	21.1	21.1	–	–
Ni-Cr-Mo			Casting	A487-72	10Q	–	1	100	125	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105[4]	26.2	26.2	26.2	26.0	25.8	25.4	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	28.7	28.7	28.7	28.4	28.2	27.8	–	–	–	–
			Plate	A514-70	All	–	1,2,3	100	115	23.7	27.7	26.7	26.0	26.0	26.0	25.9	23.6	–	–
			Plate	A514-70	All	–	1,2,4	90	105	26.2	25.2	24.4	23.7	23.7	23.7	22.8	21.6	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	26.2	26.2	26.2	26.0	25.8	25.4	25.1	24.7	–	–
Ni-Cr-Mo			Plate	A543-72a	–	2	1	100	115	28.7	28.7	28.7	28.4	28.2	27.8	27.5	27.0	–	–
3Ni-Cr-Mo-V			Forging	A579	12a	–	1,2	140	150	37.5	37.1	36.0	35.1	35.1	35.1	33.5	33.0	–	–
			Plate, Shapes	A572-73	–	42	–	42	60	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	–	–
			Plate, Shapes	A572-73	–	50	–	50	65	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	–	–
			Plate, Shapes	A588-71	A,B	–	–	42	63	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	–	–
			Plate, Shapes	A588-71	A,B	–	–	46	67	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
			Plate, Shapes	A588-71	A,B	–	–	50	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5

TABLE 2 (Cont'd)

Allowable Stress Values, S, for Ferritic Steels for Classes 1, 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	P. No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) For metal temperature, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
V-N			Plate	A633	E	–	5	60	80	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	–	–
AISI 1018			Bar	A108	1018	–	5,6	40	60	15.0	15.0	15.0	–	–	–	–	–	–	–
			Tube	A519	1018CW	–	5,7	50	70	17.5	17.5	17.5	–	–	–	–	–	–	–
Copper and Copper Alloys																			
80-10-10			Casting	B584	937	–	–	12	30	7.5	7.3	6.6	6.4	–	–	–	–	–	–

Notes
1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ in. to 4 in.
5. These materials are limited to non-welded construction and for use only for snubbers.
6. Max BHN 175.
7. Max BHN 197.

TABLE 3

Yield Strength Values, S_y, for Materials for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength ksi (Multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Copper and Copper Alloys																			
80-10-10			Casting	B584-73	937	–	–	12	30	12.0	11.7	10.6	10.2	–	–	–	–	–	–
			Th.Sh.	A500-74a	B	–	–	42	58	42.0	38.3	37.2	35.9	33.9	31.0	30.4	30.2	–	–
			Th.Sh.	A500-74a	C	–	–	46	62	46.0	41.9	40.8	39.4	37.2	34.0	33.3	33.1	–	–
			Str.Th.	A501-74	–	–	–	36	58	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
Carbon Steels																			
			Pipe	A381-73	–	Y35	–	35	60	35.0	31.9	31.0	30.0	28.3	25.4	25.4	25.2	–	–
	1	1	Bar	SA-306	65	–	–	32.5	65	32.5	29.6	28.8	27.9	26.1	24.0	23.7	23.4	–	–
	1	2	Bar	SA-306	70	–	–	35	70	35.0	31.9	31.0	30.0	28.3	25.9	25.4	25.2	–	–
	–	–	Bar	A306-72	75	–	–	37	75	37.0	33.7	32.8	31.7	29.9	27.4	26.9	26.6	–	–
	1	1	Pipe	SA-524	I	–	–	35	60	35.0	31.9	31.0	30.0	28.3	25.9	25.4	25.2	–	–
	1	1	Pipe	SA-524	II	–	–	30	55	30.0	27.3	26.6	25.7	24.2	22.2	21.8	21.6	–	–
AISI 1020,1030			Forging	A668-72	–	C	–	33	66	33.0	30.1	29.2	28.3	26.5	24.4	24.1	23.8	–	–
AISI 1020,1030			Forging	A668-72	–	D	–	37.5	75	37.5	34.2	33.2	32.1	30.3	27.7	27.2	27.0	–	–
ANSI 1035			Forging	A668-72	–	F	2	50	85	50.0	45.6	44.3	42.3	40.4	36.9	36.3	36.0	–	–
AISI 1018			Bar	A108	1018	–	6,7	40	60	40.0	37.7	36.2	–	–	–	–	–	–	–
AISI 1018			Tube	A519	1018CW	–	6,8	50	70	50.0	44.1	40.5	–	–	–	–	–	–	–
Low Alloy Steels																			
V-N			Plate	A633	E	–	5	60	80	60.0	54.5	50.1	45.6	41.5	40.7	40.3	39.7	–	–
AISI 4130,4140 4330,4340			Casting	A148-71	90-60	–	2	60	90	60.0	58.2	55.9	52.8	50.1	49.8	49.8	49.8	–	–
			Casting	A148-71	105-85	–	2	85	105	85.0	82.5	79.2	74.8	71.0	70.5	70.5	70.5	–	–
			Casting	A148-71	120-95	–	1,2	95	120	95.0	92.1	88.5	83.5	79.3	78.9	78.9	78.9	–	–
			Casting	A148-71	150-125	–	1,2	125	150	125.0	121.1	116.5	110.0	104.3	103.9	103.9	103.9	–	–
9 Cr-1 Mo	5	2	Casting	SA-217	C12	–	–	60	90	60.0	54.0	51.3	51.3	51.3	51.3	51.3	50.5	–	–
Mn-V	10A	1	Casting	SA-487	1N	–	–	55	85	55.0	52.1	49.9	46.6	43.5	41.7	40.8	40.0	–	–
Mn-¼ Mo	10F	6	Casting	SA-487	2N	–	–	53	85	53.0	50.4	48.1	45.2	42.3	41.0	40.1	39.8	–	–

TABLE 3 (Cont'd)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Ni-Cr-Mo			Casting	A-487-72	10Q	–	1	100	125	100.0	97.0	93.2	88.0	83.5	83.0	83.0	83.0	–	–
Ni-Cr-Mo	3	3	Forging	SA-508	–	2	–	50	80	50.0	47.1	45.2	44.5	43.2	42.0	41.4	40.6	–	–
Ni-Cr-Mo	3	3	Forging	SA-508	–	3	–	50	80	50.0	47.1	45.2	44.5	43.2	42.0	41.4	40.6	–	–
Ni-Cr-Mo			Forging	SA-508	–	4	–	85	105	85.0	80.0	77.5	75.8	74.5	73.2	–	–	–	–
Ni-Cr-Mo			Forging	A508-69	–	4a	1	100	115	100.0	94.2	91.2	89.2	87.7	86.1	–	–	–	–
Ni-Cr-Mo			Plate	A543-72a	–	1	–	85	105	85.0	80.0	77.5	75.8	74.5	73.2	–	–	–	–
Ni-Cr-Mo			Plate	A543-72a	–	2	1	100	115	100.0	94.2	91.2	89.2	87.7	86.1	–	–	–	–
			Plate	A514-70	All	–	1,2,3	100	115	100.0	95.8	93.0	90.2	89.5	87.5	86.0	84.4	–	–
			Plate	A514-70	All	–	1,2,4	90	105	90.0	86.1	83.6	81.1	80.5	78.8	77.4	75.4	–	–
			Forging	SA-592	A,E,F	–	1,2	100	115	100.0	95.8	93.0	90.2	89.5	87.5	86.0	84.4	–	–
			Forging	SA-592	A,E,F	–	1,2	90	105	90.0	86.1	83.6	81.1	80.5	78.8	77.4	75.4	–	–
AISI 4140 4145,4340			Bar	A434-64	–	BB	1,2	90	110	90.0	84.1	81.3	79.0	76.6	73.3	71.0	68.4	–	–
			Bar	A434-64	–	BB	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
			Bar	A434-64	–	BB	2	75	100	75.0	70.1	67.7	65.8	63.8	61.0	59.1	57.0	–	–
			Bar	A434-64	–	BB	2	75	95	75.0	70.1	67.7	65.8	63.8	61.0	59.0	57.0	–	–
			Bar	A434-64	–	BB	2	65	90	65.0	60.7	58.6	57.1	55.3	52.9	51.2	49.4	–	–
AISI 4140, 4145,4340			Bar	A434-64	–	BC	1,2	110	130	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
			Bar	A434-64	–	BC	1,2	105	125	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Bar	A434-64	–	BC	1,2	95	115	95.0	88.5	85.4	83.0	80.6	77.0	74.6	72.0	–	–
			Bar	A434-64	–	BC	2	85	110	85.0	79.5	76.8	74.6	72.4	69.1	67.0	64.6	–	–
			Bar	A434-64	–	BC	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
AISI 4140, 4145,4340			Bar	A434-64	–	BD	1,2	130	155	130.0	121.5	117.2	114.1	110.7	105.7	102.5	98.8	–	–
			Bar	A434-64	–	BD	1,2	120	150	120.0	112.1	108.4	105.2	102.1	97.6	94.6	91.1	–	–
			Bar	A434-64	–	BD	1,2	110	140	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
			Bar	A434-64	–	BD	1,2	105	135	105.0	98.1	94.8	92.2	89.4	88.5	82.9	79.8	–	–
			Bar	A434-64	–	BD	1,2	100	130	100.0	93.5	90.3	87.8	85.4	81.4	78.9	76.0	–	–
			Bar	SA-540	B21,B22, B23,B24	1	1,2	150	165	150.0	140.1	135.3	131.7	127.7	122.6	118.2	114.0	–	–
			Bar	SA-540	B21,B22, B23,B24	2	1,2	140	155	140.0	131.0	126.3	123.0	119.1	114.0	110.4	106.3	–	–
			Bar	SA-540	B21,B22, B23,B24	3	1,2	130	145	130.0	121.5	117.2	114.1	110.7	103.7	102.5	98.8	–	–

TABLE 3 (Cont'd)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength	Min Ultimate Tensile Strength	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
			Bar	SA-540	B21,B22, B23,B24	1	1,2	120	135	120.0	112.1	108.4	103.2	102.1	97.6	94.6	91.1	–	–
			Bar	SA-540	B21,B22, B23,B24	5	1,2	100	115	100.0	93.5	90.3	87.8	85.1	81.4	78.9	76.0	–	–
			Bar	SA-540	B21,B22, B23,B24	5	1,2	105	120	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Plate,Bar Shapes	A572-73	42	–		42	60	42.0	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
			Plate,Bar Shapes	A572-73	50	–		50	65	50.0	47.5	45.6	43.8	41.8	39.9	38.9	37.9	–	–
5Ni-Cr-Mo-V			Forging	A579	12a	–	1,2	140	150	140.0	138.6	134.0	129.5	127.7	126.3	123.5	117.6	–	–
			Plate,Bar Shapes	A588-71	A,B	–		42	63	42.0	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
			Plate,Bar Shapes	A588-71	A,B	–		46	67	46.0	43.8	41.9	40.3	38.6	36.7	35.8	34.8	–	–
			Plate,Bar Shapes	A588-71	A,B	–		50	70	50.0	47.5	45.6	43.0	41.8	39.9	38.9	37.9	–	–
			Tube	A618-73	II	–		50	70	50.0	–	–	–	–	–	–	–	–	–
			Tube	A618-73	III	–		50	65	50.0	–	–	–	–	–	–	–	–	–
			Forging	A471-70	–	6	1,2	125	140	125.0	117.8	114.0	111.5	109.7	107.8	106.2	104.8	–	–
			Forging	A471-70	–	7	1,2	135	150	135.0	127.1	123.0	120.3	118.3	116.2	114.8	113.1	–	–
			Forging	A471-70	–	8	1,2	145	160	145.0	136.6	132.2	129.3	127.1	124.9	123.2	121.8	–	–
			Forging	A471-70	–	9	1,2	155	170	155.0	146.0	141.2	138.1	136.0	133.5	131.8	130.0	–	–
AISI 4140, 4340,8620			Forging	A668-72	K	–	2	80	105	80.0	74.8	72.3	70.3	68.1	65.1	63.1	60.9	–	–
			Forging	A668-72	K	–	2	75	100	75.0	70.1	67.7	65.8	63.8	61.0	59.0	57.0	–	–
AISI 4140, 4340			Forging	A668-72	L	–	1,2	105	125	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–
			Forging	A668-72	L	–	1,2	95	115	95.0	88.5	85.4	83.0	80.6	77.0	74.6	72.0	–	–
			Forging	A668-72	L	–	1,2	85	110	85.0	79.5	76.8	74.6	72.4	69.1	67.0	64.6	–	–
AISI 4340			Forging	A668-72	M	–	1,2	120	145	120.0	112.1	108.4	105.2	102.1	97.6	94.6	91.1	–	–
AISI 4340			Forging	A668-72	M	–	1,2	115	140	115.0	107.5	103.8	101.0	98.0	93.6	90.0	87.5	–	–
AISI 4340			Forging	A668-72	M	–	1,2	110	135	110.0	102.9	99.4	96.6	93.6	89.5	86.8	83.6	–	–
AISI 4340			Forging	A668-72	N	–	1,2	140	170	140.0	131.0	126.3	123.0	119.1	114.0	110.4	106.3	–	–
AISI 4340			Forging	A668-72	N	–	1,2	135	165	135.0	126.1	121.9	118.5	115.0	108.9	106.5	102.7	–	–
AISI 4340			Forging	A668-72	N	–	1,2	130	160	130.0	121.5	117.2	114.1	110.7	105.7	102.5	98.8	–	–

TABLE 3 (Cont'd)

Yield Strength Values, S_Y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	P-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes	Min Yield Strength	Min Ultimate Tensile Strength	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
High Alloy Steels																			
Precipitation Hardened Steels																			
			Bar,Forg.	SA-564	630	–	1,2	105	135	105.0	97.1	93.0	89.8	87.6	84.7	83.6	82.6	–	–
			Bar,Forg.	SA-564	630	–	1,2	115	140	115.0	106.3	101.9	98.3	95.2	92.8	91.5	90.5	–	–
			Bar,Forg.	SA-564	630	–	1,2	125	145	125.0	115.6	110.7	106.9	103.5	100.9	99.5	98.5	–	–
			Bar,Forg.	A564-72	XM12	–	1,2	145	155	145.0	136.0	130.7	125.8	121.7	117.2	115.2	112.9	–	–
			Bar,Forg.	A564-72	XM12	–	1,2	125	145	125.0	117.1	112.6	108.3	104.8	101.0	99.5	97.2	–	–
			Bar,Forg.	A564-72	XM13	–	1,2,5	165	175	165.0	154.6	148.5	143.0	138.1	133.8	131.1	128.4	–	–

Notes

1. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the applicable Tables in SA-370.
2. Until rules for welding on this material are added, this material is not for welded construction.
3. Up to 2½ in. incl.
4. Over 2½ to 4 in.
5. A564 Type XM-13 shall be modified so that age hardening shall be at 1050 F, only.
6. These materials are limited to non-welded construction and for use only for snubbers.
7. Max BHN 175.
8. Max BHN 197.

TABLE 4

Yield Strength Values, S_y, for Bolting Materials for Classes 1, 2, 3, and MC Supports[5]

Nominal Composition	P-No.	Group No.	Specification No.	Type or Grade	Class	Notes	Min Yield Strength, ksi	Min Ultimate Tensile Strength, ksi	Yield Strength ksi (multiply by 1000 to obtain psi). For metal temperatures, F, not to exceed									
									100	200	300	400	500	600	650	700	750	800
Carbon Steels																		
	1	1	A307-74	A	–	2	36	58	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
			SA-307	B	–	1												
Low Alloy Steels																		
AISI 4140,4340			SA-354	BB	–	2	83	105	83.0	77.5	74.9	72.8	70.6	67.5	65.5	63.0	–	–
AISI 4340			SA-354	BB	–	2	78	100	78.0	72.9	70.4	68.5	66.4	63.5	61.5	59.3	–	–
AISI 4340			SA-354	BC	–	2,6	109	125	109.0	102.0	98.5	95.6	92.8	88.7	86.0	82.9	–	–
AISI 4340			SA-354	BC	–	2,6	99	115	99.0	92.5	89.4	86.9	84.3	80.5	78.1	75.3	–	–
AISI 4340			SA-354	BD	–	2,6	125	150	125.0	116.9	112.9	109.8	106.5	101.8	98.6	95.0	–	–
AISI 4135, 4140,4340			A490-71	–	–	2,4,6	130	150	130.0	121.5	117.2	114.1	110.7	108.7	102.5	98.8	–	–
Precipitation Hardened Steels																		
			A564-72	XM-13	–	2,3,6	165	175	165.0	154.6	148.5	143.0	138.1	133.3	131.1	128.4		
Austenitic Stainless Steels																		
AISI 304	8		SA-193	B8	1	–	30	75	30.0	25.0	22.5	20.7	19.4	18.2	17.9	17.7	17.3	16.8
AISI 304	8		SA-193	B8A	1A	–	30	75										
AISI 347	8		SA-193	B8C	1	–	30	75	30.0	27.5	25.6	23.9	22.5	21.4	21.0	20.6	20.5	20.3
AISI 347	8		SA-193	B8CA	1A	–	30	75										
AISI 316	8		SA-193	B8M	1	–	30	75	30.0	25.8	23.3	21.4	19.9	18.8	18.5	18.1	17.8	17.6
AISI 316	8		SA-193	B8MA	1A	–	30	75										
AISI 321	8		SA-193	B8T	1	–	30	75	30.0	25.4	22.7	20.6	19.1	18.2	17.8	17.5	17.3	17.2
AISI 321	8		SA-193	B8TA	1A	–	30	75										
AISI 304	8		SA-320	B8	–	–	30	75	30.0	25.0	22.5	20.7	19.4	18.2	17.9	17.7	17.3	16.8
AISI 347	8		SA-320	B8C	–	–	30	75	30.0	27.5	25.6	23.9	22.5	21.4	21.0	20.6	20.5	20.3
AISI 321	8		SA-320	B8T	–	–	30	75	30.0	25.4	22.7	20.6	19.1	18.2	17.8	17.5	17.3	17.2
AISI 303			SA-320	B8F	–	–	30	75	30.0	25.0	22.5	20.7	19.4	18.2	17.9	17.7	17.3	16.9
AISI 316	8		SA-320	B8M	–	–	30	75	30.0	25.8	23.3	21.4	19.9	18.8	18.5	18.1	17.8	17.6

Notes

1. All A307 bolts shall, in addition, meet both the chemical and mechanical requirements for SA-36 bar material. Welding is permitted.
2. No welding permitted.
3. A564, Type XM-13, shall be modified so that age hardening shall be at 1050 F, only.
4. Minimum Tempering Temperature shall be 850 F.
5. Allowable tension and shear stresses may be obtained by multiplying these yield strength values by 0.40 and 0.15 respectively. When the shear plane does not cross the threading, a factor of 0.25 may be used for allowable shear stress.
6. The maximum tensile strength shall not exceed the minimum specified tensile strength by more than 40.0 ksi. Where the Specification does not limit hardness, the maximum surface hardness shall not exceed the hardness values corresponding to the maximum tensile strength, as determined by the appli-

CASES OF ASME BOILER AND PRESSURE VESSEL CODE

Meeting of March 12, 1982
Approved by Council, June 17, 1982

This Case shall expire on June 17, 1985
unless previously annulled or reaffirmed.

Case N-71-11
Additional Materials for Component Supports Fabricated by Welding
Section III, Divison 1, Subsection NF Class 1, 2, 3, and MC Component Supports

Inquiry: What materials, in addition to those listed in Tables I-11.0, I-12.0, and I-13.0 of Appendix I of Section III, Division 1, may be used for Class 1, 2, 3, or MC component supports constructed to the requirements of Subsection NF when the items are fabricated by welding?

Reply: It is the opinion of the Committee that as alternatives to the materials listed in the tables of Appendix I referenced in Table NF-2121 (a)-1, the design stress intensity and allowable stress values, the yield strength, and the ultimate tensile strength values,[1] for the material specifications listed in Tables 1, 2, 3, 4, and 5 of this Case may be used in welded construction of Class 1, 2, 3, and MC component supports for Section III, Division 1. These materials may also be used for nonwelded construction.

The following additional requirements shall apply:

1.0 GENERAL REQUIREMENTS

1.1 The requirements of Subsection NF shall be met except as modified by this Case.

2.0 MATERIALS

2.1 Welding is not permitted on carbon and low alloy steels containing more than 0.35% carbon.

2.2 When the Nominal Composition columns in Tables 1 through 4 reference AISI grades, only materials meeting the chemical composition range requirements of the specific AISI grades listed shall be used, with the exception that 0.60% maximum silicon is permitted for castings.

2.3 Materials in Tables 1 through 4 whose nominal composition is referenced as an AISI composition may be accepted as satisfying the requirements of the ASTM specification provided the chemical requirements of the AISI specification are within the specified range of the designated ASTM specification, and certification of the material shall be in accordance with the requirements of the NCA-3867.4 (e) or (f). The term "each piece of stock material" in NCA-3867.4 (e) may be taken to refer to that portion of the material of the same heat and lot which has traceability established by the Manufacturer through his program. Where Certificates of Compliance are acceptable under Subsection NF, testing of each piece is not required.

2.4 When an ASTM specification does not specify either minimum tensile or yield strengths, the values listed in this case shall be met by the material.

2.5 The material shall be furnished in accordance with the requirements of NF-2600.

2.6 The thickness referenced in this Case is the nominal thickness of the weld, the base material or the thinner of the sections being joined, whichever is least. For fillet welds, the nominal thickness is the throat thickness, and

[1] The tabulated values of tensile strength and yield strength are those which the Committee believes are suitable for use in design calculations required by Section III, Division 1. At the temperatures above room temperature, the values of tensile strength tend toward an average or expected value which may be as much as 10% above the tensile strength trend curve adjusted to the minimum specified room temperature tensile streigth. At temperatures above room temperature, the yield strength values correspond to the yield strength trend curve adjusted to the minimum specified room temperature yield strength. Neither the tensile strength nor the yield strength values correspond exactly to either "average" or "minimum," as these terms are applied to a statistical treatment of a homogeneous set of data.

Neither the ASME or ASTM Material Specifications nor the rules of Section III, Division 1, require elevated temperature testing for tensile or yield strengths of production material for use in Code components. It is not intended that results of such tests, if performed, be compared with these tabulated tensile and yield strength values for ASME Code acceptance/rejection purposes for materials. If some elevated temperature test results on production material appear lower than the tabulated values by a large amount (more than the typical variability of material suggesting the possibility of some error), further investigation by retest or other means should be considered.

for partial penetration welds and material repair welds, the nominal thickness is the depth of weld groove or weld preparation.

2.7 Where impact tests are required by this Case or the Design Specification, impact testing shall be performed in accordance with NF-2331.

3.0 CLASSIFICATIONS

3.1 The materials in this Case have been grouped in S-Number groupings of base metals similar to the P-Number groupings in QW-422.

4.0 WELDING QUALIFICATIONS

4.1 Welding procedure qualifications, and welder and welding operator qualifications shall be performed in accordance with NF-4320. A Welding Procedure Qualification with a base metal in one P-Number and Group-Number qualifies for all other base metals in the same S-Number and Group-Number. Qualifications for S-Number materials do not qualify corresponding P-Number materials. Base metals not assigned an S-Number and Group-Number in the Tables or a P-Number and Group-Number in Table QW-422 of Section IX shall require individual procedure qualification. Welding procedure qualification tests shall be performed on as-welded test specimens, except that such tests shall be performed on postweld heat treated specimens when a postweld heat treatment (PWHT) is to be used in the fabrication of the component supports, and providing PWHT is a requirement of the Welding Procedure Specification (WPS) being qualified.

4.2 For performance qualification of welders and welding operators, the requirements of NF-4320 for P-Numbers of base metals shall also be applied to the same S-Numbers of base metals within this Case. Qualification with P-Numbers in accordance with QW-310.4 qualifies for corresponding S-Numbers.

5.0 CONSUMABLES CONTROL

5.1 Due consideration shall be given to protection of electrodes and fluxes for all welding processes in order to minimize moisture absorption and surface contamination.

5.2 Electrodes for shielded metal arc welding shall conform to the requirements of the latest edition of SFA 5.1, Specification for Mild Steel Covered Arc Welding Electrodes, SFA 5.5, Specification for Low-Alloy Steel Covered Arc Welding Electrodes, or SFA 5.4, Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes. Only low hydrogen electrodes shall be used.

5.3 All low hydrogen electrodes conforming to SFA 5.1 shall be purchased in hermetically-sealed containers or shall be dried for at least 2 hr between 450°F (230°C)[2] and 500°F (260°C) before they are used. Electrodes having low hydrogen coverings conforming to SFA 5.5 shall be purchased in hermetically-sealed containers or shall be dried at least 1 hr at temperatures between 700°F (370°C) and 800°F (430°C) before being used. Electrodes shall be dried prior to use if the hermetically sealed container shows evidence of damage. Immediately after the opening of the hermetically sealed container or removal of the electrodes from drying ovens, electrodes shall be stored in ovens held at a temperature of at least 250°F (120°C). E70XX electrodes that are not used within 4 hr, E80XX within 2 hr, E90XX within 1 hr, and E100XX within ½ hr after the opening of the hermetically sealed container or removal of the electrodes from a drying or storage oven shall be dried before use, unless evidence is presented to and accepted by the Authorized Inspector which indicates that the brand of electrode used may be exposed for longer periods of time without exceeding the moisture requirements of SFA 5.5 or 0.6% for SFA 5.1.

5.4 When use is made of low-hydrogen covered electrodes lower in strength than that for the base metal joined, the lower strength electrode shall be dried to the SFA 5.5 moisture requirements for electrodes in a strength similar to that of the base metal joined or the higher strength base metal when dissimilar strength base metals are joined.

6.0 TIME OF EXAMINATION

6.1 *Cautionary Note:* In addition to the requirements of NF-5120, consideration should be given to the application of magnetic particle or liquid penetrant examination after a sufficient time at ambient temperature to de-

[2] Metric temperature rounded to the nearest ten degrees.

tect delayed cracking. This precaution is not necessary for examination after postweld heat treatment.

7.0 EFFECTS OF WELDING

7.1 *Cautionary Note:* Consideration should be given to the possibility of reheat cracking and deterioration of toughness properties during postweld heat treatment of susceptible materials.

8.0 REQUIREMENTS FOR WELDING S-NUMBER 1 GROUP-NUMBER 1 MATERIALS

8.1 Preheat

8.1.1 Preheat is not required when the base metal temperature is 50°F (10°C) and above for material thickness up to and including 1½ in. (38 mm). A preheat of 200°F (90°C) minimum is required for material thickness greater than 1½ in. (38 mm).

8.2 Postweld Heat Treatment

8.2.1 Postweld heat treatment is not required when the material thickness is 1½ in. (38 mm) or less. When the material thickness is greater than 1½ in. (38 mm), up to and including 4 in. (102 mm), PWHT is not required provided the material, including heat affected zone and weld metal, meets the impact testing requirement given in 8.3.1 below.

8.2.2 When not exempted by 8.2.1 above, the postweld heat treatment shall be performed in accordance with NF-4622.

8.3 Impact Test Requirements

8.3.1 When material with thickness greater than 1½ in. up to and including 4 in. (102 mm) is not postweld heat treated, the lateral expansion at the lowest service temperature specified shall be 25 mils (0.64 mm) minimum (NF-2300).

8.4 Additional Requirements

8.4.1 For steels with vanadium and columbium in combination exceeding 0.10% or with vanadium alone exceeding 0.08%, which are given a postweld heat treatment above 700°F (370°C), the requirements for impact testing of paragraph 8.3.1 shall be met for these materials by separate welding procedure qualification. (This requirement should also be considered for steels in which vanadium and columbium are not specified but which may include these elements.)

9.0 REQUIREMENTS FOR WELDING S-NUMBER 1 GROUP NUMBER 2 AND 3 MATERIALS

9.1 Preheat

9.1.1 Preheat is not required when base metal temperature is 50°F (10°C) and above for material thickness up to and including 1 in. (25 mm). A preheat of 200°F (90°C) minimum is required for material thickness greater than 1 in. (25 mm).

9.2 Postweld Heat Treatment

9.2.1 Postweld heat treatment is not required for material which has a maximum carbon content of 0.30% or less and a thickness of 1 in. (25 mm) or less, nor for material which has a maximum carbon content of 0.30% or less and a thickness greater than 1 in. (25 mm) up to and including 4 in. (102 mm), provided the material, including heat affected zone and weld metal, meets the impact requirements given in 9.3.1 below.

9.2.2 When not exempted by 9.2.1 above, the postweld heat treatment shall be performed in accordance with NF-4622.

9.3 Impact Test Requirements

9.3.1 When material with thickness greater than 1 in. (25 mm) up to and including 4 in. (102 mm) is not postweld heat treated, the lateral expansion at the lowest service temperature specified shall be 25 mils (0.64 mm) minimum (NF-2300).

9.4 Additional Requirements

9.4 For steels with vanadium and columbium in combination exceeding 0.10% or with vanadium alone exceeding 0.08%, which are given a postweld heat treatment above 700°F (370°C), the requirements for impact testing of paragraph 9.3.1 shall be met for these materials by separate welding qualifications. (This requirement

should also be considered for steels in which vanadium and columbium are not specified but which may include these elements.)

10.0 REQUIREMENTS FOR WELDING S-NUMBER 3 GROUP NUMBER 1 MATERIALS

10.1 Preheat

10.1.1 A preheat of 150°F (70°C) minimum is required for material thicknesses up to and including 1½ in. (38 mm). A preheat of 250°F (120°C) minimum is required for material thickness greater than 1½ in. (38 mm).

10.2 Postweld Heat Treatment

10.2.1 No postweld heat treatment is required for material which has a maximum carbon content of 0.25% or less and a thickness up to and including 4 in. (102 mm) provided the material, including heat affected zone and weld metal, meets the impact requirements given in 10.3.1 below.

10.2.2 When not exempted by 10.2.1 above, the postweld heat treatment shall be performed in accordance with NF-4622.

10.3 Impact Test Requirements

10.3.1 When material is not postweld heat treated, for material over 5/8 in. (16 mm) thick up to and including 1 in. (25 mm), the lateral expansion at the lowest service temperature specified shall be 15 mils (.38 mm) minimum; for material thicknesses greater than 1 in. (25 mm) up to and including 4 in. (102 mm), the lateral expansion at the lowest service temperature shall be 25 mils (0.64 mm) minimum (NF-2300).

10.4 Additional Requirements

10.4.1 For steels with vanadium and columbium in combination exceeding 0.10% or with vanadium alone exceeding 0.08%, which are given a postweld heat treatment above 700°F (370°C), the requirements for impact testing of paragraph 10.3.1 shall be met for these materials by separate welding qualifications. (This requirement should also be considered for steels in which vanadium and columbium are not specified but which may include these elements.)

11.0 REQUIREMENTS FOR WELDING S-NUMBER 3 GROUP NUMBER 3 AND 4 MATERIALS

11.1 Preheat

11.1.1 A preheat temperature of 200°F (90°C) minimum is required for material thicknesses up to and including 1½ in. (38 mm). A preheat temperature of 300°F (150°C) minimum is required for material thicknesses greater than 1½ in. (38 mm).

11.2 Postweld Heat Treatment

11.2.1 No postweld heat treatment is required for material which has a maximum carbon content of 0.25% or less and a thickness up to and including 4 in. (102 mm) provided the material, including heat affected zone and weld metal, meets the impact requirements given in 11.3.1 below.

11.2.2 When not exempted by 11.2.1 above, the postweld heat treatment shall be performed in accordance with NF-4622.

11.3 Impact Test Requirements

11.3.1 When material is not postweld heat treated, for material over 5/8 in. (16 mm) thick up to and including 1 in. (25 mm), the lateral expansion at the lowest service temperature specified shall be 15 mils (38 mm) minimum; for material thicknesses greater than 1 in. (25 mm), up to and including 4 in. (102 mm), the lateral expansion at the lowest service temperature specified shall be 25 mils (0.64 mm) minimum (NF-2300).

12.0 REQUIREMENTS FOR WELDING S-NUMBER 4 GROUP NUMBER 2 AND 3 MATERIALS

12.1 The requirements for welding S-No. 4 materials are the same as those for P-No. 4 materials.

13.0 REQUIREMENTS FOR WELDING S-NUMBER 5 GROUP NUMBER 2 AND 3 MATERIALS

13.1 The requirements for welding S-No 5 materials are the same as those for P-No. 5 materials.

14.0 REQUIREMENTS FOR WELDING S-NUMBER 8 GROUP NUMBER 1 MATERIALS

14.1 The requirements for welding S-No. 8 materials are the same as those for P-No. 8 materials.

15.0 REQUIREMENTS FOR WELDING S-NUMBER 11A, S-NUMBER 11B, AND S-NUMBER 11C MATERIALS

15.1 Welding Qualifications

15.1.1 Welding procedure qualifications and welder and welding operator qualification shall be made in accordance with Section III and as given herein.

15.1.2 Welding procedure qualification of Section IX shall be by WPS and Procedure Qualification Records (PQR) for these materials and combinations of other materials with these materials. When joints are made between two different types or grades of base material, a procedure qualification shall be made for the applicable combinations of materials, even though procedure qualification tests have been made for each of the two base materials welded to itself. (Materials of the same nominal chemical analysis and mechanical properties range, even though of different product forms, may be considered as the same type or grade.)

15.2 The following, in addition to the essential variables in Section IX, QW-250, shall be considered as essential variables requiring requalification of the welding procedure.

15.2.1 A change in filler metal SFA classification or to a weld metal not covered by an SFA specification.

15.2.2 An increase in the maximum or a decrease in the minimum specified preheat or interpass temperatures. The specified range of preheat temperatures shall not exceed 150°F (70°C).

15.2.3 A change in the heat treatment (procedure qualification tests shall be subjected to heat-treatment essentially equivalent to that encountered in fabrication of the item or item parts including the maximum total aggregate time at temperature or temperatures and cooling rates).

15.2.4 A change in the type of current (AC or DC), polarity, or a change in the specified range for amperage, voltage, or travel speed.

15.2.5 A change in the thickness (T) of the welding procedure qualification test plate as given in (a) or (b) below:

(a) For welded joints which are quenched and tempered after welding, an increase in thickness (the minimum thickness qualified in all cases is ½ in. (13 mm).

(b) For welded joints which are not quenched and tempered after welding, any change as follows:

(1) For thickness less than 5/8 in. (16 mm), any decrease in thickness. (The maximum thickness qualified is 2 T.)

(2) For thicknesses 5/8 in. (16 mm) and over, any departure from the range of 5/8 in. (16 mm) to 2 T.

15.3 Consumables Control

15.3.1 Welding filler metal containing more than 0.06% vanadium shall not be used for welded joints which are postweld heat treated.

15.4 Postweld Heat Treatment Procedure

15.4.1 Postweld heat treatment shall be at a minimum temperature of 1000°F (580°C) and a maximum temperature limited only by the ability to meet the specified mechanical properties, but in no case exceeding the tempering temperature recorded on the Certified Material Test Report. Minimum holding time at the postweld heat treating temperature shall be 1 hr/in. (1 hr/ 25 mm) of weld thickness, with 1 hr minimum holding time.

15.5 Preheat

15.5.1 A minimum preheat temperature of 100°F (40°C) is required for material thicknesses up to and including ½ in. (13 mm). A minimum preheat temperature of 200°F (90°C) is required for material thicknesses above ½ in. (13 mm) up to and including 1½ in (38 mm). A minimum preheat temperature of 300°F (150°C) is required for material thickness above 1½ in. (38 mm).

15.6 Postweld Heat Treatment

15.6.1 The preheat temperature required by 15.5.1 shall be maintained for 2 hr after the weld joint is completed.

Postweld heat treatment shall be in accordance with paragraph 15.4.1.

15.6.2 Postweld heat treatment in accordance with paragraph 15.4.1 may be omitted for material which has a maximum carbon content of 0.23% or less and a thickness up to and including 4 in. (102 mm) provided the material, including heat affected zone and weld metal, meets the impact requirements given in 15.8.1 below.

15.7 Joint Design Restrictions

15.7.1 Convex fillet welds as shown in Fig. NF-4427-1 are not permitted.

15.8 Impact Test Requirements

15.8.1 When material is not postweld heat treated per paragraph 15.4.1 for material over 5/8 in. (16 mm) thick and up to and including 1 in. (25 mm), the lateral expansion at the lowest service temperature specified shall be 15 mils (.38 mm) minimum. For material thicknesses greater than 1 in. (25 mm) up to and including 4 in. (102 mm), the lateral expansion at the lowest service temperature specified shall be 25 mils (.64 mm) minimum (NF-2300).

16.0 REQUIREMENTS FOR WELDING S-NUMBER 12 GROUP NUMBER 1 MATERIAL

16.1 Preheat

16.1.1 Preheat is not required when the base metal temperature is 50°F (10°C) and above for material thickness up to and including 1½ in. (38 mm). A preheat of 200°F (90°C) minimum is required for material thickness greater than 1½ in. (38 mm).

16.2 Postweld Heat Treatment

16.2.1 Postweld heat treatment is not required when the material thickness is 1½ in. (38 mm) or less. When the material thickness is greater than 1½ in. (38 mm), postweld heat treatment is not required provided the material, including heat affected zone and weld metal, meets the impact testing requirement given in 16.3.1 below.

16.2.2 When not exempted by 16.2.1 above, the postweld heat treatment shall be performed in accordance with NF-4622, except that it shall be at least 1000°F (540°C) and shall not exceed 1150°F (620°C) for Class 1 and Class 2 material, and 1175°F (640°C) for Class 3 material.

16.3 Impact Test Requirements

16.3.1 When material with thickness greater than 1½ in. (38 mm), up to and including 4 in. (102 mm) is not postweld heat treated, the lateral expansion at the lowest service temperature specified shall be 25 mils (0.64 mm) minimum.

17.0 Identification

17.1 This Case and revision number shall be listed on the applicable documentation accompanying shipment.

TABLE 1

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Design Stress Intensity, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
AISI 1015, 1018, 1020	1	1	Bar	A108-79	1015CW, 1018CW, 1020CW	–	1a,6	40	60	16.7	16.7	16.7	16.7	–	–	–	–	–	–
– – –	1	1	Sheet	A446-76	A	–	15	37	45	15.0	15.0	15.0	15.0	–	–	–	–	–	–
AISI 1015	1	1	Tube	A513-80	1015CW	–	1a,6	55	65	16.7	16.7	16.7	16.7	–	–	–	–	–	–
AISI 1020	1	2	Tube	A513-80	1020CW	–	1a,6	60	70										
AISI 1025, 1026	1	2	Tube	A513-80	1025CW, 1026CW	–	1a,7	65	75	18.3	18.3	18.3	18.3	–	–	–	–	–	–
– – –	1	1	Plate	SA-516	60	–	–	32	60	20.0	19.5	18.9	18.3	17.3	15.8	15.5	15.4	–	–
– – –	1	1	Plate	SA-516	65	–	–	35	65	21.7	21.3	20.7	20.0	18.9	17.3	17.0	16.8	–	–
– – –	1	2	Plate	SA-516	70	–	–	38	70	23.3	23.1	22.5	21.7	20.6	18.7	18.4	18.3	–	–
AISI 1018, 1020, 1022	1	2	Tube	A519-80	1018CW, 1020CW, 1022CW	–	1a,6	60	70	16.7	16.7	16.7	16.7	–	–	–	–	–	–
AISI 1018, 1020, 1022	1	1	Tube	A519-80	1018HR, 1020HR, 1022HR	–		32	50										
AISI 1025, 1026	1	1	Tube	A519-80	1025HR, 1026HR	–		35	55	18.3	18.3	18.3	18.3	–	–	–	–	–	–
AISI 1025, 1026	1	2	Tube	A519-80	1025CW, 1026CW	–	1a,5,7	65	75										
– – –	1	2	Plate	SA-537	–	1	4	45	65	21.7	21.7	21.7	21.3	21.3	20.6	20.3	19.6	–	–
– – –	1	2	Plate	SA-537	–	1	3	50	70	23.3	23.2	22.9	22.9	22.9	22.6	22.0	21.4	–	–
– – –	1	3	Plate	SA-537	–	2	4	55	75	25.0	25.0	25.0	24.7	24.7	24.7	24.6	24.3	–	–
– – –	1	3	Plate	SA-537	–	2	3	60	80	26.7	26.7	26.7	26.4	26.4	26.4	26.2	25.9	–	–
– – –	1	1	Sheet	A611-72	A	–	–	25	42	14.0	11.0	14.0	14.0	–	–	–	–	–	–
– – –	1	1	Sheet	A611-72	B	–	–	30	45	15.0	15.0	15.0	15.0	–	–	–	–	–	–
– – –	1	1	Sheet	A611-72	C	–	–	33	48	16.0	16.0	16.0	16.0	–	–	–	–	–	–
AISI 1020,	1	1	Forging	A668-79a	–	B	10	30	60	20.0	20.0	20.0	20.0	20.0	20.0	20.0	–	–	–
1022, 1025,	1	1	Forging	A668-79a	–	C	10	33	66	22.0	22.0	22.0	22.0	22.0	22.0	22.0	–	–	–
1026, 1030	1	2	Forging	A668-79a	–	D	10	37.5	75	25.0	25.0	25.0	25.0	25.0	25.0	25.0	–	–	–

TABLE 1 (Continued)

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Design Stress Intensity, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Carbon Steels (Cont'd)																			
AISI 1030, 1330	1	3	Forging	A668-79a	–	F	10,18,19	50	85	28.3	28.3	28.3	28.3	–	–	–	–	–	–
							9,10,17	55	90	30.0	30.0	30.0	30.0	–	–	–	–	–	–
– – –	1	1	Bar	SA-675	65	–	–	32.5	65	21.7	21.7	21.7	21.7	21.7	21.7	21.7	–	–	–
– – –	1	2	Bar	SA-675	70	–	–	35	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	–	–	–
– – –	1	2	Bar	A675-79	75	–	21	37.5	75	25.0	25.0	25.0	25.0	25.0	25.0	25.0	–	–	–
Low Alloy Steels																			
AISI 4130, 4320, 4330	4	3	Casting	A148-80	90-60	–	2,8	60	90	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	–	–
Mn-V	1	2	Shapes	A441-79	Group 1&2	–	–	50	70	23.3	23.3	23.3	23.3	–	–	–	–	–	–
Ni-Cr-Mo	11C	1	Casting	A487-80	–	10Q		100	125	41.7	41.7	41.7	41.7	41.7	41.7	41.7	41.7	–	–
Ni-Cr-Mo	11B	10	Forging	A508-80a	–	4a		100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
– – –	11B	2	Plate	A514-77	E	–	20	90	100	33.3	33.3	33.3	33.3	33.3	33.3	33.2	32.6	–	–
– – –	11B	3	Plate	A514-77	F	–	4												
– – –	11B	8	Plate	A514-77	P	–	20												
– – –	11B	1	Plate	A514-77	A	–	22	100	110	36.7	36.7	36.7	36.7	36.7	36.7	36.5	35.9	–	–
– – –	11B	4	Plate	A514-77	B	–	22												
– – –	11B	5	Plate	A514-77	D	–	22												
– – –	11B	2	Plate	A514-77	E	–	3												
– – –	11B	3	Plate	A514-77	F	–	3												
– – –	11B	6	Plate	A514-77	J	–	22												
– – –	11B	8	Plate	A514-77	P	–	3												
– – –	11B	2	Plate	SA-517	E	–	20	90	105	35.0	35.0	35.0	35.0	35.0	34.8	34.0	33.2	–	–
– – –	11B	8	Plate	SA-517	P	–	4												
– – –	11B	1	Plate	SA-517	A	–	22	100	115	38.3	38.3	38.3	38.3	38.3	38.1	37.2	36.4	–	–
– – –	11B	4	Plate	SA-517	B	–	22												
– – –	11B	5	Plate	SA-517	D	–	22												
– – –	11B	2	Plate	SA-517	E	–	3												
– – –	11B	3	Plate	SA-517	F	–	3												
– – –	11B	6	Plate	SA-517	J	–	22												
– – –	11B	8	Plate	SA-517	P	–	3												

TABLE 1 (Continued)

Design Stress Intensity Values, S_m, for Ferritic Steels for Class 1 Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength ksi	Design Stress, Intensity, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Low Alloy Steels (Cont'd)																			
2¼Cr-1Mo	5	{3 / 2}	Plate	A542-79	–	{1 / 2 / 3 / 4}		85 / 100 / 75 / 60	105 / 115 / 95 / 85	35.0 / 38.3 / 31.7 / 28.3	35.0 / 38.3 / 31.7 / 28.3	35.0 / 38.3 / 31.7 / 28.3	35.0 / 38.3 / 31.7 / 28.3	34.8 / 38.1 / 31.5 / 28.2	34.4 / 37.6 / 31.1 / 27.8	31.0 / 37.3 / 30.8 / 27.5	33.6 / 36.8 / 30.4 / 27.2	– / – / – / –	– / – / – / –
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	1	–	85	105	35.0	35.0	35.0	34.6	34.4	33.8	–	–	–	–
Ni-Cr-Mo	11B	10	Plate	A543-79a	B,C	2	–	100	115	38.3	38.3	38.3	37.9	37.6	37.1	–	–	–	–
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	3	–	70	90	30.0	30.0	30.0	29.7	29.5	29.1	–	–	–	–
Mn-Cb-V	1	1	Plate, Shapes	A572-79	42	–	–	42	60	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	–	–
Mn-Cb-V	1	1	Plate, Shapes	A572-79	50	–	–	50	65	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	–	–
Mn-Cb-V	1	2	Plate, Shapes	A572-76	55	–	–	55	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	–	–
Mn-Ni-Cr-Cu-V	3	1	Plate	A588-80a	A,B	–	12	42	63	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	–	–
			Plate	A588-80a	A,B	–	9,13	46	67	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	–	–
			Plate, Shapes	A588-80a	A,B	–	9,14	50	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	–	–
Mn-Cb	1	1	Plate, Shapes, Bar	A633-79a	A	–	17	42	63	21.0	21.0	21.0	21.0	21.0	21.0	21.0	20.8	–	–
Mn-V	1	1	Plate, Shapes, Bar	A633-75	B	–	17												
Mn-Cb	1	2	Plate, Shapes, Bar	A633-79a	C,D	–	3	50	70	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.1	–	–
Mn-Cr-Ni-Cu	1	1	Plate, Shapes, Bar	A633-79a	C,D	–	4	46	65	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.5	–	–
Mn-V-N	1	3	Plate, Shapes, Bar	A633-79a	E	–	5,14	60	80	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.4	–	–
AISI 8620, 8630, 4130, 4320, 4330	4	3	Forging	A668-79a	–	k	10,19	75	100	33.3	33.3	33.3	33.3	33.3	33.3	33.3	33.3	–	–
							9,10,16	80	105	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	–	–
							2,10,19	85	110	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	–	–
						l	2,9,10,18	95	115	38.3	38.3	38.3	38.3	38.3	38.3	–	–	–	–
							2,9,10,17	105	125	41.7	41.7	41.7	41.7	41.7	41.7	–	–	–	–
Age Hardening Steels																			
Cr-Ni-Cu-Mo-Cb	12	1	Plates / Shapes / Bars	A710-79	A	1	11	85	90	30.0	30.0	30.0	30.0	30.0	30.0	–	–	–	–
						1	23	80	90	30.0	30.0	30.0	30.0	30.0	30.0	–	–	–	–
						2	24	65	72	24.0	24.0	24.0	24.0	24.0	24.0	–	–	–	–
						2	25	60	72	24.0	24.0	24.0	24.0	24.0	24.0	–	–	–	–
						2	26	55	65	21.7	21.7	21.7	21.7	21.7	21.7	–	–	–	–
						3	27	75	85	28.3	28.3	28.3	28.3	28.3	28.3	–	–	–	–
						3	26	65	75	26.0	26.0	26.0	26.0	26.0	26.0	–	–	–	–

*Notes follow Table 5.

TABLE 2

Allowable Stress Values, S, for Ferritic Steels for Classes 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
AISI 1015, 1018, 1020	1	1	Bar	A108-79	1015CW, 1018CW, 1020CW	–	1b,6	40	60	12.5	12.5	12.5	12.5	–	–	–	–	–	–
– – –	1	1	Sheet	A446-76	A	–	15	33	45	11.3	11.3	11.3	11.3	–	–	–	–	–	–
AISI 1015	1	1	Tube	A513-80	1015CW	–	1b,6	55	65	12.5	12.5	12.5	12.5	–	–	–	–	–	–
AISI 1020	1	2	Tube	A513-80	1020CW	–	1b,6	60	70										
AISI 1025, 1026	1	2	Tube	A513-80	1025CW, 1026CW	–	1b,7	65	75	13.8	13.8	13.8	13.8	–	–	–	–	–	–
– – –	1	1	Plate	SA-516	60	–	–	32	60	15.0	15.0	15.0	15.0	15.0	15.0	15.0	14.3	–	–
– – –	1	1	Plate	SA-516	65	–	–	35	65	16.2	16.2	16.2	16.2	16.2	16.2	16.2	15.2	–	–
– – –	1	2	Plate	SA-516	70	–	–	38	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	16.6	–	–
AISI 1018, 1020, 1022	1	2	Tube	A519-80	1018CW, 1020CW, 1022CW	–	1b,6	60	70										
AISI 1018, 1020, 1022	1	1	Tube	A519-80	1018HR, 1020HR, 1022HR	–	–	32	50	12.5	12.5	12.5	12.5	–	–	–	–	–	–
AISI 1025, 1026	1	1	Tube	A519-80	1025HR, 1026HR	–	–	35	55										
AISI 1025, 1026	1	2	Tube	A519-80	1025CW, 1026CW	–	1b,5,7	65	75	13.8	13.8	13.8	13.8	–	–	–	–	–	–
– – –	1	2*	Plate	SA-537	–	1	4	45	65	16.2	16.2	15.9	15.9	15.9	15.9	15.9	15.9	–	–
– – –	1	2	Plate	SA-537	–	1	3	50	70	17.5	17.5	17.2	17.2	17.2	17.2	17.2	17.2	–	–
– – –	1	3	Plate	SA-537	–	2	4	55	75	18.7	18.7	18.7	18.5	18.5	18.5	18.5	18.5	–	–
– – –	1	3	Plate	SA-537	–	2	3	60	80	20.0	20.0	20.0	19.8	19.8	19.8	19.8	19.6	–	–
– – –	1	1	Sheet	A611-72	A	–	–	25	42	10.5	10.5	10.5	10.5	–	–	–	–	–	–
– – –	1	1	Sheet	A611-72	B	–	–	30	45	11.3	11.3	11.3	11.3	–	–	–	–	–	–
– – –	1	1	Sheet	A611-72	C	–	–	33	48	12.0	12.0	12.0	12.0	–	–	–	–	–	–
AISI 1020, 1022, 1025, 1026, 1030	1	1	Forging	A668-79a	–	B	10	30	60	15.0	15.0	15.0	15.0	15.0	15.0	15.0	–	–	–
	1	1	Forging	A668-79a	–	C	10	33	66	16.5	16.5	16.5	16.5	16.5	16.5	16.5	–	–	–
	1	2	Forging	A668-79a	–	D	10	37.5	75	18.3	18.3	18.3	18.3	18.3	18.3	18.3	–	–	–

TABLE 2 (Continued)

Allowable Stress Values, S, for Ferritic Steels for Classes 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Carbon Steels (Cont'd)																			
AISI 1030, 1330	1	3	Forging	A668-79a	–	F	10, 18, 19	50	85	21.3	21.3	21.3	21.3	–	–	–	–	–	–
							9, 10, 17	55	90	22.5	22.5	22.5	22.5	–	–	–	–	–	–
– – –	1	1	Bar	SA-675	65	–	–	32.5	65	16.3	16.3	16.3	16.3	16.3	16.3	16.3	–	–	–
– – –	1	2	Bar	SA-675	70	–	–	35	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	–	–	–
– – –	1	2	Bar	A675-79	75	–	21	37.5	75	18.8	18.8	18.8	18.8	18.8	18.8	18.8	–	–	–
Low Alloy Steels																			
AISI 4130, 4320, 4330	4	3	Casting	A148-80	90-60	–	2, 8	60	90	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	–	–
MnV	1	2	Shapes	A441-79	Group 1&2		–	50	70	17.5	17.5	17.5	17.5	–	–	–	–	–	–
Ni-Cr-Mo	11C	1	Casting	A487-80a	–	10Q	–	100	125	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	–	–
Ni-Cr-Mo	11B	10	Forging	A508-80a	–	4a	–	100	115	28.8	28.8	28.8	28.4	28.2	27.9	–	–	–	–
– – –	11B	2	Plate	A514-77	E	–	20	90	100	25.0	25.0	25.0	25.0	25.0	25.0	24.9	24.5	–	–
– – –	11B	3	Plate	A514-77	F	–	4												
– – –	11B	8	Plate	A514-77	P	–	20												
– – –	11B	1	Plate	A514-77	A	–	22	100	110	27.5	27.5	27.5	27.5	27.5	27.5	27.4	26.9	–	–
– – –	11B	4	Plate	A514-77	B	–	22												
– – –	11B	5	Plate	A514-77	D	–	22												
– – –	11B	2	Plate	A514-77	E	–	3												
– – –	11B	3	Plate	A514-77	F	–	3												
– – –	11B	6	Plate	A514-77	J	–	22												
– – –	11B	8	Plate	A514-77	P	–	3												
– – –	11B	2	Plate	SA-517	E	–	20	90	105	26.3	26.3	26.3	26.3	26.3	25.3	26.2	25.7	–	–
– – –	11B	8	Plate	SA-517	P	–	4												
– – –	11B	1	Plate	SA-517	A	–	22	109	115	28.8	28.8	28.8	28.8	28.8	28.8	28.7	28.2	–	–
– – –	11B	4	Plate	SA-517	B	–	22												
– – –	11B	5	Plate	SA-517	D	–	22												
– – –	11B	2	Plate	SA-517	E	–	3												
– – –	11B	3	Plate	SA-517	F	–	3												
– – –	11B	6	Plate	SA-517	J	–	22												
– – –	11B	8	Plate	SA-517	P	–	3												

Table 2 (Continued)

Allowable Stress Values, S, for Ferritic Steels for Classes 2, 3, and MC Plate and Shell Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Allowable Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Low Alloy Steels (Cont'd)																			
2¼Cr-1Mo	5	3	Plate	A542-79	–	1	–	85	105	26.3	26.3	26.3	26.3	26.1	25.8	25.5	25.2	–	–
						2	–	100	115	28.8	28.8	28.8	28.8	28.6	28.2	28.0	27.6	–	–
2¼Cr-1Mo	5	2	Plate	A542-79	–	3	–	75	95	23.8	23.8	23.8	23.8	23.7	23.3	23.1	22.8	–	–
						4	–	60	85	21.3	21.3	21.3	21.3	21.1	20.8	20.7	20.4	–	–
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	1	–	85	105	26.3	26.3	26.3	26.0	25.8	25.4	25.1	24.7	–	–
Ni-Cr-Mo	11B	10	Plate	A543-79a	B,C	2	–	100	115	28.8	28.8	28.8	28.4	28.2	27.9	27.5	27.0	–	–
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	3	–	70	90	22.5	22.5	22.5	22.3	22.1	21.8	21.5	21.2	–	–
Mn-Cb-V	1	1	Plate, Shapes	A572-79	42	–	–	12	60	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	–	–
Mn-Cb-V	1	1	Plate, Shapes	A572-79	50	–	–	50	65	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	–	–
Mn-Cb-V	1	2	Plate	A572-76	55	–	–	55	70	17.5	17.5	17.5	17.5	–	–	–	–	–	–
Mn-Ni-Cr-Cu-V	3	1	Plate	A588-80a	A,B	–	12	42	63	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	–	–
			Bar, Plate, Shapes	A588-80a	A,B	–	9,13	46	67	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	–	–
			Plate, Shapes	A588-80a	A,B	–	9,14	50	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	–	–
Mn-Cb	1	1	Plate, Shapes	A633-79a	A	–	17	42	63	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.6	–	–
Mn-V	1	1	Plate, Shapes	A633-75	B	–	17												
Mn-Cb	1	2	Plate, Shapes	A633-79a	C,D	–	3	50	70	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.3	–	–
Mn-Cr-Ni-Cu	1	1	Plate, Shapes	A633-79a	C,D	–	4	46	65	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.1	–	–
Mn-V-N	1	3	Plate, Shapes	A633-79a	E	–	5,14	60	80	20.0	20.0	20.0	20.0	20.0	20.0	20.0	19.8	–	–
AISI 8620, 8630, 4130, 4320, 4330	4	3	Forging	A668-79a	–	K	10,19	75	100	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	–	–
							9,10,16	80	105	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	–	–
						L	2,10,19	85	110	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	–	–
							2,9,10,18	95	115	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	–	–
							2,9,10,17	105	125	31.3	31.3	31.3	31.3	31.3	31.3	–	–	–	–
Age Hardening Steel																			
Cr-Ni-Cu-Mo-Cb	12	1	Plates, Shapes, Bars	A710-79	A	1	11	85	90	22.5	22.5	22.5	22.5	22.5	22.5	–	–	–	–
						1	23	80	90	22.5	22.5	22.5	22.5	22.5	22.5	–	–	–	–
						2	24	65	72	18.0	18.0	18.0	18.0	18.0	18.0	–	–	–	–
						2	25	60	72	18.0	18.0	18.0	18.0	18.0	18.0	–	–	–	–
						2	26	55	65	16.3	16.3	16.3	16.3	16.3	16.3	–	–	–	–
						3	27	75	85	21.3	21.3	21.3	21.3	21.3	21.3	–	–	–	–
						3	26	65	75	18.8	18.8	18.8	18.8	18.8	18.8	–	–	–	–

*Notes follow Table 5.

TABLE 3

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Carbon Steels																			
AISI 1015, 1018, 1020	1	1	Bar	A108-79	1015CW, 1018CW, 1020CW	–	1c,6	40	60	32.0	29.2	28.3	27.4	–	–	–	–	–	–
– – –	1	1	Plate	SA-283	C	–	–	30	55	30.0	27.3	26.6	25.7	–	–	–	–	–	–
– – –	1	1	Plate	A284-77	B	–	–	27.5	55	27.5	25.5	24.3	23.6	–	–	–	–	–	–
– – –	1	1	Pipe	A381-79	–	Y35	–	35	60	35.0	31.9	31.0	30.0	28.3	25.9	25.6	25.2	–	–
– – –	1	1	Tb.Shp.	A500-80	B	–	1c	42	58	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
– – –	1	1	Tb.Shp.	A500-80	C	–	1c	46	62										
– – –	1	1	Str.Tb.	A501-80	–	–	–	36	58										
AISI 1015	1	1	Tube	A513-80	1015CW	–	1c,6	55	65	32.0	29.2	28.3	27.4	–	–	–	–	–	–
AISI 1020	1	2	Tube	A513-80	1020CW	–	1c,6	60	70	32.0	29.2	28.3	27.4	–	–	–	–	–	–
AISI 1025, 1026	1	2	Tube	A513-80	1025CW, 1026CW	–	1c,7	65	75	35.0	31.9	31.0	30.0	–	–	–	–	–	–
– – –	1	1	Plate	SA-516	60	–	–	32	60	32.0	29.2	28.3	27.4	25.9	23.6	23.2	23.0	–	–
– – –	1	1	Plate	SA-516	65	–	–	35	65	35.0	31.9	31.0	30.0	28.3	25.9	25.4	25.2	–	–
– – –	1	2	Plate	SA-516	70	–	–	38	70	38.0	34.6	33.7	32.6	30.7	28.1	27.6	27.4	–	–
AISI 1018, 1020, 1022	1	2	Tube	A519-80	1018CW, 1020CW, 1022CW	–	1c,6	60	70	32.0	29.2	28.3	27.4	–	–	–	–	–	–
AISI 1018, 1020, 1022	1	1	Tube	A519-80	1018HR, 1020HR, 1022HR	–	–	32	50										
AISI 1025, 1026	1	1	Tube	A519-79	1025HR, 1026HR	–	–	35	55	35.0	31.9	31.0	30.0	–	–	–	–	–	–
AISI 1025, 1026	1	2	Tube	A519-79	1025CW, 1026CW	–	1c,5,7	65	75										
AISI 1020, 1025, 1030	1	1	Forging	A521-76	–	CC	–	30	60	30.0	27.3	26.6	25.7	24.3	22.2	21.8	21.6	–	–
		2	Forging	A521-76	–	CE	–	37	75	37.0	33.7	32.8	31.7	29.9	27.4	26.9	26.6	–	–
– – –	1	1	Pipe	SA-524	I	–	–	35	60	35.0	31.9	31.0	30.0	–	–	–	–	–	–
– – –	1	1	Pipe	SA-524	II	–	–	30	55	30.0	27.3	26.6	25.7	–	–	–	–	–	–
– – –	1	2	Plate	SA-537	–	1	4	45	65	45.0	39.7	36.5	33.7	31.6	30.5	29.7	28.8	–	–
– – –	1	2	Plate	SA-537	–	1	3	50	70	50.0	44.1	40.5	37.5	35.2	33.9	33.0	32.1	–	–
– – –	1	3	Plate	SA-537	–	2	4	55	75	55.0	50.5	47.9	45.8	43.7	43.0	41.5	40.8	–	–
– – –	1	3	Plate	SA-537	–	2	3	60	80	60.0	55.0	52.2	50.0	47.6	46.0	45.2	44.5	–	–
– – –	1	1	Sheet Strip	A570-79	36	–	–	36	53	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
					45	–	–	45	60	45.0	41.0	39.9	38.5	36.4	33.3	32.6	32.4	–	–

TABLE 3 (Continued)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Carbon Steels (Cont'd)																			
AISI 1020, 1022, 1025, 1026, 1030	1	1	Forging	A668-79a	–	B	10	30	60	30.0	27.3	26.6	25.7	24.3	22.2	21.8	21.6	–	–
	1	1	Forging	A668-79a	–	C	10	33	66	33.0	30.1	29.2	28.3	26.5	24.4	24.1	23.8	–	–
	1	2	Forging	A668-79a	–	D	10	37.5	75	37.5	34.2	33.2	32.1	30.3	27.7	27.2	27.0	–	–
AISI 1030, 1330	1	3	Forging	A668-79a	–	F	10,18,19	50	85	50.0	45.6	44.3	42.9	40.4	37.0	36.3	36.0	–	–
							9,10,17	55	90	55.0	50.2	48.6	47.1	44.5	40.7	39.9	39.6	–	–
– – –	1	1	Bar	SA-675	65	–	–	32.5	65	32.5	29.6	28.8	27.9	26.3	24.0	23.8	23.4	–	–
– – –	1	2	Bar	SA-675	70	–	–	35	70	35.0	31.9	31.0	30.0	28.3	25.9	25.6	25.2	–	–
– – –	1	2	Bar	A675-79	75	–	21	37.5	75	37.5	34.2	33.2	32.1	30.3	27.7	27.4	27.0	–	–
Low Alloy Steels																			
AISI 4130, 4320, 4330	4	2	Casting	A148-80	90-60	–	2,8	60	90	60.0	58.2	55.9	52.8	50.1	49.8	–	–	–	–
AISI 8620	3	3	Bar	A331-74	8620CW	–	1c,5	75	90	35.0	31.9	31.0	30.0	–	–	–	–	–	–
MnV	1	2	Shapes	A441-79	Grp.1&2	–		50	70	50.0	45.4	41.7	38.0	34.0	33.9	33.6	33.1	–	–
Ni-Cr-Mo	11C	1	Casting	A487-80	–	10Q		100	125	100.0	97.0	93.2	88.0	83.5	83.0	83.0	83.0	–	–
Ni-Cr-Mo	11B	10	Forging	A508-80a	–	4a		100	115	100.0	94.2	91.2	89.2	87.7	80.1	–	–	–	–
– – –	11B	2	Plate	A514-77	E	–	20												
– – –	11B	3	Plate	A514-77	F	–	4	90	100	90.0	86.0	83.3	80.8	78.8	77.0	75.9	74.7	–	–
– – –	11B	8	Plate	A514-77	P	–	20												
– – –	11B	1	Plate	A514-77	A	–	22												
– – –	11B	4	Plate	A514-77	B	–	22												
– – –	11B	5	Plate	A514-77	D	–	22												
– – –	11B	2	Plate	A514-77	E	–	3	100	110	100.0	95.5	92.5	89.8	87.6	85.5	84.3	83.0	–	–
– – –	11B	3	Plate	A514-77	F	–	3												
– – –	11B	6	Plate	A514-77	J	–	22												
– – –	11B	8	Plate	A514-77	P	–	3												
– – –	11B	2	Plate	SA-517	E	–	20	90	105	90.0	86.0	83.3	80.8	78.8	77.0	75.9	74.7	–	–
– – –	11B	8	Plate	SA-517	P	–	4												
– – –	11B	1	Plate	SA-517	A	–	22												
– – –	11B	4	Plate	SA-517	B	–	22												
– – –	11B	5	Plate	SA-517	D	–	22												
– – –	11B	2	Plate	SA-517	E	–	3	100	115	100.0	95.5	92.5	89.8	87.6	85.5	84.3	83.0	–	–
– – –	11B	3	Plate	SA-517	F	–	3												
– – –	11B	6	Plate	SA-517	J	–	22												
– – –	11B	8	Plate	SA-517	P	–	3												
2¼ Cr-1Mo	11A	6	Forging	A541-80	–	6	5	85	100	85.0	81.6	79.6	78.1	76.8	75.2	74.4	73.4	–	–

TABLE 3 (Continued)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed 100	200	300	400	500	600	650	700	750	800
Low Alloy Steels (Cont'd)																			
2¼ Cr-1Mo	5	3	Plate	A542-79	–	1	–	85	105	85.0	81.6	79.6	78.1	76.8	75.2	74.4	73.4	–	–
						2	–	100	115	100.0	92.4	89.5	87.6	86.1	84.4	83.4	82.1	–	–
	5	2	Plate	A542-79	–	3	–	75	95	75.0	72.0	70.3	68.9*	67.7	66.4	65.6	64.1	–	–
						4	–	60	85	60.0	57.6	56.2	55.1	54.1	53.1	52.5	51.8	–	–
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	1	–	85	105	85.0	80.0	77.5	75.9	74.5	73.2	–	–	–	–
Ni-Cr-Mo	11B	10	Plate	A543-79a	B,C	2	–	100	115	100.0	94.2	91.2	89.2	87.7	86.1	–	–	–	–
Ni-Cr-Mo	11A	5	Plate	A543-79a	B,C	3	–	70	90	70.0	65.9	63.8	62.4	61.4	60.3	59.5	58.7	–	–
Mn-Cb-V	1	1	Plate, Bar Shapes	A572-79	42	–	–	42	60	42.0	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
Mn-Cb-V	1	1	Plate, Bar Shapes	A572-79	50	–	–	50	65	50.0	47.5	45.6	43.8	41.8	39.9	38.9	37.9	–	–
Mn-Cb-V	1	2	Plate, Bar Shapes	A572-76	55	–	–	55	70	55.0	52.3	50.2	48.2	46.0	43.9	42.8	41.7	–	–
Mn-Ni-Cr-Cu-V	3	1	Plate, Bar	A558-80a	A,B	–	12	42	63	42.9	40.0	38.3	36.8	35.2	33.5	32.7	31.8	–	–
			Plate, Bar	A558-80a	A,B	–	9,13	46	67	46.0	43.8	41.9	40.3	38.6	36.7	35.8	34.8	–	–
			Plate, Bar Shapes	A558-80a	A,B	–	9,14	50	70	50.0	47.5	45.6	43.0	41.8	39.9	38.9	37.9	–	–
– – –	11B	1	Forging	SA-592	A	–	4	90	105	90.0	86.0	83.3	80.8	78.8	77.0	75.9	74.7	–	–
– – –	11B	2	Forging	SA-592	E														
– – –	11B	3	Forging	SA-592	F														
– – –	11B	1	Forging	SA-592	A	–	3	100	115	100.0	95.5	92.5	89.8	87.6	85.5	84.3	83.0	–	–
– – –	11B	2	Forging	SA-592	E														
– – –	11B	3	Forging	SA-592	F														
Mn-Cu-V	1	2	Tube	A618-74	II	–	–	50	70	50.0	45.4	41.7	38.0	34.6	33.9	33.6	33.1	–	–
Mn-V	1	1	Tube	A618-74	III	–	–	50	65	50.0	45.4	41.7	38.0	34.6	33.9	33.6	33.1	–	–
Mn-Cb	1	1	Plate Shapes	A633-79a	A	–	–	42	63	42.0	38.2	35.1	31.9	29.1	28.5	28.2	27.9	–	–
Mn-V	1	1	Plate Shapes	A633-75	B														
Mn-Cr-Ni-Cu, Mn-Cb	1	2	Plate Shapes	A633-79a	C,D	–	3	50	70	50.0	45.4	41.7	38.0	34.6	33.9	33.6	33.1	–	–
		1	Plate Shapes	A633-79a	C,D	–	4	46	60	46.0	41.8	38.4	35.0	31.8	31.2	30.9	30.4	–	–
Mn-V-N	1	3	Plate Shapes	A63379a	E	–	5,14	60	80	60.0	54.5	50.1	45.6	43.4	40.7	40.3	39.7	–	–
AISI 4130, 4320, 4330, 8620, 8630	4	3	Forging	A668-79a	K	–	10,19	75	100	75.0	70.1	67.7	65.8	63.8	61.0	59.0	57.0	–	–
							9,10,16	80	105	80.0	74.8	72.3	70.3	68.1	65.4	63.1	60.9	–	–
					L	–	2,10,19	85	110	85.0	79.5	76.8	74.6	72.4	69.1	67.0	64.6	–	–
							2,9,10,18	95	115	95.0	88.5	85.4	83.0	80.0	77.0	74.6	72.0	–	–
							2,9,10,17	105	125	105.0	98.1	94.8	92.2	89.4	85.5	82.9	79.8	–	–

TABLE 3 (Continued)

Yield Strength Values, S_y, for Ferritic Steels for Classes 1, 2, 3, and MC Linear Type Component Supports

Nominal Composition	S-No.	Group No.	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed									
										100	200	300	400	500	600	650	700	750	800
Age Hardening Steel																			
Cr-Ni-Cu-Mo-Cb	12	1	Plates, Shapes, Bars	A710-79	A	1	11	85	90	85.0	80.0	77.1	74.1	71.5	69.6	–	–	–	–
						1	23	80	90	80.0	75.3	72.6	69.4	67.6	65.5	–	–	–	–
						2	24	65	72	65.0	61.1	56.6	56.8	54.9	53.2	–	–	–	–
						2	25	60	72	60.0	56.5	54.1	52.4	50.7	49.1	–	–	–	–
						2	26	55	65	55.0	51.8	47.6	48.1	46.5	45.0	–	–	–	–
						3	27	75	85	75.0	70.6	68.0	66.0	65.4	61.4	–	–	–	–
						3	26	65	75	65.0	61.2	57.0	56.6	54.7	53.2	–	–	–	–

*Notes follow Table 5.

TABLE 4

Yield Strength Values, S_y, for Bolting Materials for Classes 1, 2, 3, and MC Supports

Nominal Composition	S-No.	Group No.	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Yield Strength, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed									
									100	200	300	400	500	600	650	700	750	800
Carbon Steel																		
C-Mn	1	1	SA-36	–	–	28	36	58	36.0	32.8	31.9	30.8	29.1	26.6	26.1	25.9	–	–
Austenitic Stainless Steels																		
18Cr-8Ni	8	1	SA-193	B8	1	–	30	75	30.0	25.0	22.5	20.7	19.4	18.2	17.9	17.7	17.3	16.8
	8	1	SA-193	B8A	1A													
18Cr-10Ni-Cb	8	1	SA-193	B8C	1	–	30	75	30.0	27.5	25.6	23.9	22.5	21.4	21.0	20.6	20.5	20.3
	8	1	SA-193	B8CA	1A													
16Cr-12Ni-2Mo	8	1	SA-193	B8M	1	–	30	75	30.0	25.8	23.3	21.4	19.9	18.8	18.5	18.1	17.8	17.6
	8	1	SA-193	B8MA	1A													
18Cr-10Ni-Ti	8	1	SA-193	B8T	1	–	30	75	30.0	25.4	22.7	20.6	19.1	18.2	17.8	17.5	17.3	17.2
	8	1	SA-193	B8TA	1A													
18Cr-8Ni	8	1	SA-194	8A	–	29	–	–	–	–	–	–	–	–	–	–	–	–
18-10Ni-Cb	8	1	SA-194	8CA	–	29	–	–	–	–	–	–	–	–	–	–	–	–
16Cr-12Ni-2Mo	8	1	SA-194	8MA	–	29	–	–	–	–	–	–	–	–	–	–	–	–
18Cr-10Ni-Ti	8	1	SA-194	8TA	–	29	–	–	–	–	–	–	–	–	–	–	–	–
18Cr-8Ni-S	8	1	SA-320	B8F	1	–	30	75	30.0	25.0	22.5	20.7	–	–	–	–	–	–
				B8FA	1A													
18Cr-8Ni	8	1	SA-320	B8	1	–	30	75	30.0	25.0	22.5	20.7	–	–	–	–	–	–
				B8A	1A													
18Cr-10Ni-Cb	8	1	SA-320	B8C	1	–	30	75	30.0	27.5	25.6	23.9	–	–	–	–	–	–
				B8CA	1A													
18Cr-10Ni-Ti	8	1	SA-320	B8T	1	–	30	75	30.0	25.4	22.7	20.6	–	–	–	–	–	–
				B8TA	1A													
16Cr-12Ni-2Mo	8	1	SA-320	B8M	1	–	30	75	30.0	25.8	23.3	21.4	–	–	–	–	–	–
				B8MA	1A													

*Notes follow Table 5.

TABLE 5

Ultimate Tensile Stress Values, S_U, for Ferrous Steels for Classes 1, 2, 3, and MC Linear Type Component Supports, Class I Plate and Shell Type Component Supports, and for Bolting Materials for Classes 1, 2, 3, and MC Supports

Nominal Composition	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Ultimate Tensile Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed**									
								100	200	300	400	500	600	650	700	750	800
Carbon Steels																	
– – –	Plate, Bar, Shapes	SA-36	–	–	–	36	58	58.0	58.0	58.0	58.0	–	–	–	–	–	–
AISI 1015 AISI 1018 AISI 1020	Bar	A108-79	1015CW 1018CW 1020CW	–	–	40	60	50.0	50.0	50.0	50.0	–	–	–	–	–	–
– – –	Plate	SA-283	C	–	–	30	55	55.0	55.0	55.0	55.0	–	–	–	–	–	–
– – –	Plate	A284-77	B	–	–	27.5	55	55.0	55.0	55.0	55.0	–	–	–	–	–	–
– – –	Pipe	A381-79	–	Y35	–	35	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
– – –	Sheet	A440-76	A	–	–	33	45	45.0	45.0	45.0	45.0	–	–	–	–	–	–
– – –	Tubular Shapes	A500-80	B	–	–	42	58	58.0	58.0	58.0	58.0	–	–	–	–	–	–
– – –	Tubular Shapes	A500-80	C	–	–	46	62										
– – –	Str. Tb.	A501-80	–	–	–	36	58	58.0	58.0	58.0	58.0	–	–	–	–	–	–
AISI 1015	Tube	A513-80	1015CW	–	–	55	65	50.0	50.0	50.0	50.0	–	–	–	–	–	–
AISI 1020	Tube	A513-80	1020CW	–	–	60	70										
AISI 1025, 1026	Tube	A513-80	1025CW 1026CW	–	–	65	75	55.0	55.0	55.0	55.0	–	–	–	–	–	–
– – –	Plate	SA-516	60	–	–	32	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
– – –	Plate	SA-516	65	–	–	35	65	65.0	65.0	65.0	65.0	–	–	–	–	–	–
– – –	Plate	SA-516	70	–	–	38	70	70.0	70.0	70.0	70.0	–	–	–	–	–	–
AISI 1018, 1020, 1022	Tube	A519-80	1018CW 1020CW 1022CW	–	–	60	70	50.0	50.0	50.0	50.0	–	–	–	–	–	–
			1018HR 1020HR 1022HR	–	–	32	50										
AISI 1025, 1026	Tube	A519-80	1025HR 1026HR	–	–	35	55	55.0	55.0	55.0	55.0	–	–	–	–	–	–
		A519-80	1025CW 1026CW	–	–	65	75										
AISI 1020, 1025, 1030	Forging	A521-76	–	CC	–	30	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
	Forging	A521-76	–	CE	–	37	75	75.0	75.0	75.0	75.0	–	–	–	–	–	–
– – –	Pipe	SA-524	I	–	–	35	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
– – –	Pipe	SA-524	II	–	–	30	55	55.0	55.0	55.0	55.0	–	–	–	–	–	–
– – –	Plate	SA-537	–	1	–	45	65	65.0	65.0	65.0	63.8	63.8	63.8	63.8	63.8	–	–
– – –	Plate	SA-537	–	1	–	50	70	70.0	70.0	68.6	68.6	68.6	68.6	68.6	68.6	–	–
– – –	Plate	SA-537	–	2	–	55	75	75.0	75.0	75.0	74.4	74.4	74.4	73.8	72.9	–	–
– – –	Plate	SA-537	–	2	–	60	80	80.0	80.0	80.0	79.3	79.3	79.3	78.8	77.8	–	–
– – –	Sheet	A570-79	36	–	–	36	53	53.0	53.0	53.0	53.0	–	–	–	–	–	–
			45			45	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
– – –	Sheet	A611-72	A	–	–	25	42	42.0	42.0	42.0	42.0	–	–	–	–	–	–
– – –	Sheet	A611-72	B	–	–	30	45	45.0	45.0	45.0	45.0	–	–	–	–	–	–
– – –	Sheet	A611-72	C	–	–	33	48	48.0	48.0	48.0	48.0	–	–	–	–	–	–

TABLE 5 (Continued)

Ultimate Tensile Stress Values, S_U, for Ferrous Steels for Classes 1, 2, 3, and MC Linear Type Component Supports, Class 1 Plate and Shell Type Component Supports, and for Bolting Materials for Classes 1, 2, 3, and MC Supports

Nominal Composition	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Ultimate Tensile Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed**									
								100	200	300	400	500	600	650	700	750	800
Carbon Steels (Cont'd)																	
AISI 1020, 1022, 1025, 1026, 1030	Forging	A668-79a	–	B	–	30	60	60.0	60.0	60.0	60.0	–	–	–	–	–	–
	Forging	A668-79a	–	C	–	33	66	66.0	66.0	66.0	66.0	–	–	–	–	–	–
	Forging	A668-79a	–	D	–	37.5	75	75.0	75.0	75.0	75.0	–	–	–	–	–	–
AISI 1030, 1330	Forging	A668-79a	–	F	–	50 55	85 90	85.0 90.0	85.0 90.0	85.0 90.0	85.0 90.0	–	–	–	–	–	–
– – –	Bar	SA-675	65	–	–	32.5	65	65.0	65.0	65.0	65.0	–	–	–	–	–	–
			70	–	–	35	70	70.0	70.0	70.0	70.0	–	–	–	–	–	–
– – –	Bar	A675-79	75	–	–	37.5	75	75.0	75.0	75.0	75.0	–	–	–	–	–	–
Low Alloy Steels																	
AISI 8620	Bar	A331-74	8620CW	–	–	75	90	90.0	90.0	90.0	90.0	–	–	–	–	–	–
9CR-1 Mo	Casting	SA-217	C12	–	–	60	90	90.0	89.6	87.2	86.6	86.2	85.0	83.6	82.0	–	–
AISI 4130, 4330	Casting	A148-80	90-60	–	–	60	90	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	–	–
Mn-V	Shapes	A441-79	Group 1 Group 2	–	–	50	70	70.0	70.0	70.0	70.0	70.0	70.0	–	–	–	–
Ni-Cr-Mo	Casting	A487-80	–	10Q	–	100	125	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	–	–
Ni-Cr-Mo	Forging	A508-80a	–	4a	–	100	115	115.0	115.0	115.0	113.9	113.1	111.4	110.0	98.1	–	–
– – –	Plate	A514-77	A B D E F J P	–	–	100	110	110.0	110.0	110.0	110.0	110.0	110.0	110.0	107.7	–	–
– – –	Plate	A514-77	E F P	–	–	90	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.9	–	–
– – –	Plate	SA-517	E P	–	–	90	105	105.0	105.0	105.0	105.0	105.0	105.0	105.0	102.8	–	–
– – –	Plate	SA-517	A B D E F J P	–	–	100	115	115.0	115.0	115.0	115.0	115.0	115.0	115.0	112.6	–	–

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TABLE 5 (Continued)

Ultimate Tensile Stress Values, S_U, for Ferrous Steels for Classes 1, 2, 3, and MC Linear Type Component Supports, Class I Plate and Shell Type Component Supports, and for Bolting Materials for Classes 1, 2, 3, and MC Supports

Nominal Composition	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Ultimate Tensile Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed**									
								100	200	300	400	500	600	650	700	750	800
Low Alloy Steels (Cont'd)																	
2¼Cr-1Mo	Forging	A541-79a	–	6	–	85	105	105.0	105.0	105.0	105.0	104.0	103.1	102.1	101.0	–	–
2¼Cr-1Mo	Plate	A542-79	–	3	–	75	95	95.0	95.0	95.0	95.0	94.6	93.2	91.4	91.4	–	–
				4	–	60	85	85.0	85.0	85.0	85.0	84.6	83.4	82.6	81.7	–	–
				1	–	85	105	105.0	105.0	105.0	105.0	104.0	103.1	102.1	101.0	–	–
				2	–	100	115	115.0	115.0	115.0	115.0	113.9	112.9	111.8	110.6	–	–
Ni-Cr-Mo	Plate	A543-79a	B,C	1	–	85	105	105.0	105.0	105.0	104.0	103.3	101.9	100.4	98.8	–	–
				2	–	100	115	115.0	115.0	115.0	113.9	113.1	111.5	109.9	108.4	–	–
Ni-Cr-Mo	Plate	A543-76a	B,C	3	–	70	90	90.0	90.0	90.0	98.1	88.6	87.3	86.0	84.7	–	–
Mn-Cb-V	Plate, Bar, Shapes	A572-79	42	–	–	42	60	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	–	–
Mn-Cb-V	Plate, Bar, Shapes	A572-79	50	–	–	50	65	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	–	–
Mn-Cb-V	Plate	A572-76	55	–	–	55	70	70.0	70.0	70.0	70.0	–	–	–	–	–	–
Mn-Cr-Cu-V	Plate, Bar	A588-80a	A,B	–	–	42	63	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	–	–
Mn-Ni-Cr-Cu-V	Plate, Bar	A588-80a	A,B	–	–	46	67	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	–	–
	Plate, Bar Shapes	A588-80a	A,B	–	–	50	70	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	–	–
– – –	Forging	SA-592	A,E,F	–	–	100	115	115.0	115.0	115.0	115.0	115.0	115.0	115.0	112.6	–	–
– –	Forging	SA-592	A,E,F	–	–	90	105	105.0	105.0	105.0	105.0	105.0	105.0	105.0	102.8	–	–
Mn-Cu-V	Tube	A618-74	II	–	–	50	70	70.0	70.0	70.0	70.0	70.0	70.0	70.0	69.3	–	–
Mn-V	Tube	A618-74	III	–	–	50	65	65.0	65.0	65.0	65.0	65.0	65.0	65.0	64.4	–	–
Mn-Cb	Plate, Shapes	A633-79a	A	–	–	42	63	63.0	63.0	63.0	63.0	63.0	63.0	63.0	62.4	–	–
Mn-V	Plate, Shapes	A633-79	B	–	–	42	63	63.0	63.0	63.0	63.0	63.0	63.0	63.0	62.4	–	–
Mn-Cb	Plate, Shapes	A633-79a	C,D	–	–	50	70	70.0	70.0	70.0	70.0	70.0	70.0	70.0	69.3	–	–
Mn-Cr-Ni-Cu	Plate, Shapes	A633-79a	C,D	–	–	46	65	65.0	65.0	65.0	65.0	65.0	65.0	65.0	64.4	–	–
Mn-V-N	Plate, Shapes	A633-79a	E	–	–	60	80	80.0	80.0	80.0	80.0	80.0	80.0	80.0	78.2	–	–
AISI 4130, 4320, 4330, 8620, 8630	Forging	A668-79a	K	–	–	75	100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	–	–
						80	105	105.0	105.0	105.0	105.0	105.0	105.0	105.0	–	–	–
			L	–	–	85	110	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	–	–
						95	115	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	–	–
						105	125	125.0	125.0	125.0	125.0	125.0	125.0	–	–	–	–

TABLE 5 (Continued)

Ultimate Tensile Stress Values, S_U, for Ferrous Steels for Classes 1, 2, 3, and MC Linear Type Component Supports, Class I Plate and Shell Type Component Supports, and for Bolting Materials for Classes 1, 2, 3, and MC Supports

Nominal Composition	Product Form	Specification No.	Type or Grade	Class	Notes*	Min. Yield Strength, ksi	Min. Ultimate Tensile Strength, ksi	Ultimate Tensile Stress, ksi (multiply by 1000 to obtain psi) for metal temperatures, °F, not to exceed** 100	200	300	400	500	600	650	700	750	800
Age Hardening Steels																	
Cr-Ni-Cu-Mo-Cb	Plates	A710-79	A	1	11	85	90	90.0	90.0	90.0	90.0	90.0	90.0	–	–	–	–
				1	23	80	90	90.0	90.0	90.0	90.0	90.0	90.0	–	–	–	–
	Shapes			2	24	65	72	72.0	72.0	72.0	72.0	72.0	72.0	–	–	–	–
				2	25	60	72	72.0	72.0	72.0	72.0	72.0	72.0	–	–	–	–
	Bars			2	26	55	65	65.0	65.0	65.0	65.0	65.0	65.0	–	–	–	–
				3	27	75	85	85.0	85.0	85.0	85.0	85.0	85.0	–	–	–	–
				3	25	65	75	75.0	75.0	75.0	75.0	75.0	75.0	–	–	–	–
Bolting Materials																	
C-Mn	Threaded Rod	SA-36	–	–	–	36	58	58.0	58.0	58.0	58.0	–	–	–	–	–	–
18Cr-8Ni	–	SA-193	B8	1	–	30	75	75.0	71.0	66.0	64.4	63.5	63.5	63.5	63.5	63.1	62.7
		SA-193	B8A	1A													
18Cr-10Ni-Cb	–	SA-193	B8C	1	–	30	75	75.0	71.8	66.0	61.9	60.2	59.4	59.0	58.6	58.6	58.6
		SA-193	B8CA	1A													
16Cr-12Ni-2Mo	–	SA-193	B8M	1	–	30	75	75.0	75.0	73.4	71.8	71.8	71.8	71.8	71.8	71.4	71.0
		SA-193	B8MA	1A													
18Cr-10Ni-Ti	–	SA-193	B8T	1	–	30	75	75.0	73.4	69.3	68.5	–	–	–	–	–	–
		SA-193	B8TA	1A													
18Cr-8Ni	–	SA-194	8	1	–	30	75	75.0	71.0	66.0	64.4	–	–	–	–	–	–
		SA-194	8A	1A													
18Cr-10Ni-Cb	–	SA-194	8C	1	–	30	75	75.0	71.8	66.0	61.9	–	–	–	–	–	–
		SA-194	8CA	1A													
16Cr-12Ni-2Mo	–	SA-194	8M	1	–	30	75	75.0	75.0	73.4	71.8	–	–	–	–	–	–
		SA-194	8MA	1A													
18Cr-10-Ni-Ti	–	SA-194	8T	1	–	30	75	75.0	73.4	69.3	68.5	–	–	–	–	–	–
		SA-194	8TA	1A													
18Cr-8Ni	–	SA-320	B8	1	–	30	75	75.0	71.0	66.0	64.4	–	–	–	–	–	–
		SA-320	B8A	1A													
18Cr-10Ni-Cb	–	SA-320	B8C	1	–	30	75	75.0	71.8	66.0	61.9	–	–	–	–	–	–
		SA-320	B8CA	1A													
18Cr-10Ni-Ti	–	SA-320	B8T	1	–	30	75	75.0	73.4	69.3	68.5	–	–	–	–	–	–
		SA-320	B8TA	1A													
17Cr-8Ni-S	–	SA-320	B8F	1	–	30	75	75.0	71.0	66.0	64.4	–	–	–	–	–	–
		SA-320	B8FA	1A													
16Cr-12Ni-2Mo	–	SA-320	B8M	1	–	30	75	75.0	75.0	73.4	71.8	–	–	–	–	–	–
		SA-320	B8MA	1A													

*Notes follow Table 5.
**When the Ultimate Tensile Stress at 100°F is different from the minimum tensile strength, see Notes 1a, 1b, or 1c, as applicable.

TABLE 5 (Continued)

Notes:

1a. When welding is performed on these materials, the allowable stress intensity value is based on an ultimate tensile strength of 50.0 ksi except for AISI 1025CW and 1026CW which are based on 55.0 ksi. Materials for nonwelded construction have been transferred to Code Case N-249.
1b. When welding is performed on these materials the allowable stress is limited to 12.5 ksi (for 1025CW and 1026CW 13.8 ksi). Materials for nonwelded construction have been transferred to Code Case N-249.
1c. For welded construction the yield strengths tabulated are those for hot rolled material: 32.0 ksi for AISI 1015CW, 1018CW, 1020CW; 35.0 ksi for AISI 1025CW, 1026CW, 8020CW; 36.0 ksi for A500, A501.
2. There is no standard AISI composition 4330. By agreement with the material manufacturer, the carbon content of AISI 4320 can be ordered as 27% to 33%.
3. Up to 2½ in. incl.
4. Over 2½ in. to 4 in.
5. These materials are limited for use only for component standard supports.
6. Max. BHN 215.
7. Max. BHN 225.
8. The elongation and reduction of area requirements for this material may be specified as 17% and 35% minimum, respectively.
9. By agreement between Purchaser and Material Manufacturer, these materials may be procured to the lower specified minimum ultimate tensile strength and minimum yield strength values given in this table.
10. For each forging 250 lb. and less, the marking requirements of A668-79a shall be met by a suitable code or symbol identified by the manufacturer in his Certificate of Compliance or Certified Material Test Report. The hardness test requirement may be performed only on the tensile test specimen.
11. Up to 5/16 in. incl.
12. Over 5 in. to 8 in. incl.
13. Over 4 in. to 5 in. incl.
14. Plates up to 4 in. inclusive and all structural shapes.
15. Proper ventilation for the welder is required when welding on galvanized steel (Ref. ANSI-Z49.1).
16. Up to 7 in. incl.
17. Up to 4 in. incl.
18. Over 4 in. to 7 in. incl.
19. Over 7 in. to 10 in. incl.
20. Over 2½ in. to 6 in. incl.
21. Max. Carbon 0.35%.
22. Up to 1¼ in. incl.
23. Over 5/16 in. to 3/4 in.
24. Up to 1 in.
25. Over 1 in. to 2 in.
26. Over 2 in.
27. Up to 2 in.
28. Threaded rods only.
29. No yield strength or tensile strength specified. Assumed to be the same strength as SA-193 bolting material of the equivalent grade for nut design calculation.