The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

February 25, 1985
ST-HL-AE-1185
File No.: G25, G4.2

Mr. Hugh L. Thompson, Jr.Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Thompson::

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
STP Position On Piping System Support/Building
Structure Jurisdictional Boundary

Pursuant to the November 9, 1984 meeting between the Nuclear Regulatory Commission (NRC), Houston Lighting & Power Company (HL&P) and Bechtel Energy Corporation, enclosed is the requested information that states and justifies the South Texas Project (STP) position on piping system support/building jurisdictional boundary. Based upon the November 9 discussions and the information provided in Attachments to this letter STP considers discussions on this issue to be complete and we are currently implementing the attached position in design and construction.

Attachment 1 is the handout presented and discussed during the November 9, 1984 meeting.

Attachment 2 provides responses to the specific comments by the NRC during the November 9, 1984 meeting.

Attachment 3 provides a detailed assessment of the ASME B&PV Code Section III Subsection NF requirements in relation to current practices on the South Texas Project.

The first draft of this assessment was discussed with the NRC at the November 9, 1984 meeting. This attachment reflects comments discussed in the meeting and includes the requirements for penetrant examinations of all full penetration welds on ASME Class 1 piping system support structures outside the NF boundary.

B001
1/1

W2/MEP/h

If you should have any questions concerning this matter, please contact Mr. Michael E. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

KS:MEP:yd
Attachments

1) Handout From 11/9/84 NRC Meeting
2) Response to NRC Concerns
3) Assessment of ASME B&PV Code, Section III, Subsection NF to STP

W2/MEP/h

cc:

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Washington, DC 20555

SOUTH TEXAS PROJECT

STP POSITION ON

PIPING SYSTEM SUPPORT/BUILDING STRUCTURE
JURISDICTIONAL BOUNDARY

NOVEMBER 9, 1984

STATEMENT

- HL&P IS AWARE OF THE VARIOUS INTERPRETATIONS OF JURISDICTIONAL BOUNDARIES USED AT OTHER CONSTRUCTION SITES. HL&P/BECHTEL HAVE FORMULATED A PROGRAM CONSISTENT WITH THE ASME THAT RESULTS IN A SAFE CONSERVATIVE DESIGN.

PURPOSE

- BRIEF PRESENTATION OF THE STP POSITION.
- RESPOND TO NRC QUESTIONS IN A WORKING MEETING FORMAT.
- STAFF ACCEPTANCE OF THE PROGRAM.

INTRODUCTION

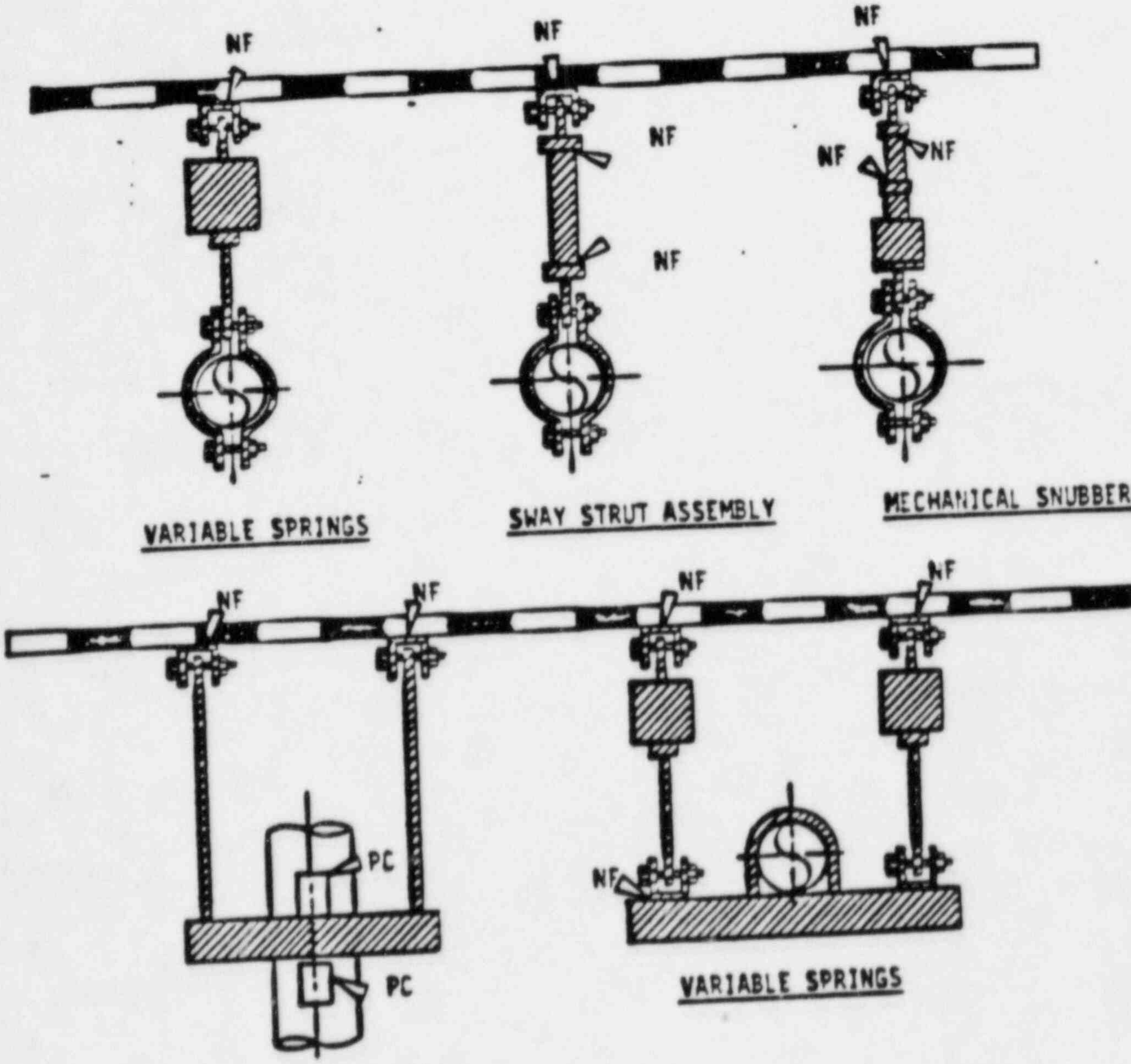
- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND PRESSURE VESSEL CODE SECTION III, SUBSECTION NF, ENTITLED "COMPONENT SUPPORTS", DEFINES THE DESIGN PRACTICES, MATERIAL TO BE USED, WELDING, INSPECTION, DOCUMENTATION, ETC. TO BE USED FOR CLASS 1, 2, AND 3 PIPE SUPPORTS.

- THE CODE ASSIGNS THE RESPONSIBILITY OF DEFINING THE JURISDICTIONAL BOUNDARY TO THE OWNER. THAT IS THE OWNER DEFINES WHERE THE DESIGN, CONSTRUCTION AND INSPECTION BOUNDARIES CHANGE FROM THE STRUCTURAL SPECIFICATIONS TO THE MECHANICAL ENGINEERING CODE.

- STP IS COMMITTED TO SUBSECTION NF OF ASME III 1974 - WINTER 1975 INSIDE THE BOUNDARY.

STP POSITION

o THE STP APPLICATION OF THE NF/AISC BOUNDARY SATISFIES ASME CODE REQUIREMENTS. THE STP POSITION CONSIDERS PIPE SUPPORT STRUCTURAL STEEL UP TO THE CONNECTION OF THE FIRST NF COMPONENT TO BE AN EXTENSION OF THE BUILDING STRUCTURE. COMPONENT STANDARD SUPPORTS AND SHAPES WHICH TRANSMIT LOADS TO THE EXTENSIONS OF BUILDING STRUCTURES ARE CONSIDERED TO BE INSIDE THE NF JURISDICTIONAL BOUNDARY.



VARIABLE SPRINGS

SWAY STRUT ASSEMBLY

MECHANICAL SNUBBERS

VARIABLE SPRINGS

LUG ATTACHMENTS

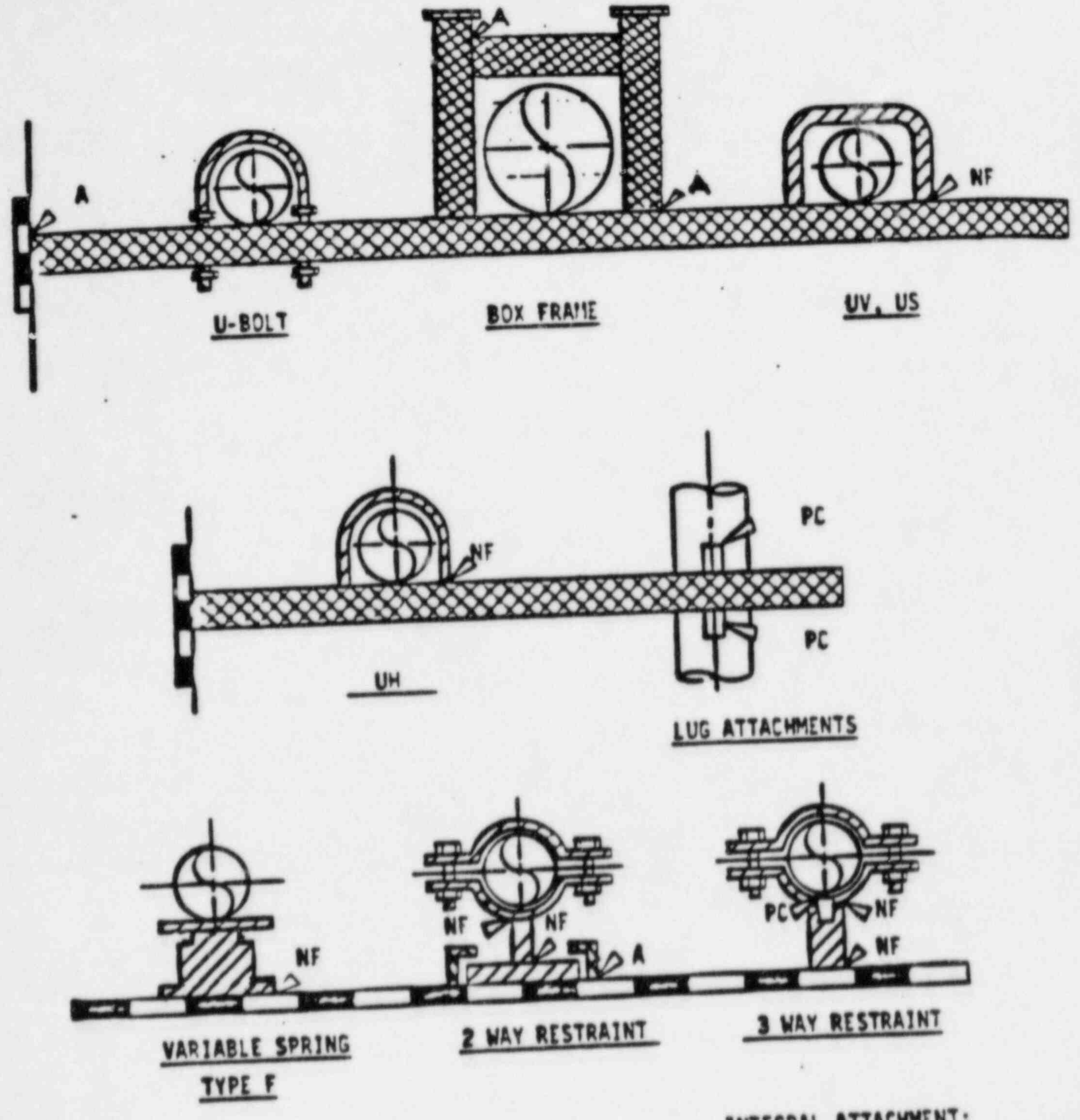
- BUILDING STRUCTURE
- WELDS

PC - PIPE CLASS
NF - SUBSECTION NF
A - AWS

- INTEGRAL ATTACHMENT: MATERI GOVERNED BY PIPE CLASS
- PIPE SUPP. STRUCTURE: MATER GOVERNED BY ASTM W/AISC ALLO
- COMPONENT SUPPORTS: MATERIAL GOVERNED BY NF.

NOTE: ALL LUGS ARE INTEGRAL ATTACHMENTS

NF BOUNDARIES FOR ASME SUPPORTS



- BUILDING STRUCTURE
- WELDS

PC - PIPE CLASS

NF - SUBSECTION NF

A - AWS

- INTEGRAL ATTACHMENT: MATERIAL GOVERNED BY PIPE CLASS
- PIPE SUPP. STRUCTURE: MATERIAL GOVERNED BY ASTM W/AISC ALLOW.
- COMPONENT SUPPORT: MATERIAL GOVERNED BY SUBSECTION NF

NOTE: ALL LUGS ARE INTEGRAL ATTACHMENTS.

NF BOUNDARIES FOR ASME SUPPORTS

STP CRITERIA FOR PIPE SUPPORT STRUCTURES (OUTSIDE BOUNDARY)

DESIGN/ANALYSIS

- THE STP PIPE SUPPORT PROGRAM USES LINEAR ANALYSIS.
- STP USES THE AISC SPECIFICATION STRESS ALLOWABLES WHICH ARE EQUAL TO APPENDIX XVII FOR DESIGN, NORMAL AND UPSET CONDITIONS.
- ASME CODE ALLOWS AN INCREASE OF UP TO 2.1 OF THE STRESS ALLOWABLES (NOT TO EXCEED 0.70 SU OR 2/3 CRITICAL BUCKLING) FOR THE FAULTED LOAD CONDITION. STP HAS CHOSEN TO USE 1.33 TIMES THE NORMAL CONDITION STRESS LIMITS (0.8 SY BUT NOT MORE THAN 2/3 CRITICAL BUCKLING) FOR THE EMERGENCY AND FAULTED CONDITIONS.
- THE LOADING COMBINATIONS USED ARE THE SAME AS THOSE INSIDE THE NF BOUNDARY.
- INCREASED ALLOWABLE STRESSES PERMITTED FOR COMPACT SECTIONS ARE NOT USED.
- MULTIPLE SUPPORTS ARE DESIGNED BY APPLYING THE MAXIMUM LOADING CONDITIONS FROM EACH PIPE SIMULTANEOUSLY.

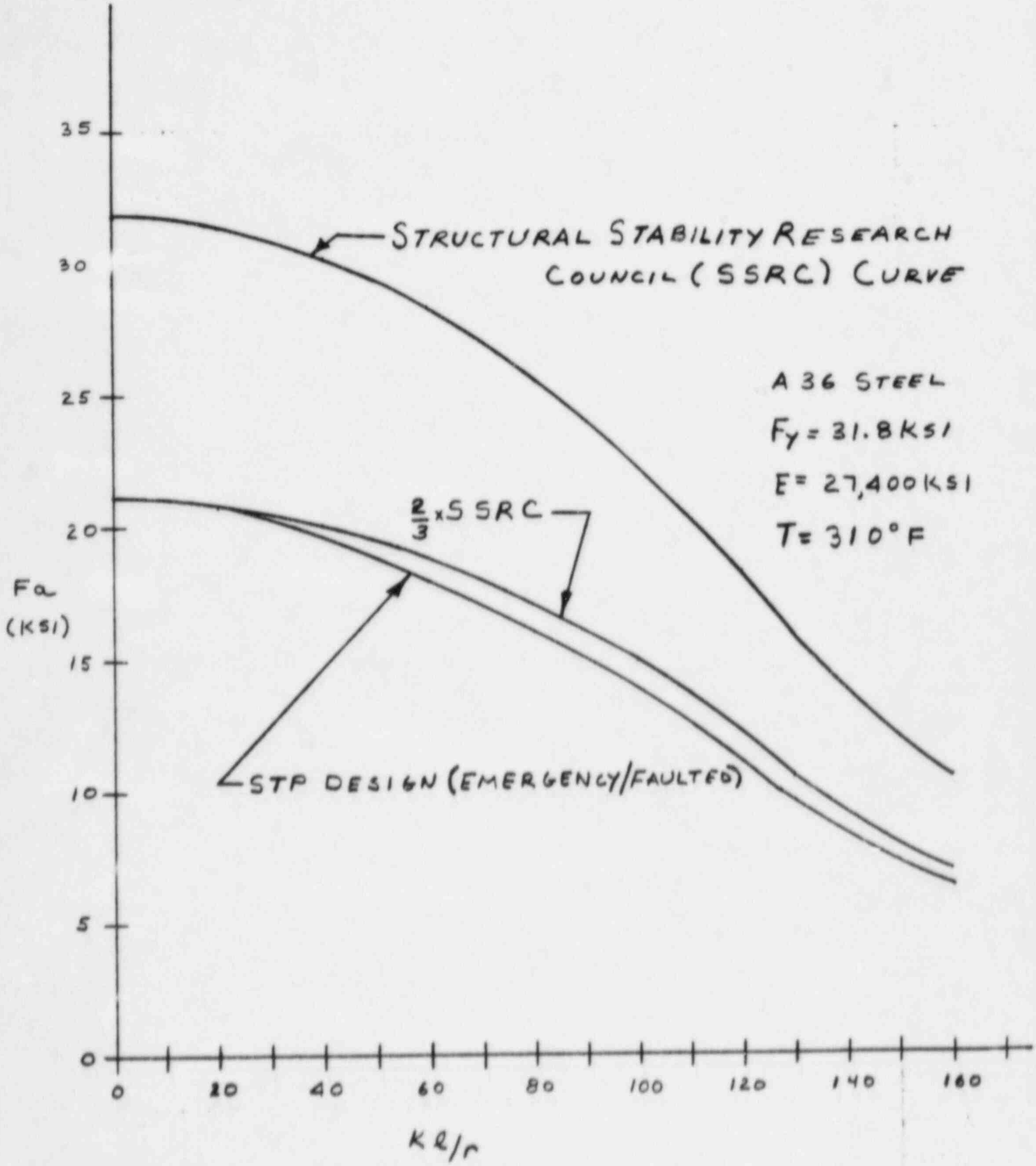
- 2/3 CRITICAL BUCKLING STRESS CRITERIA IS SATISFIED FOR ALL DESIGN CONDITIONS.

- USE OF TUBE STEEL IS MAXIMIZED IN THE SUPPORT DESIGN BASED UPON THE INHERENT STABILITY ASSOCIATED WITH CLOSED SECTIONS.

- STRUCTURAL MEMBERS MEET THE WIDTH-THICKNESS REQUIREMENTS FOR COMPACT SECTIONS.

- COMPRESSION MEMBERS ARE DESIGNED WITH EFFECTIVE LENGTH FACTOR ("K") OF 2.1.

- A LOAD MARGIN OF 15 PERCENT IS INCLUDED IN THE INITIAL DESIGN OF LARGE BORE PIPE SUPPORTS.



ALLOWABE AXIAL COMPRESSIVE STRESS COMPARISON FOR EMERGENCY AND FAULTED CONDITIONS

MATERIAL

- MATERIALS ARE PROCURED FROM QUALIFIED SUPPLIERS WITH AN APPROVED QA PROGRAM.

- CERTIFIED MATERIAL TEST REPORTS (CMTRS), CERTIFICATE OF COMPLIANCES (COCS) OR CERTIFIED MATERIAL LISTS (CMLS) ARE OBTAINED FOR MATERIALS.

- ANSI N45.2.2 AND DAUGHTER STANDARDS ARE APPLIED FOR RECEIVING, STORAGE AND RELEASE TO CONSTRUCTION AT THE JOBSITE.

- MATERIAL RECEIVES UNIQUE IDENTIFICATION COLOR CODING.

- SINCE 1984, A SITE USERS' TEST MARKING IS PROVIDED FOR BULK A-36 STEEL SHAPES AND A-500 GR. B (WITHOUT HEAT TRACEABILITY) USED FOR PIPE SUPPORT STRUCTURES. THE SITE USERS' TEST CONSISTS OF MECHANICAL PROPERTIES TESTING ON SAMPLE BULK LOTS.

- THE QUALITY ASSURANCE ACTIVITIES MEET THE REQUIREMENTS OF 10CFR50 APPENDIX B.

- SITE WELDING CONSUMABLES ARE PROCURED TO ASME II, PART C RECEIVED WITH CMTRS INCLUDING HEAT CODE NUMBER, AND STORED AND DISBURSED IN A CONTROLLED MANNER.

- TRACEABILITY OF SITE WELDING CONSUMABLES IS MAINTAINED UP TO AND INCLUDING THE POINT OF ISSUE.

FABRICATION

- o WELDING PROCEDURES ARE QUALIFIED IN ACCORDANCE WITH EITHER AWS D1.1, (1975 OR LATER).
- o WELDERS ARE QUALIFIED TO AWS D1.1 AND/OR ASME SECTION IX.
- o ALIGNMENT PRIOR TO WELDING IS MONITORED FOR FULL PENETRATION WELDS, PARTIAL PENETRATION WELDS (EXCLUDING TS FLAIR BEVEL WELDS) AND FILLET WELDS WITH A GAP EQUAL TO OR GREATER THAN 1/16 INCH.
- o WELDER QUALIFICATION RECORDS ARE MAINTAINED. PIPE SUPPORT WELDS ARE IDENTIFIED TO A WELDER.
- o WELDED JOINTS ARE VISUALLY INSPECTED AFTER COMPLETION.
- o UNACCEPTABLE WELD DEFECTS ARE REMOVED AND REPAIRED USING SITE APPROVED PROCEDURES. THE AREA IS REINSPECTED TO CONFIRM DEFECT REMOVAL.

EXAMINATION

- THE NDE PROCEDURES ARE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

- THE ACCEPTANCE STANDARDS FOR VISUAL EXAMINATION OF WELDS ARE DEFINED IN THE SPECIFICATIONS AND APPENDIX 3.8B OF THE FSAR.

- SITE PROCEDURES PROVIDE ACCEPTANCE CRITERIA, SUCH AS LIMITATIONS ON ROLL OVER, UNDERCUT, UNDERSIZE WELDS, POROSITY, CRACKS, WELD SPATTER, ARC STRIKES, WELD PROFILE, MISALIGNMENT, FUSION AND OVERSIZE FILLET WELDS.

- AWS VISUAL INSPECTORS ARE QUALIFIED TO REQUIREMENTS OF ANSI N45.2.6.

- QUALIFICATION RECORDS ARE RETAINED IN ACCORDANCE WITH PROJECT REQUIREMENTS.

- INSPECTION IS PERFORMED TO VERIFY SUPPORT DIMENSIONS, CONFIGURATION, CLEARANCES, AND EXAMINATION OF STRUCTURAL WELDS.

SUMMARY

PLANT SAFETY IS ASSURED BY

- o CONSISTENT APPLICATION OF AISC SPECIFICATION
- o ADHERENCE TO NF INSIDE BOUNDARY
- o 2/3 CRITICAL BUCKLING STRESS IS MET FOR ALL DESIGN CONDITIONS
- o CONSERVATIVE ALLOWABLES
- o STRINGENT MATERIAL CONTROL
- o STRINGENT CONTROL OF INSTALLATION AND FABRICATION
- o PROJECT SPECIFIC INSPECTION REQUIREMENTS

ATTACHMENT 2
ST-HL-AE-1185

RESPONSE TO NRC COMMENTS

This attachment provides responses to various comments made by the NRC during the NRC/HL&P/Bechtel Meeting in Bethesda, Maryland on November 9, 1984.

1. Material Shown on Pipe Support Drawings

   STP pipe support drawings show both NF and AISC material on the drawing. Material within the NF boundary is called out in the Bill of Material as NF. Material outside the NF boundary is called out in the Bill of Material as AISC. Welds between the NF portion of the support and that portion of the support outside the boundary are shown as NF. All welds within the NF boundary are NF.

2. Non-Destructive Examination of Full Penetration Welds Outside the NF Boundary

   HL&P has reviewed the current Non-Destructive Examination practices at STP and decided to augment the existing requirements for certain welds in the following manner. Full penetration welds on ASME Class 1 piping system support structures outside the NF boundary will be examined both visually and by the dye penetrant (PT) examination techniques. This modification will provide an additional level of confidence in the continuity of the load path between the NF boundary and the building structure.

3. In-Process Surveillance Inspection (Stop Work Authority)

   Quality control inspectors performing in-process surveillance inspections have stop work authority in accordance with project Quality Assurance and Quality Control procedures. In addition, both the Quality Assurance and Quality Control organizations have the right to increase the frequency of surveillance inspections based on previous inspections.

4. Bolting in the Extension of Building Structure

   The maximum measured ultimate tensile strength of the bolting material does not exceed 170 ksi in view of the susceptibility of high-strength materials to brittleness and stress corrosion cracking.

   A. Preloading Techniques

      Bolts within AISC boundary are installed in accordance with AISC specifications. Bolts are tightened either by turn-of-the-nut method, or by the calibrated wrench method. According to AISC specifications these preloading techniques will produce bolt stresses, on the average, equivalent to 70% of the minimum ultimate tensile strength.

ATTACHMENT 2

B. Stress Corrosion Cracking

Bolting used outside the NF boundary is limited to the following:

ASTM A-307
ASTM A-325
ASTM A-449
ASTM A-540
ASTM A-193
ASTM A-490

Stress corrosion cracking should not be a problem with the above materials as their maximum ultimate tensile strength is less than or equal to 170 ksi.

ATTACHMENT 3

TABLE OF CONTENTS

<u>SUBJECT</u>

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS

MATERIAL

I-ASME NF

NF-2120 COMPONENT SUPPORT MATERIALS

NF-2121 Permitted Material Specification

(a) Except as provided in (b), materials for component supports shall conform to the requirements of the specifications for materials listed in tables of Appendix I applicable to the class of construction as indicated in Table NF-2121(a)-1.

(b) The requirements of this Article do not apply to items such as gaskets, seals, springs, compression spring end plates, bearings, retaining rings, washers, wear shoes, hydraulic fluids, etc. Requirements, if any, for these materials shall be stated in the Design Specifications (NA-3250). Such items shall be made of materials that are not injuriously affected by the fluid, temperature, or irradiation conditions to which the item will be subjected. The component support Manufacturer shall provide the Owner with a list of such materials. These materials do not require Material Manufacturers' Certificates of Compliance (NF-2130).

II-AISC

SECT. 1.4 MATERIAL

1.4.1 Structural Steel

1.4.1.1 Material conforming to one of the following listing (latest date of issue) is approved for use under this specification:

- Structural Steel, ASTM A36
- Welded and Seamless Steel Pipe, ASTM A53, Grade B
- High-Strength Low-Alloy Structural Steel, ASTM A242
- High-Strength Low-Alloy Hot-Rolled Steel Sheet and Strip, ASTM A375
- High-Strength Structural Steel, ASTM A440
- High-Strength Low-Alloy Structural Manganese Vanadium Steel, ASTM A441
- Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, ASTM A500
- Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, ASTM A501

III-STP PRACTICE OUTSIDE THE NF BOUNDARY

**

* ASTM - A - 36 - Plates-Shapes-Bars
* ASME - SA - 36 - Plates-Shapes-Bars
ASTM - A - 500 Tubing

Bolts	Nuts
ASTM A - 325	A - 194
A - 490	A - 563
A - 307	
A - 449	
A - 540	
A - 193	

Ref SS - 0026
GS - 1009

* ASME SA-36 and ASTM A-36 Identical

IV-COMMENTS

Materials for Construction inside and outside the boundary are similar

** These are the only materials used at STP for pipe support structures outside the boundary.

NOTES:
1. Column I identifies excerpts from the NF Code.
2. Column II identifies excerpts from the AISC specification
3. Column III identifies STP practices outside the boundary that may be different from I or II or limitations of I or II.
4. Column IV states pertinent comments as required to clarify the previous columns.
5. NPSI stands for Nuclear Power Services, Incorporated

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Materials Used ASME - SA - 36 Plate - Bars - Shapes ASME - SA - 266 Forging ASTM - A - 500- Tubing-Code Case 1644 ASTM - A 668 - Forging-Code Case 1644 Bolting Materials SA - 193 SA - 194 - Code Case 1644 SA - 307 - Code Case 1644 SA - 325 - Code Case 1644 SA - 449 - Code Case N-71 SA - 490 - Code Case 1644			
Welding Consumables ASME II Part C	Welding Consumables to AWS - A 5.1, 5.5, 5.17, 5.18, 5.20	Welding Consumables Site-ASME II Part-C All consumables (ASME-AWS) procured To highest standard of anticipated use. Ref. WS - 0001 NPSI - ASME II Part C Ref. JS - 1000	
NF-2122 Special Requirements Conflicting with Permitted Material Specifications Special requirements stipulated in this Article shall apply in lieu of the requirements of the material specifications wherever the special requirements conflict with the material specification requirements [NA-3766.6(a)(1)]. When the special requirements include an examination, test, or treatment which is also required by the material specification, the examination, test, or treatment need be performed only once. All required nondestructive examinations shall be performed as specified for each product form in NF-2500. Any examination, repair, test, or treatment required by a material specification or by this Article may be performed by the	Not specifically addressed, however material is supplied with certification to the ASTM Specification.	Examination, Tests and Repair in accordance with the material Specification. Ref. SS030	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Material Manufacturer, Manufacturer, or the Installer, as provided in NF-4121. Pipe or tube materials used under the rules of Subsection NF need not be hydrostatically or pneumatically tested. Provided these meterials are not used to retain pressure. Examination, tests and repair in accordance with the material specification.			
NF-2124 Size Ranges Material outside the limits of size or thickness given in any specification in Section II may be used. If the material is in compliance with the other requirements of the specification and no size limitation is given in the rules for construction. In those specifications in which chemical composition or mechanical properties are indicated to vary with size or thickness, Any material outside the specification range shall be required to conform to the composition and mechanical properties shown for the nearest specified range [NA-3766.6(a)(1)]. There are no exceptions taken to the specifications for materials supplied, with the exception of limiting the Carbon Content to Tighter Limits on Forgings to improve weldability	Not addressed	There are no exceptions taken to the specification for material supplied	
NF-2130 CERTIFICATION BY MATERIALS MANUFACTURER All materials used in the construction of component supports shall be certified as required in NA-3767.4 and NA-3767.5. Certified Material Test Reports shall be provided for material for Class 1 plate and shell	1.4.1.1 Certified mill test reports or certified reports of tests made by the fabricator or a testing laboratory in accordance with ASTM A6 and the governing specification shall constitute sufficient evidence of conformity with one of the above ASTM specifications. Additionally, the fabricator shall, if requested, provide an affi-	Non NPSI Supplied Site Ordered Material - CMTR Required For Bulk Supplied Material NPSI supplied-CMTP for Class 1, CMTP, CML, or COC for Class 2-3 Ref. SS0030	In addition the Site User Test Program is used to confirm material conforms to certification

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL supports, Class 1 linear supports, and material for other types and Classes of component supports when impact testing is required (NF-2311). A Certificate of Compliance in lieu of a Certified Material Test Report may be provided for material for all other component supports. Copies of all Certified Material Test Reports and Certificates of Compliance applicable to each material used in the component support shall be furnished with the material. CMTR required for Class 1 and impact tested material COC required for Class 2-3 CML (Certified material Listing) Allowed by Code Case N 225 May be supplied in lieu of COC	davit stating that the structural steel furnished meets the requirements of the grade specified. 1.4.1.2 Unidentified steel, if free from surface imperfections, may be used for parts of minor importance, or for unimportant details, where the precise physical properties of the the steel and its weldability would not affect the strength of the structure. Code of Standard Practice SECT. 6 INSPECTION AND DELIVERY (a) Test of Materials Mill tests are performed to demonstrate material conformance to contract requirements. Unless special requirements are included in the invitation to bid, mill testing is limited to those tests required by the applicable ASTM material specifications. Mill test reports are furnished by the fabricator only if requested by the owner in either the invitation to bid or otherwise made in writing prior to the time the fabricator places his material orders with the mill. The fabricator customarily makes no tests of steel material. The owner must rely on mill tests required by contract and on such additional tests as he orders the fabricator to have made at the owner's expense. If tests other than mill tests are desired, the owner so specifies in th invitation to bid and should arrange for such testing through the fabricator.	Expansion Anchors: Expansion Bolts including Hilti Kwik Bolts and Maxi Bolts supplied as Safety Related Items Rock Bolts supplied as commercial Item - Certification is by user Tests per SS1000 Ref. SS1007 Bolting Materials: ASTM A - 325 - COC* A - 490 - COC A - 307 - COC A - 194 - COC A - 563 - COC A - 449 - CMTR A - 540 - CMTR A - 193 - CMTR	 *COC = Certificate of Conformance

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL			
NF-2140 WELDING AND BRAZING MATERIALS For the requirements governing the materials to be used for welding and brazing, see NF-2400. Welding Consumable Procured to ASME II Part C	1.4.5 Filler Metal for Welding Welding electrodes for manual shielded metal-arc welding shall conform to the Specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.5, latest edition. Bare electrodes and granular flux used in the submerged-arc process shall conform to F60 or F70 AWS-flux classifications of the Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding, AWS A5.17, latest edition, or the provisions of Sect. 1.17.3. E60S or E70S electrodes used in the gas metal-arc process shall conform to the Specification for Mild Steel Electrodes for Gas Metal-Arc Welding, AWS A5.18, latest edition, or the provisions of Sect. 1.17.3; E60T or E70T electrodes used in the flux cored-arc process shall conform to the Specification for Mild Steel Electrodes for Flux-Cored-Arc Welding, AWS A5.20, latest edition, or the provisions of Sect. 1.17.3. Manufacture's certification shall constitute sufficient evidence of conformity with the specifications.	Ref. SS0026 and GS1009 Welding concumable procured to ASME II Part C Ref. WS0001	
NF-2150 MATERIAL IDENTIFICATION The identification of material requiring Certified Material Test Reports shall meet the requirements of NA-3766.6. Materials furnished with Certificates of Compliance shall be identified with the applicable material specification, grade, and	SUPPLEMENT 3 "1.26.5 Identification of Steel The fabricator shall be able to demonstrate by a written procedure and by actual practice a method of material application and traceability, visible at least through the 'fit up' operation, of the main stress carrying	Class 1 Components: All material supplied by NPSI has heat number grade and Class indicated on the material. Class 2 & 3 and NPSI bulk supplied same as Class 1. NPSI fabricated and Non-NPSI bulk identification to heat number is maintained	Site practice is in excess of AISC requirements with regard to stock or bulk material. In addition construction materials are further verified during site user tests. Ref. SS0030 SCN 20

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL class. Materials for small items shall be controlled during the manufacture of the component supports so that they are identifiable as acceptable material until the material is actually consumed in the process. Material supplied with CMTR's as required by NF-2130 must carry the specification, grade and heat number through to the completed component stage. Material supplied with a COC as required by NF-2130 need only be marked with the specification and grade. Alternately the supplier may involve Code Case N-225 for material which is permitted to be supplied with a COC. Identification of the material to the materials manufacturerers certificate of compliance is not required after the component support manufacturer or the material supplier who furnishes component supports as material, has verified that the material meets the specification. Therefore material supplied to code case N-225 does not require permanent marking traceable to the to the certification document.	elements of a shipping piece. The traceability method shall be capable of verifying proper material application as it relates to: A. Material specification designation B. Heat number, if required C. Material test report for special requirements" Code of Standard Practice SECT. 5 STOCK MATERIALS (a) Many fabricators maintain stocks of steel products for use in their fabricating operations. Such materials as are taken from stock by the fabricator for use for structural purposes must be of a quality at least equal to that required by the specifications of the American Society for Testing and Materials applicable to the classifications covering the intended use. Mill test reports are accepted in the trade as sufficient record of the quality of materials carried in stock by the fabricator. The fabricator checks and retains the mill test reports covering the materials he purchases for stock, but, because it is obviously impracticable to do so, he does not maintain records such as would identify individual pieces of stock material against individual mill test reports. Such records are not required if the fabricator	Ref. WPP 23.0 Para 6.1 ATS-5 Para 12.4	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL			
Code Case N-225 also allows the supplier to provide a CML (Certified material listing) in lieu of a COC.	purchases for stock under established specifications as to grade and quality and the purchases can be checked against mill test reports. (b) It is common practice for the fabricator to use steel materials from his stock in his faoricating operations whenever he desires to do so, instead of ordering items from the mill for the specific use. Stock materials purchased under no particular specifications or under specifications less rigid than those mentioned above, or stock materials which has not been subject to mill or other recognized test reports, are not used without the express approval of the owner and then only under rigid inspection, except that such material may be used for small unimportant details where the quality of the material could not affect the strength of the structure.		
NF-2160 DETERIORATION OF MATERIAL IN SERVICE Consideration of deterioration of materials caused by service is generally outside the scope of this Subsection. It is the responsibility of the Owner to select materials suitable for the conditions stated in the Design Specifications (NA-3250), with specific attention being given to the effect of service conditions upon the properties of the materials. Requirements of ANSI N45.2.2 Level D Site Procedure GS1002	Not Addressed	Material and Components are received, unloaded, handled, an of stored in designated areas. Requirements of ANSI N45.2.2 Level D apply. Site Procedure GS1002	Site Procedure GS1002 Rev. 3 Complies with ANSI N45.2.2 for Level D Storage Additional Environmental conditions are specified Insite Procedure Requirements imposed on vendors see JS1000 and JQ1000

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL			
NF-2170 HEAT TREATMENT TO ENHANCE IMPACT PROPERTIES Carbon steel, low-alloy steels, and high-alloy chromium (Series 4XX) steels may be heat treated by quenching and tempering to enhance their impact properties [NA-3766(a)(1)]. Postweld heat treatment of the component at a temperature of not less than 1100F may be considered to be the tempering phase of the heat treatment. Not applicable to materials involved at this time	1.4.1.1 Only Applicable to ASTM A-514	Not applicable.	No quenched and tempered materials involved. No PWHT involved at this time may be required on later components NPSI has not supplied any component requiring PWHT-they have an approved procedure if required
NF-2211 Test Coupon Heat Treatment for Ferritic Materials[1] When ferritic steel materials are subjected to heat treatment during construction of a component, the material used for the impact test specimens shall be heat treated in the same manner as the component, except that test coupons and specimens for P-No. 1 materials with a nominal thickness of 2 in. or less are not required to be so heat treated. The component support Manufacturer shall provide the Material Manufacturer with the temperature and heating and cooling rate to be used. In case of postweld heat treatment, the total time at temperature or temperatures for the test material shall be at least 80% of the total time at temperature or temperatures during actual postweld heat treatment of the material, and the total time at temperature or temperatures for the test material may be performed in a single cycle.	1.2.3.6 When required by the plans or specifications, welded assemblies shall be stress relieved by heat treating in accordance with the provisions of Article 310 of AWS D1.0-69. The technique of welding employed, the appearance and quality of welds made, and the methods used in correcting defective work shall conform to Section 3 - Workmanship and Section 4 - Technique of the Code for Welding in Building Construction, D1.0-69, of the American Welding Society, except that the tolerance for flatness of girder webs given in Article 305 need not apply for statically loaded girders.	Not applicable.	Materials used do not require inprocess heat treatment.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Any postweld heat treatment time which is anticipated to be applied to the material or item after it is completed shall be specified in the Design Specification. The manufacturer shall include this time in the total time at temperature specified to be applied to the test specimens. No inprocess heat treatment required.			
NF-2212 Test Coupon Heat Treatment for Quenched and Tempered Materials Through and Including NF-2222 Not applicable to materials involved.	1.4.1 ASTM A514 Only Q&T Material	Not applicable.	No quenched and tempered materials involved.
NF-2300 FRACTURE TOUGHNESS REQUIREMENTS FOR MATERIALS NF-2310 MATERIALS TO BE IMPACT TESTED NF-2311 Component Supports For Which Impact Testing of Materials Is Required The Design Specifications (NA-3250) for each component support shall state whether impact testing is required for the materials of which the support is constructed. When so required the impact test temperature shall be specified and the tests become a requirement of this Section. Supports integral with components shall meet the requirements for impact testing stipulated for such components in the applicable	Not Addressed	Not applicable.	Materials utilized by STP for pipe support construction outside the NF boundary do not require impact tests.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Subsection. The requirements for nonintegral supports shall be as specified in NF-2300, except that the materials described in (a) through (g) below are not to be impact tested as a requirement of this Subsection: (a) Materials with a nominal section thickness of 5/8 in. and less; (b) Bolting, including studs, nuts, and bolts, with a nominal size of 1 in. and less; (c) Bars with a nominal cross sectional area of 1 sq in. and less; (d) Materials for fittings with all pipe connections of 5/8 in. nominal wall thickness and less; (e) Austenitic stainless steels; (f) Nonferrous materials; (g) Materials for supports when the maximum stress does not exceed 6000 psi tension or is compressive. Only for Integral Components.			
NF-2320 IMPACT TEST PROCEDURES NF-2321 Charpy V-Notch Tests The Charpy V-notch test (C) when required, shall be performed in accordance with SA-370. Specimens shall be in accordance SA-370, Fig. 11, Type A. A test shall consist of a set of three full-size 10 x 10 mm specimens. The test temperature and the lateral expansion, the absorbed energy and per cent shear fracture as well as the orientation and location of all tests performed to meet the requirements of NF-2330 shall be reported in the Certified Material Test Report.	Not Addressed	Not applicable.	Materials utilized by STP for support construction outside the NF boundary do not require impact tests.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Through and Including NF-2360 Only for Integral Attachments			
NF-2400 WELDING AND BRAZING MATERIALS NF-2410 GENERAL REQUIREMENTS All welding materials used in the construction and repair of components or material, except welding materials used for hard surfacing, shall conform to the requirements of the welding material specification or to the requirements for other welding material as permitted in Section IX. In addition, welding material shall conform to the requirements stated in this Subarticle and to the rules covering identification in NF-2150. Through and Including NF-2450 Welding Consumables Conform to ASME II Part C No Brazing on Components	1.4.5 Filler Metal for Welding Welding electrodes for manual shielded metal-arc welding shall conform to the Specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1, latest edition, or the Specification for Low-Alloy Steel Covered Arc-Welding Electrodes, AWS A5.5, latest edition. Bare electrodes and granular flux used in the submerged-arc process shall conform to F60 or F70 AWS-flux classifications of the Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding, AWS A5.17, latest edition, or the provisions of Sect. 1.17.3. E60S or E70S electrodes used in the gas metal-arc process shall conform to the Specification for Mild Steel Electrodes for Gas Metal-Arc Welding, AWS A5.18, latest edition, or the provisions of Sect. 1.17.3; E60T or E70T electrodes used in the flux cored-arc process shall conform to the Specification for Mild Steel Electrodes for Flux-Cored-Arc Welding, AWS A5.20, latest edition, or the provisions of Sect. 1.17.3. Manufacturer's certification shall constitute sufficient evidence of conformity with the specifications.	Welding Consumables Site - For all applications (ASME-AWS-AISC) conform to ASME II Part C. Ref. WS0001 Welding Consumables NPSI ordered to ASME III Part C Ref. JS1000 See comment.	The site procures all Welding Consumables to the highest level of anticipated use. This practice precludes the use of unqualified consumables No brazing on pipe support structures outside the NF boundary

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL Visual examination shall be applied to the areas of threads, shanks, and heads of final machined parts. Harmful discontinuities such as laps, seams, or cracks that would be determinetal to the intended service are unacceptable.			
NF-2585 Repair By Welding Weld repairs of bolting material and rods are not permitted.	Not Addressed	No Weld repairs made to bolts or rods Ref. IS1000 Para 7.1.2	ASTM specifications for bolting material do not provide for weld repair
NF-2600 MATERIAL MANUFACTURER'S QUALITY SYSTEM PROGRAMS NF-2610 DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS Material Manufacturers shall document and maintain Quality System Programs (NA-3700). JS1000 involves the use of the 1976 Summer Addenda see below. NF-2610 DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS (a) Except as provided in (b) below, Material Manufactures and Material Suppliers shall have a Quality System Program or an Identification and Verification Program, as applicable, which meets the requirements of NA-3700.	SECT. 1.26 QUALITY CONTROL 1.26.1 General The fabricator shall provide quality control procedures to the extent that he deems necessary to assure that all work is performed in accordance with this specification. In addition to the fabricator's quality control procedures, material and workmanship at all times may be subject to inspection by qualified inspectors representing the purchaser. If such inspection by representatives of the purchaser will be required, it shall be so stated in the information furnished to the bidders. 1.26.2 Cooperation As far as possible all inspection by representatives of the purchaser shall be made at the fabricator's plant. The fabricator shall cooperate with the inspector, permitting access for inspection to all places where work is being done. The purchaser's inspector shall		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS
MATERIAL			
NF-2500 EXAMINATION AND REPAIR OF MATERIALS NF-2510 EXAMINATION AND REPAIR OF MATERIALS OTHER THAN BOLTING Materials for component supports shall be examined in accordance with material specifications. Unacceptable defects may be repaired as permitted by the material specification. Material examined and repaired in accordance with the material specification.	Not specifically Addressed	Material examined and repaired in accordance with the material specification Ref. SS00026	In addition to the repair criteria detailed in the material specifications The site uses CSP82 and CSP86 to control repairs of AWS or ASME materials Repairs outside the limits noted in the material specifications are dispositioned on an "NCR"
NF-2580 EXAMINATION OF BOLTING MATERIALS AND RODS NF-2581 Required Examinations NF-2581.1 For Class 1 Component Supports. All bolting materials and rods shall be visually examined (NF-2582). Nominal sizes greater than 2 in. shall be examined by either the magnetic particle or liquid penetrant method (NF-2583). In addition, nominal sizes greater than 4 in. shall be ultrasonically examined as required by NF-2584. NF-2581.2 For Class 2, 3 and MC Component Supports. Bolts, studs, and nuts shall be examined in accordance with the requirements of the material specification and NF-2582. NF-2582 Visual Examination	1.4.4 Bolts High strength steel bolts shall conform to one of the following specifications, latest edition: High Strength Bolts for Structural Steel Joints, Including Suitable Quenched and Tempered Steel Bolts and Studs, ASTM A449 Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints, ASTM A490 Other bolts shall conform to the Specification for Low-Carbon Steel Externally and Internally Threaded Standard Fasteners, ASTM A307, latest edition, hereinafter designated as A307 bolts. Manufacturer's certification shall constitute sufficient evidence of conformity with the specifications.	All bolting material inspected by the Supplier in accordance with the ASTM specifiation. All ASTM A-540 Bolting materials require vendor to perform visual inspection and for Bolts over 2" a PT or MT In addition all category 1 bolts get a user test where the properties reported by the supplier are confirmed Ref. SS0030 CS0027 (PLT-Testing Spec)	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE NF BOUNDARY	IV-COMMENTS

MATERIAL

TABLE 1.17.2

** Base Metal	WELDING PROCESS[1, 2] Shielded Metal-Arc	Submerged-Arc	Gas Metal-Arc	Flux Cored-Arc
ASTM A36, A53 Gr. B, A375, A500, A501, A529, and A570 Gr. D and E	AWS A5.1 or A5.5, E60XX or E70XX[3]	AWS A5.17 F6X or F7X-EXXX	AWS A5.18 E70S-X or E70U-1	AWS 5.20 E60T-X or E70T-X (except EXXT-2 and EXX-3
ASTM A242, A441, A572 Grades 42 thru 60 and A588[4]	AWS A5.1 or A5.5, E70XX[5]	AWS A5.17 F7X-EXXX	AWS A5.18 E70S-X or E70U-1	AWS 5.20 E70T-X (Except E70T-2 and E70T-3)
ASTM A572 Grade 65	AWS A5.5 E80XX[5]	Grade F80	Grade E80S	Grade E80T
ASTM A514 over 2 1/2" thick	AWS A5.5 E100XX[5]	Grade F100	Grade E100S	Grade E100T
ASTM A514 2 1/2" thick and under	AWS A5.5 E110XX[5]	Grade F110	Grade E110S	Grade E110T

Use of the same type filler metal having next higher mechancial properties is permitted.

1. When welds are to be stress relieved the deposited weld metal shall not exceed 0.05 percent vanadium.
2. See Article 422 of AWS D1.0-69 for electroslag and electrogas weld metal requirements.
3. On joints involving base metals of different yield strengths, filler metals applicable to the lower yield strength may be used.
4. For architectural exposed bare unpainted applications, the deposited weld metal shall have similar atmospheric corrosion resistance and coloring characteristics as the base metal used. The steel manufacturer's recommendation shall be followed.
5. Low hydrogen classifications.

** Table 1.17.2 is included in its entirety for completeness. Actual materials used for pipe support construction outside the NF boundary are limited to those materials indicated on Page 1M.

I-ASME NF | II-AISC | III-STP PRACTICE OUTSIDE THE NF BOUNDARY | IV-COMMENTS

MATERIAL

(b) the requirements of NA-3767.4 shall be met as required by NF-2130. The other requirements of NA-3700 need not be used by Material Manufacturers or Material Suppliers for small products, as defined in (c) below, and for material which is allowed by this Section to be furnished with a Certificate of Compliance. For these products, the Manufactuer's or Installer's Quality Assurance Program (NA-4000) shall include measures to provide assurance that the material is furnished in accordance with the material specification, and the special requirements of this Section.

(c) For the purpose of this paragraph, small products are defined as given in (1) through (3) below:

(1) pipe, tube, pipe fittings, and flanges of 2 in. nominal size and less

(2) bolting material including studs, nuts, and bolts of 2 in. nominal diameter and less

(3) structural material with a nominal cross-sectional area of 2 sq in. and less

(d) When impact testing is required in accordance with NF-2300, the material not exempted by NF-2311 shall be furnished with Certified Material Test Reports in accordance with NA-3767.4.

so schedule his work as to provide the minimum interruption to the work of the fabricator.

1.26.3 Rejections

Material or workmanship not in reasonable conformance with the provisions of this Specification may be be rejected at any time during the progress of the work. The fabricator shall receive copies of all reports furnished to the purchaser by the inspection agency.

1.26.4 Inspection of Welding

The inspection of welding shall be performed in accordance with the provisions of Section 6 of the Code for Welding in Building Construction, D1.0-69, of the American Welding Society.

When non-destructive testing is required, the process, extent, technique and standards of acceptance shall be clearly defined in information furnished to the bidders.

NPSI Supplied material invokes NA3767.4 and ANSI N45.2

Ref. JS1000

Non-NPSI supplied material invokes ANSI N-45.2

Ref. SS0030

II COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE TENSION STRESS

ASME

XVII-2211 Stress In Tension

The allowable stress in tension shall be as given in (a), (b), and (c) below.

(a) On the net section, except at pin holes, the allowable stress in tension shall be:

$$F_t = 0.60 S_y \quad (1)$$

but not more than 0.5 times the minimum tensile strength of the steel.

(b) On the net section at pin holes in eyebars, pin-connected plates, or built up members, the allowable stress in tension shall be:

$$F_t = 0.45 S_y \quad (2)$$

(c) XVII-2461.1 provides the rules for the design of threaded parts in tension.

XVII-2461.1 Tensile Stress Only. Bolts loaded in direct tension shall be so proportioned that their average tensile stress, F_{ba}, computed on the basis of the actual tensile stress area available (independent of any initial tightening force), shall not exceed:

(a) For ferritic steels:

$$F_{ba} = \frac{S_u}{2}$$

(b) For austenitic steels:

$$F_{ba} = \frac{S_u}{3.33}$$

S_u is the ultimate tensile strength at temperature. The applied load shall be the sum of the external load and any tension resulting from prying action produced by deformation of the connected parts.

AISC

1.5.1.1 Tension

On the net section, except at pin holes:

$$F_t = 0.60 F_y$$

but not more than 0.5 times the minimum tensile strength of the steel.

On the net section at pin holes in eyebars, pin-connected plates or built-up members:

$$F_t = 0.45 F_y$$

For tension on threaded parts see Table 1.5.2.1.

1.5.2 Rivets, Bolts, and Threaded Parts

1.5.2.1 Allowable tension and shear stresses on rivets, bolts and threaded parts (kips per square inch of area of rivets before driving or unthreaded-body area of bolts and threaded parts except as noted) shall be as given in Table 1.5.2.1. High strength bolts required to support applied load by means of direct tension shall be so proportioned that their average tensile stress, computed on the basis of nominal bolt area and independent of any initial tightening force, will not exceed the appropriate stress given in Table 1.5.2.1. The applied load shall be the sum of the external load and any tension resulting from prying action produced by deformation of the connected parts.

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE SHEAR STRESS

ASME	AISC	STP PRACTICE
XVII-2212 Stress in Shear On the gross section, the allowable stress in shear shall be: $F_v = 0.40S_y$ (3) The gross section of rolled and fabricated shapes may be taken as the product of the overall depth and the thickness of the web. XVII-2263.2 gives the reduction in shear stress required for thin webs.	**1.5.1.2 Shear** On the gross section: $F_v = 0.40F_y$ (The gross section of rolled and fabricated shapes may be taken as the product of the overall depth and the thickness of the web. See Sect. 1.10 for reduction required for thin webs. For discussion of high shear stress within boundaries of rigid connections of members whose webs lie in a common plane, see Commentary Sect. 1.5.1.2.)	SAME AS AISC

ALLOWABLE COMPRESSION STRESS

ASME	AISC	STP PRACTICE
XVII-2213 Stress in Compression The allowable stress in compression shall be as required by the following subparagraphs. **XVII-2213.1 For Gross Sections Where Kl/r Is Less Than C_c.** On the gross section of axially loaded compression members when Kl/r, the largest effective slenderness ratio of any unbraced segment as defined in XVII-2240, is less than C_c, the allowable stress in compression shall be:	**1.5.1.3 Compression** **1.5.1.3.1** On the gross section of axially loaded compression members when Kl/r, the largest effective slenderness ratio of any unbraced segment as defined in Sect. 1.8, is less than C_c: $$F_a = \frac{\left[1 - \frac{(Kl/r)^2}{2C_c^2}\right]F_y}{\frac{5}{3} + \frac{3(Kl/r)}{8C_c} - \frac{(Kl/r)^3}{8C_c^3}} \quad (1.5\text{-}1)$$ where $C_c = \sqrt{\frac{2\pi^2 E}{F_y}}$	SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE COMPRESSION STRESS (Con't)

ASME

$$F_a = \frac{\left[1 - \frac{(Kl/r)^2}{2C_c^2}\right] S_y}{\frac{5}{3} + \frac{3(Kl/r)}{8C_c} - \frac{(Kl/r)^3}{8C_c^3}} \qquad (4)$$

where

$$C_c = \sqrt{\frac{2\pi^2 E}{S_y}}$$

XVII-2213.2 For Gross Sections Where Kl/r Is Greater Than C_c. On the gross section of axially loaded compression members when Kl/r exceeds C_c, the allowable stress in compression shall be:

$$F_a = \frac{12\pi^2 E}{23\,(Kl/r)^2} \qquad (5)$$

XVII-2213.3 For Gross Sections Where the Slenderness Ratio Exceeds 120. On the gross section of axially loaded bracing and secondary members, when l/r exceeds 120,[1] the allowable stress in compression shall be:

$$F_{as} = \frac{F_a[\text{Eq. (4) or (5)}]}{1.6 - \frac{l}{200r}} \qquad (6)$$

XVII-2213.4 For Plate Girder Stiffeners. On the gross area of plate girder stiffeners, the allowable stress in compression shall be:

$$F_a = 0.60 S_y \qquad (7)$$

XVII-2213.5 For Webs of Rolled Shapes. On the webs of rolled shapes at the toes of the fillets, the allowable stress in compression shall be:

$$F_a = 0.75 S_y \qquad (8)$$

AISC

1.5.1.3.2 On the gross section of axially loaded compression members, when Kl/r exceeds C_c:

$$F_a = \frac{12\pi^2 E}{23(Kl/r)^2} \qquad (1.5\text{-}2)$$

1.5.1.3.3 On the gross section of axially loaded bracing and secondary members, when l/r exceeds 120:**

$$F_{as} = \frac{F_a\,[\text{by Formula (1.5-1) or (1.5-2)}]}{1.6 - \frac{l}{200r}} \qquad (1.5\text{-}3)$$

1.5.1.3.4 On the gross area of plate girder stiffeners:

$$F_a = 0.60 F_y$$

1.5.1.3.5 On the web of rolled shapes at the toe of the fillet (crippling, see Sect. 1.10.10):

$$F_a = 0.75 F_y$$

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE BENDING STRESS

ASME

XVII-2214 Stress in Bending

The allowable bending stress resulting from tension and compression in structural members shall be as required by the following subparagraphs.

XVII-2214.1 In Compact Sections

(a) Tension and compression on extreme fibers of compact hot rolled or built up members symmetrical about and loaded in the plane of their minor axes and meeting the requirements of Subsection NF shall result in a maximum bending stress:

$$F_b = 0.66S_y \qquad (9)$$

In order to qualify, a member shall meet the requirements of (1) through (5) below.

(1) The flanges shall be continuously connected to the web or webs.

(2) The width to thickness ratio of unstiffened projecting elements of the compression flange, as defined in XVII-2224, shall not exceed $52.2/\sqrt{S_y}$.

(3) The width to thickness ratio of stiffened elements of the compression flange, as defined in XVII-2224, shall not exceed $190/\sqrt{S_y}$.

(4) The depth to thickness ratio of the web or webs shall not exceed the value

$$d/t = 412\left(1 - 2.33\frac{F_a}{S_y}\right)\Big/\sqrt{S_y} \qquad (10)$$

except that it need not be less than $257/\sqrt{S_y}$.

(5) The compression flange shall be supported laterally at intervals not to exceed $76b_f/\sqrt{S_y}$ or

$$\frac{20{,}000}{(d/A_f)S_y}.$$

AISC

1.5.1.4 Bending

1.5.1.4.1 Tension and compression on extreme fibers of compact hot-rolled or built-up members (except hybrid girders and members of A514 steel) symmetrical about, and loaded in, the plane of their minor axis and meeting the requirements of this section:

$$F_b = 0.66F_y$$

In order to qualify under this section a member must meet the following requirements:

a. The flanges shall be continuously connected to the web or webs.
b. The width-thickness ratio of unstiffened projecting elements of the compression flange, as defined in Sect. 1.9.1.1, shall not exceed $52.2/\sqrt{F_y}$.
c. The width-thickness ratio of stiffened elements of the compression flange, as defined in Sect. 1.9.2.1, shall not exceed $190/\sqrt{F_y}$.
d. The depth-thickness ratio of the web or webs shall not exceed the value given by Formula (1.5-4a) or (1.5-4b), as applicable.

$$d/t = \frac{640}{\sqrt{F_y}}\left(1 - 3.74\frac{f_a}{F_y}\right) \quad \text{when } f_a/F_y \le 0.16 \qquad (1.5\text{-}4a)$$

$$d/t = 257/\sqrt{F_y} \quad \text{when } f_a/F_y > 0.16 \qquad (1.5\text{-}4b)$$

e. The laterally unsupported length of the compression flange of members other than circular or box members shall not exceed the value

$$\frac{76b_f}{\sqrt{F_y}} \quad \text{nor} \quad \frac{20{,}000}{(d/A_f)F_y}$$

"f. The laterally unsupported length of the compression flange of a box-shaped member of rectangular cross section whose depth is not more than 6 times the width and whose flange thickness is not more than 2 times the web thickness shall not exceed the value

$$\left(1950 + 1200\frac{M_1}{M_2}\right)\frac{b}{F_y}$$

except that it need not be less than $1200(b/F_y)$.

STP PRACTICE

$0.60\ S_y$

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE BENDING STRESS (Con't)

ASME

(b) Beams and girders (including members designed on th· basis of composite action) which meet the requirements of (1) through (5) above and are continuous over supports or are rigidly framed to columns by r.eans of high strength bolts or welds may be proportioned for nine-tenths of the negative moments produ·:ed by gravity loading which are maximum at points of support, provided that, for such members, the maximum positive moment shall be increased by one-tenth of the average negative moments. This reduction shall not apply to moments produced by loading on cantilevers. If the negative moment is resisted by a column rigidly framed to the beam or girder, the one-tenth reduction may be used in proportioning the column for the combined axial and bending loading, provided that the stress, f_a, due to any concurrent axial load on the member, does not exceed $0.15F_a$.

XVII-2214.2 In Members With High Flange Width Thickness Ratio. Members which meet the requirements of XVII-2214.1, except that $b_f/2t_f$ exceeds $52.2/\sqrt{S_y}$ but is less than $95/\sqrt{S_y}$, may be designed on the basis of an allowable bending stress:

$$F_b = S_y\left[0.733 - 0.0014\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right] \quad (11)$$

XVII-2214.3 In Doubly Symmetrical Members With Bending About the Minor Axis. Tension and compression on extreme fibers of doubly symmetrical I and H sh pe members meeting the requirements of XVII-2214.1(a) and (b) and bent about their minor axis, solid round and square bars and solid rectangular sections bent about their weaker axis shall result in a maximum bending stress:

$$F_b = 0.75S_y \quad (12)$$

AISC

Except for hybrid girders and members of A514 steel, beams and girders (including members designed on the basis of composite action) which meet the requirements of subparagraphs a through f above, and are continuous over supports or are rigidly framed to columns by means of rivets, high-strength bolts, or welds, may be proportioned for $^9/_{10}$ of the negative moments produced by gravity loading which are maximum at points of support, provided that, for such members, the maximum positive moment shall be increased by $^1/_{10}$ of the average negative moments. This reduction shall not apply to moments produced by loading on cantilevers. If the negative moment is resisted by a column rigidly framed to the beam or girder, the $^1/_{10}$ reduction may be used in proportioning the column for the combined axial and bending loading, provided that the stress, f_a, due to any concurrent axial load on the member, does not exceed $0.15F_a$.

1.5.1.4.2 Members (except hybrid girders and members of A514 steel) which meet the requirements of Sect. 1.5.1.4.1, except that $b_f/2t_f$ exceeds $65/\sqrt{F_y}$ but is less than $95/\sqrt{F_y}$, may be designed on the basis of an allowable bending stress

$$F_b = F_y\left[0.79 - 0.002\left(\frac{b_f}{2t_f}\right)\sqrt{F_y}\right] \quad (1.5\text{-}5a)$$

1.5.1.4.3 Tension and compression on extreme fibers of doubly-symmetrical I- and H-shape members meeting the requirements of Sect. 1.5.1.4.1, subparagraphs a and b, and bent about their minor axes (except members of A514 steel); solid round and square bars; and solid rectangular sections bent about their weaker axes:

$$F_b = 0.75F_y$$

Doubly-symmetrical I- and H-shape members bent about their minor axis (except hybrid girders and members of A514 steel) meeting the requirements of Sect. 1.5.1.4.1, subparagraph 1, except where $b_f/2t_f$ exceeds $65/\sqrt{F_y}$ but is less than $95/\sqrt{F_y}$, may be designed on the basis of an allowable bending stress

$$F_b = F_y\left[1.075 - 0.005\left(\frac{b_f}{2t_f}\right)\sqrt{F_y}\right] \quad (1.5\text{-}5b)$$

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE BENDING STRESS (Con't)

ASME

XVII-2214.4 In Box Type Flexural Members. Tension and compression on extreme fibers of box type flexural members whose compression flange or web width to thickness ratio does not meet the requirements of XVII-2214.1 but does conform to the requirements of XVII-2224 and whose compression flange is braced laterally at intervals not exceeding $2500/S_y$ times the transverse distance out to out of the webs shall result in a maximum bending stress:

$$F_b = 0.60S_y \qquad (13)$$

XVII-2214.5 In Miscellaneous Members

(a) Tension on extreme fibers of flexural members not covered in XVII-2214.1 through XVII-2214.4 shall result in a maximum bending stress:

$$F_b = 0.60S_y \qquad (14)$$

(b) Compression on extreme fibers of flexural members included in (a) above, having an axis of symmetry in and loaded in the plane of their web and compression on extreme fibers of channels[7] bent about their major axis shall have the larger value of bending stress computed by Eqs. (15), (16), and (17), as applicable, but not more than $0.60S_y$.

When $\sqrt{\frac{102\times10^3C_b}{S_y}} \le \frac{l}{r_c} \le \sqrt{\frac{510\times10^3C_b}{S_y}}$

$$F_b = \left[\frac{2}{3} - \frac{S_y(l/r_c)^2}{1530\times10^3C_b}\right] \qquad (15)$$

When $l/r_c \ge \sqrt{\frac{510\times10^3C_b}{S_y}}$

$$F_b = \frac{170\times10^3C_b}{(l/r_c)^2} \qquad (16)$$

AISC

1.5.1.4.4 Tension and compression on extreme fibers of box-type flexural members whose compression flange or web width-thickness ratio does not meet the requirements of Sect. 1.5.1.4.1, but does conform to the requirements of Sect. 1.9:

$$F_b = 0.60F_y$$

Lateral torsional buckling need not be investigated for a box section whose depth is less than 6 times its width. Lateral support requirements for box sections of larger depth-to-width ratios must be determined by special analysis.

1.5.1.4.5 On extreme fibers of flexural members not covered in Sect. 1.5.1.4.1, 1.5.1.4.2, 1.5.1.4.3, or 1.5.1.4.4:

$$F_b = 0.60F_y$$

1.5.1.4.6a Compression on extreme fibers of flexural members included under Sect. 1.5.1.4.5, having an axis of symmetry in, and loaded in, the plane of their web, and compression on extreme fibers of channels* bent about their major axis: the larger value computed by Formulas (1.5-6a) or (1.5-6b) and (1.5-7) as applicable (unless a higher value can be justified on the basis of a more precise analysis**), but not more than $0.60F_y$.***

When $\sqrt{\frac{102\times10^3C_b}{F_y}} \le \frac{l}{r_T} \le \sqrt{\frac{510\times10^3C_b}{F_y}}$

$$F_b = \left[\frac{2}{3} - \frac{F_y(l/r_T)^2}{1{,}530\times10^3C_b}\right]F_y \qquad (1.5\text{-}6a)$$

* Only Formula (1.5-7) applicable to channels.

** See Appendix D and Commentary Sects. 1.5.1.4.5 and 1.5.1.4.6, last two paragraphs, for alternate procedures."

*** See Sect. 1.10 for further limitations in plate girder flange stress.

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ALLOWABLE BENDING STRESS (Con't)

ASME

When compression flange is solid and approximately rectangular in cross section and its area is not less than that of the tension flange

$$F_b = \frac{12 \times 10^3 C_b}{ld/A_f} \quad (17)$$

where

$C_b = 1.75 + 1.05(M_1/M_2) + 0.3(M_1/M_2)^2 \leq 2.3$ where M_1 is the smaller and M_2 the larger bending moment at the ends of the unbraced length, taken about the strong axis of the member, and where M_1/M_2, the ratio of end moments, is positive when M_1 and M_2 have the same sign (reverse curvature bending) and negative when they are of opposite signs (single curvature bending); when the bending moment at any point within an unbraced length is larger than that at both ends of this length, the value of C_b shall be taken as unity; C_b shall also be taken as unity in computing the value of F_{bx} and F_{by} to be used in Eq. (19) (XVII-2230 gives further limitation in plate girder flange stress)

(c) For hybrid plate girders, S_y for Eqs. (15) and (16) is the yield stress of the compression flange. Equation (17) shall not apply to hybrid girders.

XVII-2214.6 In Miscellaneous Members Braced Laterally. Compression in extreme fibers of flexural members included in XVII-2214.5(a) but not included in XVII-2214.5(b) shall result in a maximum bending stress:

$$F_b = 0.60 S_y \quad (18)$$

provided that sections bent about their major axis are braced laterally in the region of compression stress at intervals not exceeding $76 b_f/\sqrt{S_y}$

Only Eq. (17) is applicable to channels.

AISC

When $l/r_T \geq \sqrt{\frac{510 \times 10^3 C_b}{F_y}}$:

$$F_b = \frac{170 \times 10^3 C_b}{(l/r_T)^2} \quad (1.5\text{-}6b)$$

Or, when the compression flange is solid and approximately rectangular in cross section and its area is not less than that of the tension flange:

$$F_b = \frac{12 \times 10^3 C_b}{ld/A_f} \quad (1.5\text{-}7)$$

In the foregoing,

- l = distance between cross sections braced against twist or lateral displacement of the compression flange, inches. For cantilevers braced against twist only at the support, l may conservatively be taken as the actual length.
- r_T = radius of gyration of a section comprising the compression flange plus ⅓ of the compression web area, taken about an axis in the plane of the web, inches
- A_f = area of the compression flange, square inches
- C_b = $1.75 + 1.05(M_1/M_2) + 0.3(M_1/M_2)^2$, but not more than 2.3,[1] where M_1 is the smaller and M_2 the larger bending moment at the ends of the unbraced length, taken about the strong axis of the member, and where M_1/M_2, the ratio of end moments, is positive when M_1 and M_2 have the same sign (reverse curvature bending) and negative when they are of opposite signs (single curvature bending). When the bending moment at any point within an unbraced length is larger than that at both ends of this length, the value of C_b shall be taken as unity. When computing F_{bx} and F_{by} to be used in Formula (1.6-1a), C_b may be computed by the formula given above for frames subject to joint translation, and it shall be taken as unity for frames braced against joint translation. C_b may conservatively be taken as unity for cantilever beams.*

For hybrid plate girders, F_y for Formulas (1.5-6a) and (1.5-6b) is the yield stress of the compression flange. Formula (1.5-7) shall not apply to hybrid girders.

1.5.1.4.6b Compression on extreme fibers of flexural members included under Sect. 1.5.1.4.5, but not included in Sect. 1.5.1.4.6a:

$$F_b = 0.60 F_y$$

provided that sections bent about their major axis are braced laterally in the region of compression stress at intervals not exceeding $76.0 b_f/\sqrt{F_y}$

STP PRACTICE

$0.60\ S_y$

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

COMBINED STRESS

AXIAL COMPRESSION AND BENDING

ASME

XVII-2215 Combined Stresses

XVII-2215.1 Axial Compression and Bending. For members subjected to both axial compression and bending, stresses shall be proportioned to satisfy the requirements of Eqs. (19), (20), and (21).

$$\frac{f_a}{F_a} + \frac{C_{m_x} f_{b_x}}{\left(1 - \frac{f_a}{F'_{e_x}}\right) F_{b_x}} + \frac{C_{m_y} f_{b_y}}{\left(1 - \frac{f_a}{F'_{e_y}}\right) F_{b_y}} \leq 1.0 \quad (19)$$

$$\frac{f_a}{0.60 S_y} + \frac{f_{b_x}}{F_{b_x}} + \frac{f_{b_y}}{F_{b_y}} \leq 1.0 \quad (20)$$

When $f_a/F_a \leq 0.15$, Eq. (21) may be used in lieu of Eqs. (19) and (20)

$$\frac{f_a}{F_a} + \frac{f_{b_x}}{F_{b_x}} + \frac{f_{b_y}}{F_{b_y}} \leq 1.0 \quad (21)$$

In Eqs. (19), (20), and (21), the subscripts x and y indicate the axis of bending about which a particular stress or design property applies and

$$F'_e = \frac{12\pi^2 E}{23(Kl_b/r_b)^2}$$

(In the expression for F'_e, as in the case of F_a, F_b and $0.6S_y$, F'_e may be increased one-third for Level C Conditions)

AISC

SECTION 1.6 COMBINED STRESSES

1.6.1 Axial Compression and Bending

Members subjected to both axial compression and bending stresses shall be proportioned to satisfy the following requirements:

$$\frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{\left(1 - \frac{f_a}{F'_{ex}}\right) F_{bx}} + \frac{C_{my} f_{by}}{\left(1 - \frac{f_a}{F'_{ey}}\right) F_{by}} \leq 1.0 \quad (1.6\text{-}1a)$$

$$\frac{f_a}{0.60 F_y} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0 \quad (1.6\text{-}1b)$$

When $\frac{f_a}{F_a} \leq 0.15$, Formula (1.6-2) may be used in lieu of Formulas (1.6-1a) and (1.6-1b)

$$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0 \quad (1.6\text{-}2)$$

In Formulas (1.6-1a), (1.6-1b), and (1.6-2) the subscripts x and y, combined with subscripts b, m and e, indicate the axis of bending about which a particular stress or design property applies, and

F_a = axial stress that would be permitted if axial force alone existed

F_b = compressive bending stress that would be permitted if bending moment alone existed

$F'_e = \frac{12\pi^2 E}{23(Kl_b/r_b)^2}$ (In the expression for F'_e, l_b is the actual unbraced length *in the plane of bending* and r_b is the corresponding radius of gyration. K is the effective length factor *in the plane of bending*. As in the case of F_a, F_b and 0.6 F_y, F'_e may be increased one-third in accordance with Sect. 1.5.6.)

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

COMBINED STRESS

AXAIL COMPRESSION AND BENDING (Con't)

ASME

where C_m is a coefficient whose value shall be as given in (a), (b), and (c) below:

(a) For compression members in frames subject to joint translation, $C_m = 0.85$

(b) For restrained compression members in frames braced against joint translation and not subject to transverse loading between their supports in the plane of bending,

$$C_m = 0.6 - 0.4\frac{M_1}{M_2} \text{ but not less than } 0.4$$

where

M_1/M_2 = the ratio of the smaller to larger moments at the ends of that portion of the member unbraced in the plane of bending under consideration. M_1/M_2 is positive when the member is bent in reverse curvature and negative when it is bent in a single curvature

(c) For compression members in frames braced against joint translation in the plane of loading and subjected to transverse loading between their supports, the value of C_m may be determined by rational analysis; however, in lieu of such analysis, the following values may be used:

(1) for members whose ends are restrained, $C_m = 0.85$

(2) for members whose ends are unrestrained, $C_m = 1.0$

AISC

f_a = computed axial stress

f_b = computed compressive bending stress at the point under consideration

C_m = a coefficient whose value shall be taken as follows:

1. For compression members in frames subject to joint translation (sidesway), $C_m = 0.85$.
2. For restrained compression members in frames braced against joint translation and not subject to transverse loading between their supports in the plane of bending,

   $$C_m = 0.6 - 0.4\frac{M_1}{M_2}, \text{ but not less than } 0.4,$$

   where M_1/M_2 is the ratio of the smaller to larger moments at the ends of that portion of the member unbraced in the plane of bending under consideration. M_1/M_2 is positive when the member is bent in reverse curvature and negative when it is bent in single curvature.
3. For compression members in frames braced against joint translation in the plane of loading and subjected to transverse loading between their supports, the value of C_m may be determined by rational analysis. However, in lieu of such analysis, the following values may be used: (a) for members whose ends are restrained, $C_m = 0.85$; (b) for members whose ends are unrestrained, $C_m = 1.0$.

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ASME

XVII-2452.10 Fillet Welds in Holes and Slots. Fillet welds in holes or slots may be used to transmit shear in lap joints or to prevent the buckling or separation of lapped parts and to join components of built up members. Such fillet welds may overlap, subject to the provisions of XVII-2452.5. Fillet welds in holes or slots are not to be considered plug or slot welds.

XVII-2453 Plug and Slot Welds

XVII-2453.1 Use of Plug and Slot Welds. Plug and slot welds may be used to transmit shear in a lap joint or to prevent buckling of lapped parts and to join component parts of built up members.

XVII-2453.2 Diameter of Holes for Plug Welds. The diameter of the holes for a plug weld shall be not less than the thickness of the part containing it plus 5/16 in. (8 mm), rounded to the next greater odd 1/16 in. (1.6 mm), nor greater than 2¼ times the thickness of the weld metal.

XVII-2453.3 Spacing of Plug Welds. The minimum center to center spacing of plug welds shall be 4 times the diameter of the hole.

XVII-2453.4 Length of Slot Welds. The length of slot for a slot weld shall not exceed 10 times the thickness of the weld. The width of the slot shall be not less than the thickness of the part containing it plus 5/16 in. (8 mm), rounded to the next greater odd 1/16 in. (1.6 mm), nor shall it be greater than 2¼ times the thickness of the weld. The ends of the slot shall be semicircular or shall have the corners rounded to a radius not less than the thickness of the part containing it, except those ends which extend to the edge of the part.

XVII-2453.5 Spacing of Slot Welds. The minimum spacing of lines of slot welds in a direction transverse to their length shall be four times the width of the slot.

AISC

1.17.11 Fillet Welds in Holes and Slots

Fillet welds in holes or slots may be used to transmit shear in lap joints or to prevent the buckling or separation of lapped parts, and to join components of built-up members. Such fillet welds may overlap, subject to the provisions of Sect. 1.14.7. Fillet welds in holes or slots are not to be considered plug or slot welds.

1.17.12 Plug and Slot Welds

Plug or slot welds may be used to transmit shear in a lap joint or to prevent buckling of lapped parts and to join component parts of built-up members.

The diameter of the holes for a plug weld shall be not less than the thickness of the part containing it plus 5/16-inch, rounded to the next greater odd 1/16-inch, nor greater than 2¼ times the thickness of the weld metal.

The minimum center-to-center spacing of plug welds shall be 4 times the diameter of the hole.

The length of slot for a slot weld shall not exceed 10 times the thickness of the weld. The width of the slot shall be not less than the thickness of the part containing it, plus 5/16-inch, rounded to the next greater odd 1/16-inch, nor shall it be greater than 2¼ times the thickness of the weld. The ends of the slot shall be semicircular or shall have the corners rounded to a radius not less than the thickness of the part containing it, except those ends which extend to the edge of the part.

The minimum spacing of lines of slot welds in a direction transverse to their length shall be 4 times the width of the slot. The minimum center-to-center spacing in a longitudinal direction on any line shall be 2 times the length of the slot.

The thickness of plug or slot welds in material 5/8-inch or less in thickness shall be equal to the thickness of the material. In material over 5/8-inch in thickness, it shall be at least one-half the thickness of the material but not less than 5/8-inch.

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ASME

XVII-2431 Lap Joint Design

The minimum amount of lap on lap joints shall be five times the thickness of the thinner part joined and not less than 1 in. (25 mm). Lap joints joining plates or bars subjected to axial stress shall be fillet welded along the end of both lapped parts except where the deflection of the lapped parts is sufficiently restrained to prevent opening of the joint under maximum loading.

XVII-2452 Fillet Welds

XVII-2452.1 Minimum Size of Fillet Welds. In joints connected only by fillet welds, the minimum size of fillet weld to be used shall be as shown in Table XVII-2452.1-1. Weld size is determined by the thicker of the two parts joined, except that the weld size need not exceed the thickness of the thinner part joined unless a larger size is required by calculated stress.

TABLE XVII-2452.1-1
MINIMUM SIZE OF FILLET WELDS

Material Thickness of Thicker Part Joined in.	Min. Size of Fillet Weld in.
To 1/4 inclusive	1/8
Over 1/4 to 1/2	3/16
Over 1/2 to 3/4	1/4
Over 3/4 to 1 1/2	5/16
Over 1 1/2 to 2 1/4	3/8
Over 2 1/4 to 6	1/2
Over 6	5/8

AISC

1.17.9 Lap Joints

The minimum amount of lap on lap joints shall be 5 times the thickness of the thinner part joined and not less than 1 inch. Lap joints joining plates or bars subjected to axial stress shall be fillet welded along the end of both lapped parts except where the deflection of the lapped parts is sufficiently restrained to prevent opening of the joint under maximum loading.

1.17.5 Minimum Size of Fillet Welds

In joints connected only by fillet welds, the minimum size of fillet weld to be used shall be as shown in Table 1.17.5. Weld size is determined by the thicker of the two parts joined, except that the weld size need not exceed the thickness of the thinner part joined unless a larger size is required by calculated stress:

TABLE 1.17.5

Material Thickness of Thicker Part Joined (Inches)	Minimum Size of Fillet Weld (Inches)	Material Thickness of Thicker Part Joined (Inches)	Minimum Size of Fillet Weld (Inches)
To 1/4 inclusive	1/8	Over 1 1/2 to 2 1/4	3/8
Over 1/4 to 1/2	3/16	Over 2 1/4 to 6	1/2
Over 1/2 to 3/4	1/4	Over 6	5/8
Over 3/4 to 1 1/2	5/16		

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ASME

XVII-2452.2 Maximum Effective Size of Fillet Welds. The maximum size of a fillet weld that may be assumed in the design of a connection shall be such that the stresses in the adjacent base material do not exceed the values allowed in Table NF-3292.1-1. The maximum size that may be used along edges of connected parts shall be as stipulated in (a) and (b) below:

(a) Along edges of material less than 1/4 in. (6 mm) thick, the maximum size may be equal to the thickness of the material.

(b) Along edges of material 1/4 in. (6 mm) or more in thickness, the maximum size shall be 1/16 in. (6 mm) less than the thickness of the material, unless the weld is especially designated on the drawings to be built out to obtain full throat thickness.

XVII-2452.3 Length of Fillet Welds

(a) The effective length of a fillet weld shall be the overall length of full size fillet including returns.

(b) The minimum effective length of a strength fillet weld shall be not less than four times the nominal size or else the size of the weld shall be considered not to exceed one-fourth of its effective length.

(c) If longitudinal fillet welds are used alone in end connections of flat bar tension members, the length of each fillet weld shall be not less than the perpendicular distance between them. The transverse spacing of longitudinal fillet welds used in end connections shall not exceed 8 in. (203 mm), unless the design otherwise prevents excessive transverse bending in the connection.

AISE

1.17.6 Maximum Effective Size of Fillet Welds

The maximum size of a fillet weld that may be assumed in the design of a connection shall be such that the stresses in the adjacent base material do not exceed the values allowed in Sect. 1.5.1. The maximum size that may be used along edges of connected parts shall be:

1. Along edges of material less than 1/4-inch thick, the maximum size may be equal to the thickness of the material.
2. Along edges of material 1/4-inch or more in thickness, the maximum size shall be 1/16-inch less than the thickness of the material, unless the weld is especially designated on the drawings to be built out to obtain full throat thickness.

1.17.7 Length of Fillet Welds

The minimum effective length of a strength fillet weld shall be not less than 4 times the nominal size, or else the size of the weld shall be considered not to exceed one-fourth of its effective length.

If longitudinal fillet welds are used alone in end connections of flat bar tension members, the length of each fillet weld shall be not less than the perpendicular distance between them. The transverse spacing of longitudinal fillet welds used in end connections shall not exceed 8 inches, unless the design otherwise prevents excessive transverse bending in the connection.

STP PRACTICE

SAME AS AISC

COMPARISON BETWEEN ASME, AISC CODES AND STP PRACTICE FOR PIPE SUPPORT DESIGN OUTSIDE NF BOUNDARIES

ASME	AISC	STP PRACTICE
XVII-2452.8 Intermittent Fillet Welds. Intermittent fillet welds may be used to transfer calculated stresses across a joint or faying surface, when the strength required is less than that developed by a continuous fillet weld of the smallest permitted size and to join components of built-up members. The effective length of any segment of intermittent fillet welding shall not be less than four times the weld size with a minimum of 1½ in. (38 mm).	**1.17.8 Intermittent Fillet Welds** Intermittent fillet welds may be used to transfer calculated stress across a joint or faying surfaces when the strength required is less than that developed by a continuous fillet weld of the smallest permitted size, and to join components of built-up members. The effective length of any segment of intermittent fillet welding shall be not less than 4 times the weld size with a minimum of 1½ inches.	SAME AS AISC
XVII-2452.9 End Returns of Fillet Welds. Side or end fillet welds terminating at ends or sides, respectively, of parts or members shall, whenever practicable, be returned continuously around the corners for a distance not less than twice the nominal size of the weld. This provision shall apply to side and	**1.17.10 End Returns of Fillet Welds** Side or end fillet welds terminating at ends or sides, respectively, of parts or members shall, wherever practicable, be returned continuously around the corners for a distance not less than twice the nominal size of the weld. This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connections, on the plane about which bending moments are computed. End returns shall be indicated on the design and detail drawings.	

III Loading Combination Allowables

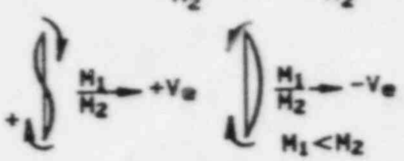
LEGEND

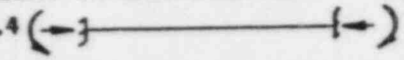
BS - Building differential settlement
DBA - Design-basis accident (displacement at mechanical penetrations due to SLB or LOCA)
DE - Dynamic events defined in emergency conditions
DF - Dynamic events associated with faulted conditions excluding LOCA, JI & DBA
DW - Deadweight (including any other sustained mechanical load)
DU - Transient dynamic events associated with upset plant conditions
FV - Fast valve closure
JI - Loads due to jet impingement, pipe motion, and pipe impact resulting from high energy break including LOCA
LOCA - Loss-of-coolant accident, LOCA = LOCA JET and/or LOCA MOTION
OBE - Operational-basis earthquake (Inertia)
OCC - Occasional loads (short time)
PD - Design Pressure
PHT - Hydrotest pressure (unbalanced expansion joint force)
PO - Operating pressure including any transient pressures associated with the plant condition under consideration
RVC - Relief valve-closed system (transient)
RVO - Relief valve-open system (sustained)
SAM - Seismic anchor movement
SSE - Safe-shutdown earthquake (Inertia)
TH - Thermal expansion and thermal anchor movements
WL - Wind load (for piping exposed to atmosphere i.e. outside the building only)
P - Presure load due to unbalanced expansion joints
SLB - Steam line Break
SSRC - Structural Stability Research Council
NPSI - Nuclear Power Services, Incorporated

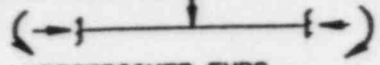
S_y = MIN. YIELD STRENGTH
S_u = MIN. ULTIMATE TENSILE STRENGTH
E = MODULUS OF ELASTICITY
F_a = ALLOWABLE AXIAL COMP. STRESS
f_a = COMPUTED AXIAL COMP. STRESS
F_t = ALLOWABLE AXIAL TENSILE STRESS
f_t = COMPUTED AXIAL COMPRESSION STRESS
F_v = ALLOWABLE SHEAR STRESS
f_v = COMPUTED SHEAR STRESS
F_{bxc} = ALLOWABLE COMP. STRESS DUE TO BENDING ABOUT MAJOR AXIS
F_{bxt} = ALLOWABLE TENSILE STRESS DUE TO BENDING ABOUT MAJOR AXIS
F_{byc} = ALLOWABLE COMP. STRESS DUE TO BENDING ABOUT THE MINOR AXIS
F_{byt} = ALLOWABLE TENSILE STRESS DUE TO BENDING ABOUT THE MINOR AXIS
f_b = COMPUTED BENDING STRESS
Z = ELASTIC SECTION MODULUS

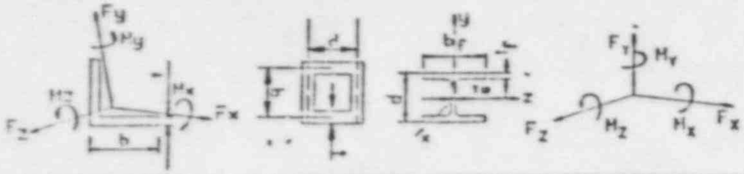
A_w = AREA OF WEB
A_f = AREA OF FLANGE
J = TORSIONAL CONSTANT (REF. AISC)
K = EFFECTIVE LENGTH FACTOR
= 1.0 FOR MEMBERS IN FRAMES BRACED ON BOTH SIDES.
= 1.5 FOR MEMBERS IN FRAMES WITH ONE OR BOTH SIDES NOT BRACED
C_c = COLUMN SLENDERNESS RATIO SEPARATING ELASTIC AND INELASTIC BUCKLING
r_c = RADIUS OF GYRATION OF A SECTION COMPRISING OF COMPRESSION FLANGE PLUS ONE-THIRD OF THE COMPRESSION WEB AREA TAKEN ABOUT AN AXIS IN THE PLANE OF THE WEB (REF. AISC)
l = UNBRACED LENGTH IN THE PLANE OF BENDING
r = RADIUS OF GYRATION (LESSER OF Y_x AND Y_y)
$\frac{KL}{r}$ $\leq$ 200 FOR COMPRESSION MEMBERS
$\leq$ 240 FOR MAIN TENSION MEMBERS

C_b = BENDING COEFFICIENT
$= 1.75 + 1.05\left(\frac{M_1}{M_2}\right) + 0.3\left(\frac{M_1}{M_2}\right)^2 \leq 2.3$



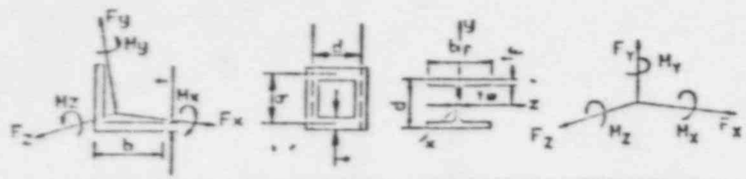
C_b = 1 WHEN MOMENT AT ANY POINT IN UNBRACED LENGTH > M_1 OR M_2
$C_m = 0.6 - 0.4\frac{M_1}{M_2}$ BUT NOT < 0.4 

FOR MEMBERS WITH JOINTS BRACED AGAINST JOINT TRANSLATION AND WITHOUT TRANSVERSE LOADING.
= 0.85 FOR MEMBERS IN FRAMES SUBJECT TO JOINT TRANSLATION
= 0.85 FOR MEMBERS WITH RESTRAINED ENDS AND SUBJECT TO TRANSVERSE LOADING 
= 1 FOR MEMBERS WITH UNRESTRAINED ENDS..



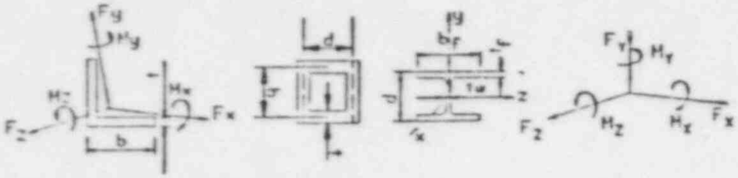
ALLOWABLE SHEAR STRESS

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.4S_y$	$0.4S_y$	$0.4S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.4S_y$	$0.4S_y$	$0.4S_y$	
3. Emergency	P + DW + TH + DE	$\frac{4}{3}(0.4S_y)$	$\frac{4}{3}(0.4S_y)$	$\frac{4}{3}(0.4S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	LESSER OF: $1.2(\frac{S_y}{0.6S_y})(0.4S_y)$ $0.7(\frac{S_u}{0.6S_y})(0.4S_y)$	$\frac{4}{3}(0.4S_y)$	$\frac{4}{3}(0.4S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.4S_y$	$0.4S_y$	$0.4S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



ALLOWABLE TENSION STRESS

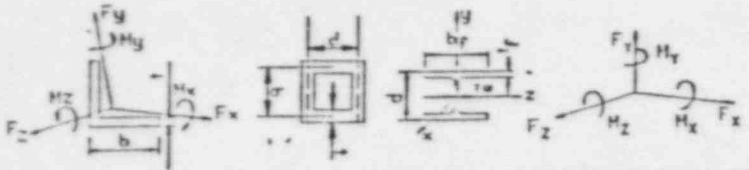
DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.6S_y$	$0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.6S_y$	$0.6S_y$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	$F_t = 1.2S_y$ BUT $\ngtr 0.7S_u$	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.6S_y$	$0.6S_y$	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



ALLOWABLE COMPRESSION STRESS $\frac{KL}{r} \le C_c$

$$C_c = \sqrt{\frac{2\pi^2 E}{S_y}}$$

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVO c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVO g. P + DW + TH + DU	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	
3. Emergency	P + DW + TH + DE	$\frac{2}{3}\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y$	$\frac{4}{3}\ \frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{4}{3}\ \frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	RESTRICTED TO 2/3 CRITICAL BUCKLING
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVO c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	$\frac{2}{3}\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y$	$\frac{4}{3}\ \frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{4}{3}\ \frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	RESTRICTED TO . 2/3 CRITICAL BUKLING
5. Hydrotest	DW (with water) + PHT	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	$\frac{\left[1-\frac{(KL/r)^2}{2C_c^2}\right]S_y}{\frac{5}{3}+\frac{3(KL/r)}{8C_c}-\frac{(KL/r)^3}{8C_c^3}}$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				

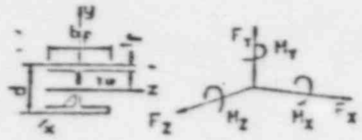


ALLOWABLE COMPRESSION STRESS (Con't)

$$200 \geq \frac{kl}{r} > C_c$$

$$C_c = \sqrt{\frac{2\pi^2 E}{S_y}}$$

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DJ	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	
3. Emergency	P + DW + TH + DE	$\frac{4}{3}\left(\frac{12\pi^2 E}{23(\frac{kl}{r})^2}\right)$	$\frac{4}{3}\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{4}{3}\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	RESTRICTED TO 2/3 CRITICAL BUCKLING
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	$\frac{4}{3}\left(\frac{12\pi^2 E}{23(\frac{kl}{r})^2}\right)$	$\frac{4}{3}\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{4}{3}\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	RESTRICTED TO 2/3 CRITICAL BUCKLING
5. Hydrotest	DW (with water) + PHT	$\frac{12\pi^2 E}{23(K\frac{L}{r})^2}$	$\frac{12\pi^2 E}{23(\frac{kl}{r})^2}$	$\frac{12\pi^2 \pi}{23(\frac{KL}{r})^2}$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



MAJOR AXIS

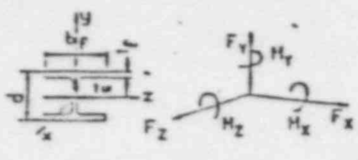
ALLOWABLE BENDING STRESS

COMPACT SECTION

$\frac{[illegible]}{\sqrt{S_y}} \geq \frac{b_f}{2t_f}$ ASME

$\frac{65}{\sqrt{S_y}} \geq \frac{b_f}{2t_f}$ AISC

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.66S_y$	$0.66S_y$	$0.60S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.66S_y$	$0.66S_y$	$0.60S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}$(CASE I ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}$(CASE I ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	
5. Hydrotest	DW (with water) + PHT	$0.66S_y$	$0.66S_y$	$0.60S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



MAJOR AXIS

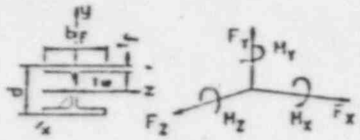
ALLOWABLE BENDING STRESS

COMPACT SECTION

$\frac{52.2}{\sqrt{S_y}} < \frac{b_f}{2t_f} < \frac{95}{\sqrt{S_y}}$ ASME

$\frac{65}{\sqrt{S_y}} < \frac{b_f}{2t_f} < \frac{95}{\sqrt{S_y}}$ AISC

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$S_y\left[0.733 - 0.0014\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$S_y\left[0.79 - 0.002\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$S_y\left[0.733 - 0.0014\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$S_y\left[0.79 - 0.002\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}S_y\left[0.79 - 0.002\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2\ (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}S_y\left[0.79 - 0.002\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE 1 ALLOWABLE	CASE 1 ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



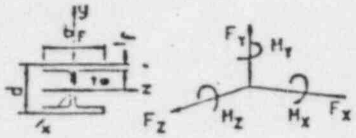
MAJOR AXIS

ALLOWABLE BENDING STRESS

NON-COMPACT SECTION

$$\frac{l}{r_c} < \sqrt{\frac{102 \times 10^3 C_b}{S_y}}$$

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.6S_y$	$0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.6S_y$	$0.6S_y$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.6S_y$	$0.6S_y$	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				

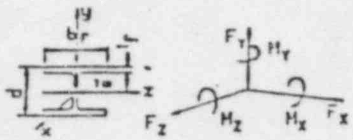


MAJOR AXIS

ALLOWABLE BENDING STRESS
NON-COMPACT SECTION

$$\frac{l}{r_c} > \sqrt{\frac{510\times10^3 C_b}{S_y}}$$

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	LARGER OF: $\frac{170\times10^3 C_b}{(l/r_c)^2}$, $\frac{12\times10^3 C_b}{ld/A_f}$ BUT $\ngtr 0.6S_y$	LARGER OF: $\frac{170\times10^3 C_b}{(l/r_c)^2}$, $\frac{12\times10^3 C_b}{ld/A_f}$ BUT $\ngtr 0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	CASE I ALLOWABLE	(CASE 1 ALLOWABLE)	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



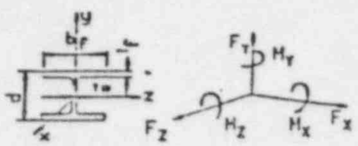
MAJOR AXIS

ALLOWABLE BENDING STRESS

NON-COMPACT SECTION

$$\sqrt{\frac{102\times10^3 C_b}{S_y}} \le \frac{l}{r_c} \le \sqrt{\frac{510\times10^3 C_b}{S_y}}$$

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	LARGER OF: $\left[\frac{2}{3} - \frac{S_y(l/r_c)^2}{1530\times10^3 C_b}\right] S_y$ $\frac{12\times10^3 C_b}{ld/A_f}$ $\ngtr 0.6S_y$	LARGER OF: $\left[\frac{2}{3} - \frac{S_y(l/r_c)^2}{1530\times10^3 C_b}\right] S_y$ $\frac{12\times10^3 C_b}{ld/A_f}$ $\ngtr 0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}$ CASE I ALLOWABLE	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2\ (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}$ CASE I ALLOWABLE	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



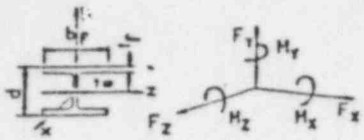
MINOR AXIS

ALL[illegible]BLE BENDING STRESS

$\frac{52.2}{\sqrt{S_y}} \geq \frac{b_f}{2t_f}$ ASME

$\frac{65}{\sqrt{S_y}} \geq \frac{b_f}{2t_f}$ AISC

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.75S_y$	$0.75S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2\ (OBE)]^{1/2}$ + RVO c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVO g. P + DW + TH + DU	$0.75S_y$	(CASE 1 ALLOWABLE)	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2\ (SSE)]^{1/2}$ + RVO c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2\ (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



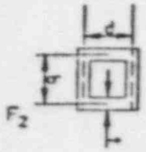
MINOR AXIS

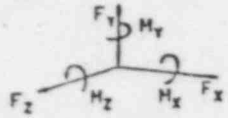
ALLOWABLE BENDING STRESS

$\frac{[illegible]}{\sqrt{S_y}} < \frac{b_f}{2t_f} < \frac{95}{\sqrt{S_y}}$ ASME

$\frac{65}{\sqrt{S_y}} < \frac{b_f}{2t_f} < \frac{95}{\sqrt{S_y}}$ AISC

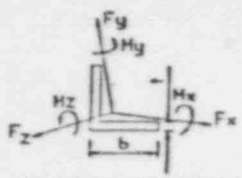
DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.75S_y$	$S_y\left[1.075-0.005\left(\frac{b_f}{2t_f}\right)\sqrt{S_y}\right]$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVO c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVO g. P + DW + TH + DU	$0.75S_y$	(CASE 1 ALLOWABLE)	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVO c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF $1.2(S_y/0.6S_y)$ CASE 1 $0.7(S_u/0.6S_y)$ CASE 1	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				





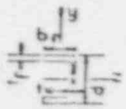
ALLOWABLE BENDING STRESS

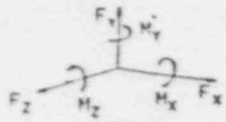
DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.6S_y$	$0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.6S_y$	$0.6S_y$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION =1.12 ($0.6S_y$) TENSION LESSER OF: $1.2S_y$ $0.7S_u$	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.6S_y$	$0.6S_y$	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				



ALLOWABLE BENDING STRESS

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.6S_y$	$0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.6S_y$	$0.6S_y$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION $\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION =1.12 $(0.6S_y)$ TENSION LESSER OF: $1.2S_y$ $0.7S_u$	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.6S_y$	$0.6S_y$	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				

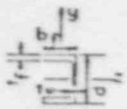


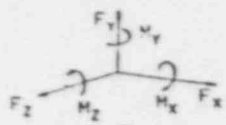


MAJOR AXIS

ALLOWABLE BENDING STRESS

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	COMPRESSION $= \frac{12X10^3 C_b}{ld/A_f}$ BUT > $0.6S_y$ TENSION $0.6S_y$	COMPRESSION $= \frac{12X10^3 C_b}{ld/A_f}$ BUT > $0.6S_y$ TENSION $0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	(CASE 1 ALLOWABLE)	CASE I ALLOWABLE	$0.6S_y$	
3. Emergency	P + DW + TH + DE	$\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION 1.12(CASE 1 ALLOWABLE) TENSION LESSER OF: $1.2S_y$ $0.7S_u$	$\frac{4}{3}$ (CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	CASE I ALLOWABLE	CASE I ALLOWABLE	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				





MINOR AXIS

ALLOWABLE BENDING STRESS

DESIGN CONDITION	DESIGN LOADING COMBINATIONS	ALLOWABLE STRESS			COMMENTS
		ASME CODE	AISC SPEC.	STP	
1. Normal	P + DW + TH	$0.6S_y$	$0.6S_y$	$0.6S_y$	
2. Upset	a. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ b. P + DW + TH + $[OBE^2 + SAM^2 (OBE)]^{1/2}$ + RVD c. P + DW + TH + RVC d. P + DW + TH + FV e. P + DW + TH + WL f. P + DW + TH + WL + RVD g. P + DW + TH + DU	$0.6S_y$	$0.6S_y$	$0.6S_y$	
3. Emergency	P + DW + TH + DE	$\frac{4}{3}$(CASE 1 ALLOWABLE)	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
4. Faulted	a. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ b. P + DW + TH + $[SSE^2 + SAM^2 (SSE)]^{1/2}$ + RVD c. P + DW + TH + DF d. P + DW + TH + JI + DBA (2) e. P + DW + TH + $[SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ f. P + DW + TH + JI g. P + DW + TH + DBA	COMPRESSION =1.12 $(0.6S_y)$ TENSION LESSER OF: $1.2S_y$ $0.7S_u$	$\frac{4}{3}(0.6S_y)$	$\frac{4}{3}(0.6S_y)$	
5. Hydrotest	DW (with water) + PHT	$0.6S_y$	$0.6S_y$	$0.6S_y$	
6. Building Settlement	Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.				

IV NF-3000 DESIGN

ASME (NF) | STP (OUTSIDE BOUNDARY) | COMMENTS

NF-3111 Loading Conditions

The loadings that shall be taken into account in designing a component support include, but are not limited to, those in (a) through (g) below:

(a) weight of the component and normal contents under operating or test conditions, including loads due to static and dynamic head and fluid flow effects

(b) weight of the component support

(c) superimposed loads and reactions induced by the supported system components

(d) dynamic loads, including loads caused by earthquake and vibration

(e) restrained thermal expansion

(f) anchor and support movement effects

(g) environmental loads such as wind and snow loads

NF-3112 Design Loadings

The Design Loadings shall be established in accordance with NA-2142.1 and the following subparagraphs.

DESIGN LOADING COMBINATIONS FOR
ASME CODE CLASS 1, 2, 3 PIPING SUPPORTS

DESIGN CONDITION		DESIGN LOADING COMBINATIONS
1. Normal		P + DW + TH
2. Upset	a.	$P + DW + TH + [OBE^2 + SAM^2 (OBE)]^{1/2}$
	b.	$P + DW + TH + [OBE^2 + SAM^2 (OBE)]^{1/2} + RVO$
	c.	P + DW + TH + RVC
	d.	P + DW + TH + FV
	e.	P + DW + TH + WL
	f.	P + DW + TH + WL + RVO
	g.	P + DW + TH + DU
3. Emergency	a.	P + DW + TH + DE
4. Faulted	a.	$P + DW + TH + [SSE^2 + SAM^2 (SSE)]^{1/2}$
	b.	$P + DW + TH + [SSE^2 + SAM^2 (SSE)]^{1/2} + RVO$
	c.	P + DW + TH + DF
	d.	P + DW + TH + JI + DBA (2)
	e.	$P + DW + TH + [SSE^2 + SAM^2 (SSE) + LOCA^2]^{1/2}$ (1)
	f.	P + DW + TH + JI
	g.	P + DW + TH + DBA
5. Hydrotest		DW (with water) + PHT
6. Building Settlement		Combine the loads due to Building Settlement with all load cases except hydrotest when applicable.

LEGEND: Refer to page 1 of 17 of Loading Combination Allowables

Note 1. This loading combination applies only to piping connected to Reactor coolant loop.

Note 2. JI and DBA must result from same break postulation.

Note 3. Pressure load due to unbalanced expansion joints shall be considered for normal, upset, emergency and faulted conditions where applicable.

Applicaple for inside and outside the NF boundary.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3112.1 Design Temperature. The specified Design Temperature shall be established in accordance with NA-2142.1(b). It shall be used in conjunction with the Design Pressure. If necessary, the metal temperature shall be determined by computation using accepted heat transfer procedures or by measurement from equipment in service under equivalent operating conditions. In no case shall the temperature at the surface of the metal exceed the maximum temperature listed in Tables I-11.0, I-12.0, and I-13.0 nor exceed the maximum temperature limitations specified elsewhere in this Subsection.	Specified by Plant Design in accordance to NF Code.	

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY) REFERENCE JQ1000	COMMENTS

NF-3121 Component Deformation Limits

Deformation limits for the supported component, if required, shall be stipulated in the Design Specifications.

MAXIMUM ALLOWABLE DEFLECTION (BASED ON NORMAL OPERATING CONDITION)

It should be noted that support deflections are to be checked based only on the piping Normal Operating Loads. Upset or Faulted Loads are not to be used for computing deflections. Deflection, due to friction force, need not be considered.

The following allowables pertain only to the restrained directions of piping:

SUPPORT TYPE	ALLOWABLE DEFLECTION
ALL NF SUPPORTS	1/16"
UPGRADED B 31.1* (SEISMICALLY SUPPORTED)	1/16"
OTHER PIPING	1/8"

Complies with NF

* Upgraded piping is the non-safety related piping which may interact unacceptably with safety related systems and components during a seismic event.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY) REFERENCE J01000	COMMENTS
NF-3122 Functional Requirements When a component support is to be designed to perform a specific function during any Service Condition, the functional requirements shall be designated in the Design Specifications.	Pipe supports shall provioe for proper support of piping while maintaining economy, simplicity, and function. The oesign shall be optimized by combining supports and restraints where possible, and by providing common supports or multiple supports for parallel piping systems.	Complies with NF requirements

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY) REF: RQ1002	COMMENTS
NF-3123 Vibration Piping shall be arranged and supported so that vibration shall be minimized.	SUPPORT LOCATION The following will be the major considerations for locating supports: A. Inservice inspection guidelines given in section 6.10 should be followed. B. First support from the equipment nozzle should be located considering the effects of nozzle movement and allowable nozzle loads. If necessary, a frictionless device shall be recommended to the support designer. C. Seismic restraints on valve operators should be avoided. If these restraints are absolutely necessary, vendor approval should be obtained. D. Rigid supports should be used whenever possible instead of springs and snubbers. Avoid using springs and snubbers where pipe thermal movement is 1/8 inch or less. E. Construction tolerance given in Pipe Support Field Fabrication and Installation Specification, 5L340JS1002. F. Design tolerance given in Specification for Field Selection of Pipe Supports for Small Bore Piping 5L340JS1003 for small bore (2" and smaller) piping. G. Deviations from the analyzed support locations and orientations shall be evaluated prior to the release of pipe support drawings.	Meets NF requirements.

IV NF-3000 DESIGN

ASME (NF)

STP (OUTSIDE BOUNDARY)

REFERENCE JQ1000

COMMENTS

NF-3124 Provisions for Movement of Supported Component

Consideration shall be given to the relative motion of the supported piping or other supported component and the component support. When clearances or travel ranges or both are required to accommodate component movements, sufficient design margins shall be introduced to allow for variations due to fabrication and installation. Care shall be taken to ensure that design clearances and travel ranges are based on the maximum range that might occur between two operating conditions and not necessarily on the maximum cold to hot range. All parts of the support shall be fabricated and assembled so that they will not be disengaged by the movement of the supported component. Supports needed only to provide stability during the plant Level C or Level D Service Limits shall be designed and installed so as not to overstress the component during plant Level A or Level B Service Limits.

NF-3133.2 Anchors, Guides, Pivots, and Restraints. Anchors, guides, pivots, and restraints shall be designed to secure the desired points of piping in relatively fixed positions. They shall permit the piping to expand and contract freely as directed from the anchored or guided point and shall be structurally capable of withstanding the thrusts, moments, and other imposed loads.

Hangers shall be designed not to become disengaged by movements of the supported pipe.

Pipe supports shall be designed to facilitate field adjustment during installation.

Construction tolerance of ± 4" (combined effect of structural erection tolerance and pipe erection tolerance) must be considered in pipe support design. This is applicable to all new designs.

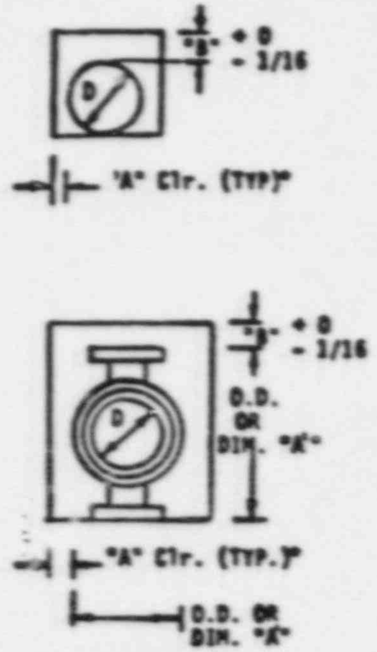
Construction tolerance of ± 2" and pipe erection tolerance of ± 1/2" must be considered for pipe support designs prior to March 31, 1982.

Base plate tolerances as shown in specification JS1002 must be considered in the design.

Meets NF requirements.

IV NF-3000 DESIGN

CLEARANCE REQUIREMENTS FOR RESTRAINED PIPE



* Min. total Clr. "C".
Max. total Clr. "2A".

NOTES:

1. Use "Design Temperature" from the "Line Designation List", do not use operating temperature.
2. Min. & Max. total clearance must be specified if Min. clearance is 1/16" or greater.

STAINLESS STEEL

NPS (IN.)	PIPE O.D. OR DIM. "X" (IN.)	DESIGN TEMPERATURE (°F) < 150	150 - 199	200 - 299	300 - 399	400 - 499	500 - 599	600 - 649	650	CLEARANCE (IN.) MIN. TOTAL REQ'D "C"	DIM. "A"	DIM. "B"
2-1/2	2.875											
3	3.5											
4	4.5											
6	6.625											
8	8.625									1/16	1/16	1/8
10	10.75											
12	12.75											
14	14.0											
16	16.0									1/8	1/8	3/16
18	18.0											
20	20.0											
24	24.0											
28	28.0									3/16	1/8	1/4
32	32.0											
36	36.0									1/4	3/16	5/16
48	48.0									5/16	3/16	3/8

CARBON STEEL

NPS (IN.)	PIPE O.D. OR DIM. "X" (IN.)	DESIGN TEMPERATURE (°F) < 150	150 - 199	200 - 299	300 - 399	400 - 499	500 - 599	600 - 649	650	CLEARANCE (IN.) MIN. TOTAL REQ'D "C"	DIM. "A"	DIM. "B"
2-1/2	2.875											
3	3.5											
4	4.5											
6	6.625											
8	8.625											
10	10.75											
12	12.75									1/16	1/16	1/8
14	14.0											
16	16.0											
18	18.0											
20	20.0									1/8	1/8	3/16
24	24.3											
28	28.0											
32	32.0											
36	36.0									3/16	1/8	1/4
48	48.0									1/4	3/16	5/16

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3126 Rolling and Sliding Supports *(a) Rolling and sliding supports* shall permit free movement of the component or the component shall be designed to include the imposed load and frictional resistance of these types of supports; their dimensions shall provide for the designed movement of the supported component. *(b) Sliding supports (or shoes) and brackets* shall be designed to accommodate the forces caused by friction in addition to the loads imposed by bearing. The dimensions of the support shall provide for the design movement of the supported component. Material and lubricants used in sliding supports shall be suitable for the environment of the metal at the point of sliding contact.	Not Applicable	Meets NF Requirements. - Lubrite plates are designed and supplied by NPSI according to NF Code - Supports are designed for the following friction coefficients. 1. Steel on steel = .3 2. Steel on L. Plate = 0.2

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3127 Sway Braces and Vibration Dampeners Sway braces and vibration dampeners may be used to limit the effects of vibration and may be of the rigid strut (linear type) tension/compression type. If employed in the design or added as a result of observation under startup or initial operating conditions (NF-3120), the effect of sway braces shall be included in the stress analysis of the component for all of the specified conditions.	Flow induced steady state vibrations are not considered during the design; however vibration dampeners will be used as needed during startup.	Meets NF requirements.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
	Not Applicable	Complies with NF inside boundary.

NF-3128 Structural Attachments

Structural attachments (NF-1221) may be of either the integral or nonintegral type.

NF-3128.1 Integral Attachments

(a) Integral attachments include ears, shoes, lugs, cylindrical attachments, rings, and skirts that are fabricated so the attachment is an integral part of the component. Integral attachments shall be used in conjunction with restraints or braces when multiaxial restraint in a single member is required to be maintained. Consideration shall be given to the localized stresses induced into the component by integral attachments.

(b) Integral lugs, plates, and angle clips, used as part of an assembly for the support or guiding of a component, may be welded directly to the component, provided the materials are compatible for welding, and the design is adequate for the temperature and load.

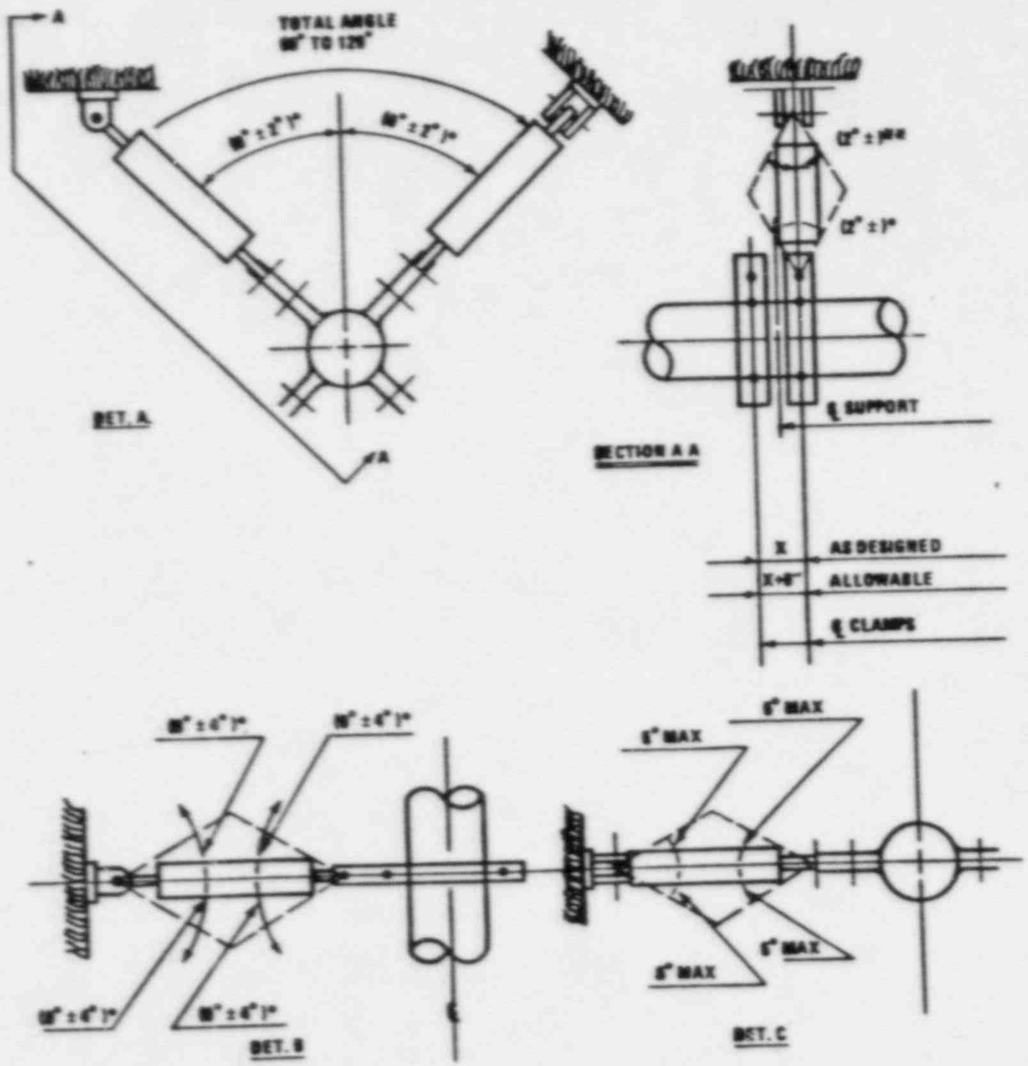
NF-3128.2 Nonintegral Attachments

(a) Nonintegral attachments include clamps, slings, cradles, saddles, straps, and clevises.

(b) When clamps are used to support vertical piping lines, it is recommended that shear lugs be welded to the pipe to prevent slippage.

(c) In addition to the provision of (b) above, clamps to support vertical piping lines shall be designed to support the total load on either arm in the event the load shifts because of pipe or hanger movement or both.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY) (JS1002) MECHANICAL SHOCK ARRESTOR AND SWAY STRUT INSTALLATION TOLERANCES	COMMENTS
NF-3129 Snubbers The end connection of the snubber shall be designed to accommodate vertical and horizontal movement of the component, as required.		Meets NF requirements.

*FROM DESIGN POSITION
**FROM DESIGN POSITION – NOT TO EXCEED 5°

IV NF-3000 DESIGN

	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3130 GENERAL DESIGN RULES **NF-3131 Scope** Design rules generally applicable to component supports are provided in the following paragraphs. **NF-3132 Design Procedures** **NF-3132.1 Types of Procedure** *(a)* The design procedure which may be used is dependent on the type of component support being designed and the class of construction involved. Three design procedures are recognized, namely: *(1)* design by analysis *(a)* maximum shear stress theory *(b)* maximum stress theory *(2)* experimental stress analysis (Appendix II) *(3)* load rating *(b)* Table NF-3132.1(b)-1 lists the types of component supports and shows the design procedure which may be used in designing them for each class of construction. See also Table NF-2121(a)-1 for the design stress intensity or allowable stress values to be employed in designing each type of support, depending on the class of construction involved. *(c)* Unless either the experimental stress analysis procedure or the load rating procedure is used, the requirements of the following subparagraphs apply.	STP support design is by analysis only. Experimental stresses and load rating are not used in support design except in selecting concrete expansion anchors and anchor bolts.	Meets NF requirements

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3132.2 Plate and Shell Type Supports—Analysis Procedure *(a)* Elastic analysis based on maximum shear stress theory in accordance with the rules of NF-3220 shall be used in the design of plate and shell type supports of Class 1 construction. *(b)* Elastic analysis based on maximum stress theory shall be used in the design of plate and shell type supports of Class 2, MC, and 3 construction.	Not Applicable	Meets NF Requirements, in that pipe support structure outside the NF boundary is designed as linear type supports.

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3132.3 Linear Type Supports—Analysis Procedure *(a)* Elastic analysis based on maximum stress theory in accordance with the rules of NF-3230 and Appendix XVII-2000 shall be used for the design of linear type supports of Class 1, 2, 3, and MC, construction. *(b)* Limit analysis in accordance with the procedures of Appendix XVII-4000 may be used in the design of linear type supports of Class 1, 2, 3, and MC, construction. *(c)* High cycle fatigue analysis in accordance with procedures of XVII-3000 shall be used in the design of linear type supports of Class 1, 2, 3, and MC, construction.	All pipe supports are designed as linear supports unless otherwise instructed. See Sheets 1 of 17 through 17 of 17 for allowable stress comparison. Fatigue analysis of pipe supports is not considered on SIP due to small number of fatigue cycles. Meets NF requirements for all loading conditions.	Meets NF requirements.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3132.4 Component Standard Supports—Analysis Procedure. Component Standard Supports designed by analysis shall be designed to either the requirements of NF-3132.2 or NF-3132.3, according to whether they are plate and shell type or linear type Component Standard Supports.	Not Applicable	Component standard supports are designed and supplied by NPSI in accordance with NF Code.
NF-3393 Permissible Types of Weld Joints in Component Standard Supports The permissible types of welded joints for component standard supports shall be as stipulated in NF-3391 and NF-3392. **NF-3393.1 Allowable Stress Limits.** Stress limits for welds in component standard supports shall not exceed the allowable limits stipulated in NF-3391.1 or NF-3392.1.		

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3133 Design Rules for Pipe Supports **NF-3133.1 Spacing of Piping Supports.** Supports for piping with longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive shear stresses resulting from sag and bending in the piping with special consideration given when components such as pumps and valves impose concentrated loads. The suggested maximum spans for spacing of weight supports for standard weight and heavier pipe are given in Table NF-3133.1-1.	Complies with NF	Pipe supports are spaced by the stress analysis group and computer analysis is used to ensure that pipe stresses are within the allowables of ASME Code.

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ASME (NF)

NF-3133.3 Support Adjustments

(a) Screwed adjustments shall have threaded parts to conform to ANSI B1.1 coarse threaded series, Class 2 fit.

(b) Turnbuckles and adjusting nuts shall have the full length of thread in engagement. Means shall be provided for determining that full thread length is engaged. All screw and equivalent adjustments shall be provided with suitable locking devices.

STP OUTSIDE BOUNDARY

Reference JQ1000

For all pipe support designs, right hand threaded connections excluding concrete anchor bolts, shall be provided with locking devices except when high-strength bolts are used.

All bolted connections, except concrete anchor bolts, shall be provided with locking devices except when high-strength bolts (such as A325 or A490) are used. High-strength bolts shall be installed in accordance with NF-4724.

COMMENTS

STP uses locking devices for righthand threads only.

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
	Reference RQ1001 (Cookbook)	

NF-3134.1 General Requirements. Component Standard Supports (NF-1214) shall conform to the design considerations of NF-3120, general design rules of NF-3130, and the following additional requirements.

Meets NF Requirements.

TABLE NF-3133.1-1
SUGGESTED PIPE SUPPORT SPACING

Nominal Pipe Size, in.	Suggested Maximum Span, ft — Water Service	Suggested Maximum Span, ft — Steam, Gas, or Air Service
1	7	9
2	10	13
3	12	15
4	14	17
6	17	21
8	19	24
12	23	30
16	27	35
20	30	39
24	32	42

NOTES:
(1) Suggested maximum spacing between pipe supports for horizontal straight runs of standard and heavier pipe at maximum operating temperatures of 750 F.
(2) Does not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc.
(3) The spacing is based on a maximum combined bending and shear stress of 1500 psi and insulated pipe filled with water or the equivalent weight of steel pipe for steam, gas or air service and the pitch of the line is such that a sag of 0.1 in. between supports is permissible.

MAXIMUM SPAN LENGTH FOR SEISMIC CATEGORY I PIPING

PIPE NOMINAL SIZE (INSULATION THICKNESS, INCHES)	PIPE SCH.	MAXIMUM SPACING, FT FOR BUILDINGS AND ELEVATIONS			
		RCB Cont. Str.: 37.0, 68.0 Int. Str.: All EL's St. Gen.: 19.0 Reac. Str.: 32.0 MEAB: 10.0, 21.0, 35.0 FHB: -29.0, 4.0 ECWS: All EL's	MEAB: 51.0, 72.0, 86.0, 95.0, 96.0 FHB: 48.0, 68.0 RCB Cont. Str.: 108.0, 153.0, 203.75	DGB: All EL's RCB St. Gen.: 40.5	FHB: 119.0
1/2	40	7.6	6.5	5.8	5.2
	80	7.7	6.6	5.9	5.3
(1)	160	7.7	6.6	5.9	5.3
3/4	40	8.2	7.0	6.2	5.7
	80	8.4	7.2	6.4	5.8
(1-1/2)	160	8.5	7.3	6.4	5.8
1	40	9.1	7.8	6.9	6.3
	80	9.3	8.0	7.1	6.4
(2)	160	9.4	8.1	7.2	6.5
1-1/2	40	11.5	9.9	8.8	8.0
	80	11.8	10.1	9.0	8.2
(2)	160	12.0	10.3	9.2	8.3
2	40	13.1	11.2	10.0	9.1
	80	13.5	11.6	10.3	9.4
(2)	160	13.8	11.9	10.6	9.6
DESIGN FREQUENCY, CPS		6	8	10	12
WEIGHT STRESS, PSI		5117	3838	3070	2558
SEISMIC OBE STRESS, PSI		6345	7600	8380	8876

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3134.2 Loads *(a) Component Standard Supports* shall be capable of carrying all concurrently acting loads listed in NF-3111 and stipulated in the Design Specifications. The supports shall be designed to provide the required supporting effort and to permit the designed component movement. *(b) Spring supports* shall be capable of exerting a supporting force equal to the load, as determined by weight-balance calculations, plus the weight of all hanger parts, such as clamps, and rods, that will be supported by a spring at the point of attachment to a pressure retaining component or to an integral attachment. *(1)* The design shall be such as to prevent complete release of the component load in the event of spring failure or misalignment. *(2)* When springs are to be enclosed in spaces where high ambient temperatures occur, the spring material shall be such that the spring constants will not be significantly changed at the temperature to be experienced. *(c)* Snubbers shall meet the requirements of (a) above and (1) and (2) below: *(1)* The following occasional loads shall be considered: *(a)* seismic inertial *(b)* seismic anchor displacement *(c)* hydraulic transient loads resulting from, but not limited to, water hammer, steam hammer, pump startup, pump shutdown, safety valves, and safety relief valves *(2) Thermal expansion and thermal anchor displacement*—The snubber shall not resist the effects of thermal growth of the component, piping system, or the anchorage to the degree where it imposes a significant load or stress on the component.	Not Applicable	All component standard supports are designed and supplied by NPSI in accordance with NF Code.

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ASME (NF)	STP OUTSIDE BOUNDARY	COMMENTS
NF-3134.3 Constant Support Spring Hangers. Constant support spring hangers may be used to support components at those locations requiring a substantially uniform supporting force throughout the travel range but which, while subject to thermal movement, cannot tolerate appreciable variability of the supporting force. They shall have a mean variability (deviation), including friction, of no more than 6% throughout the travel range. Deviation is the sum of kinematic friction and manufacturing tolerance factor. Determination of deviation is by load test machine and is calculated as follows: deviation = (maximum reading moving down - minimum reading moving up) ÷ (maximum reading moving down + minimum reading moving up)	Not Applicable	Constant springs are not currently used on STP but will comply with this portion of NF if used.

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
	Not Applicable	Meets NF requirements, inside boundary.

NF-3134.4 Variable Support Spring Hangers. Variable support spring hangers may be used to support components at those locations subject to vertical movement due to temperature differences where a variability of the supporting force up to a factor of 0.25, as calculated by the following equation, can be tolerated:

variability factor = (travel × spring rate)/load

(a) The variability of the supporting force resulting from movement of the component shall be considered in the loadings used in the stress analysis of the component.

(b) Variable support spring supports shall be provided with means to limit misalignment, buckling, and eccentric loading and to prevent overstressing of the spring.

(c) It is recommended that all hangers employing springs be provided with means to indicate at all times the compression of the spring with respect to the approximate hot and cold positions of the component.

NF-3134.5 Hanger Rods. Design loads for threaded hanger rods shall be based on the root area of the threads. In no case shall hanger rods less than ⅜ in. (10 mm) diameter be used for supporting pipe 2 in. (51 mm) and smaller, or less than ½ in. (13 mm) diameter rod for supporting pipe 2½ in. (64 mm) and larger. Pipe, structural shapes, or bars may be used instead of hanger rods. Hanger rods, structural shapes, etc., shall be designed to permit the free movement of piping as indicated in the thermal stress analysis. The possibility of moment loading of hanger rods or shapes as a result of pipe motion shall be considered and avoided unless the support is specifically designed for such loading.

NF-3134.6 Snubbers

(a) Snubbers may be incorporated in the system design to accommodate Design Mechanical Load or conditions of a vibratory or dynamic nature. Snubbers may be attached to a component to protect it against dynamic type loading. Snubbers shall allow essentially free movement of the component to which they are attached during nondynamic application of load such as that imposed by expansion and contraction.

(b) Snubbers shall be carefully applied to ensure that they will perform their intended function without placing unacceptable loads on the piping system or other components.

(c) The Design Specifications shall contain, but not be limited to, the following:

(1) the design loadings for loading conditions and transients, and combinations of loadings for which the snubber is designed to accommodate

(2) required force, time, and displacement relationship

(3) the environmental conditions that the snubber will be exposed to, such as:

- *(a)* temperature
- *(b)* irradiation
- *(c)* corrosive atmosphere
- *(d)* moisture
- *(e)* airborne particles

(4) consideration of material characteristics such as:

- *(a)* compatibility
- *(b)* stability
- *(c)* fire resistance
- *(d)* wear
- *(e)* aging

(5) tests are required prior to installation

(d) Design of functional members such as interconnections, tubing and fitting reservoirs, and

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3200 DESIGN OF CLASS 1 COMPONENT SUPPORTS **NF-3210 GENERAL REQUIREMENTS** **NF-3211 Requirements for Acceptability** The requirements for acceptability of Class 1 component support design are given in (a) through (e) below. *(a)* The design shall be such that the stress intensity values or the stress values (whichever is applicable) will not exceed the limits given in this Subarticle. Table NF-3132(b)-1 indicates the rules and limits to be used for the various classes and types of design procedures. The applicable table of allowable stress values for a given material to be used with a specific design procedure are given in Table NF-2121(a)-1. *(b)* The design procedure shall be one of those given in Table NF-3132.1(b)-1 as being applicable to Class 1 component supports. *(c)* The design details shall conform to the rules of this Subarticle or to those referred to herein. *(d)* For configurations where compressive stresses occur, in addition to the requirements of (a), (b), and (c) above, the critical buckling stress shall be taken into account. *(e)* Protection against nonductile fracture shall be provided. An acceptable procedure for nonductile failure prevention is given in Appendix G.	Complies with AISC for design, normal and upset condition. STP has used 1.33 times AISC stress limits, but not more than 2/3 critical buckling, for the emergency and faulted conditions.	

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3212 Basis for Determining Stresses in Design by Analysis *(a)* The theory of failure used in the rules of this Subsection for combining stresses for the design of Class 1 plate and shell type supports including such component standard type supports that fall into that category is the maximum shear stress theory. The maximum shear stress at a point is equal to one-half the difference between the algebraically largest and the algebraically smallest of the three principal stresses at the point. *(b)* The theory of failure used in the rules of NF-3230 and Appendix XVII for the design of Class 1 linear supports is the maximum stress theory. In the maximum stress theory, the controlling stress is the maximum principle stress.	Complies with NF	Plate and shell type supports are not used at STP outside the boundary.

NF-3213 Terms Relating to Design by Analysis

(a) Terms used in the Design of Plate and Shell Type Supports by Stress Analysis are defined in NF-3213.1 through NF-3213.13 below.

(b) Terms used in the design of linear types of supports by stress analysis are defined in Appendix XVII.

NF-3213.1 Stress Intensity.[1] Stress intensity is the equivalent intensity of combined stress or, in short, the stress intensity is defined as twice the maximum shear stress. In other words, the stress intensity is the difference between the algebraically largest principal stress and the algebraically smallest principal stress at a given point. Tensile stresses are considered positive and compressive stresses are considered negative.

NF-3213.2 Gross Structural Discontinuity. Gross Structural Discontinuity is a geometric or material discontinuity which affects the stress or strain distribution through the entire thickness of the member. Gross discontinuity type stresses are those portions of the actual stress distributions that produce net bending and membrane force resultants when integrated through the thickness. Examples of gross structural discontinuities are junctions between parts of different diameters or thicknesses and flange-to-shell junction.

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3213.3 Normal Stress. Normal Stress is the component of stress normal to the plane of reference. This is also referred to as direct stress. Usually the distribution of normal stress is not uniform through the thickness of a part, so this stress is considered to be made up in turn of two components, one of which is uniformly distributed and equal to the average value of stress across the thickness under consideration, and the other of which varies from this average value with the location across the thickness.	Same for STP	
NF-3213.4 Shear Stress. Shear stress is the component of stress tangent to the plane of reference.		
NF-3213.5 Membrane Stress. Membrane stress is the component of normal stress which is uniformly distributed and equal to the average of stress across the thickness of the section under consideration.		
NF-3213.6 Bending Stress. Bending stress is the variable component of normal stress described in NF-3213.3. The variation may or may not be linear across the thickness.		
NF-3213.7 Primary Stress. Primary stress is any normal stress or a shear stress developed by an imposed loading which is necessary to satisfy the laws of equilibrium of external and internal forces and moments. The basic characteristic of a primary stress is that it is not self-limiting. Primary stresses which considerably exceed the yield strength will result in failure or, at least, in gross distortion. A thermal stress is not classified as a primary stress. A general primary membrane stress is one which is so distributed in the structure that no redistribution of load occurs as a result of yielding. An example of primary stress is general membrane stress in a circular cylindrical shell due to distributed live loads.		

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3213.8 Secondary Stress. Secondary stress is a normal stress or a shear stress developed by the constraint of adjacent material or by self-constraint of the structure. The basic characteristic of a secondary stress is that it is self-limiting. Local yielding and minor distortions can satisfy the conditions which cause the stress to occur and failure from one application of the stress is not to be expected. An example of secondary stress is bending stress at a gross structural discontinuity.	Same as STP	
NF-3213.9 Total Stress. Total stress is the sum of the primary and secondary stress contributions. Recognition of each of the individual contributions is essential to establishment of appropriate stress limitations.		
NF-3213.10 Free End Displacement. Free end displacement consists of the relative motions that would occur between an attachment and connected structure or equipment if the two members were separated. Examples of such motions are those that would occur because of relative thermal expansion of piping, equipment, and equipment supports, or because of rotations imposed upon the equipment by sources other than the piping.		
NF-3213.11 Expansion Stresses. Expansion stresses are those stresses resulting from restraint of free end displacement of the piping system.		Not used at STP.
NF-3213.12 Limit Analysis—Collapse Load. The methods of limit analysis are used to compute the maximum load or combination of loads a structure made of ideally plastic (nonstrain-hardening) material can carry. The deformations of an ideally plastic structure increase without bound at this load which is termed the *collapse load*. Among the methods used in limit analysis is a technique which assumes elastic, perfectly plastic, material behavior and a constant level of moment or force in those redundant structural elements in which membrane yield, plastic, hinge or critical buckling load has been reached. Any increase in load must be accompanied by a stable primary structure until a failure mechanism defined by the lower bound theorem of limit analysis is reached in the primary structure.	Not applicable	

IV NF-3000 DESIGN

ASME (NF)		STP (OUTSIDE BOUNDARY)	COMMENTS

NF-3213.13 Collapse Load—Lower Bound. If, for a given load, any system of stresses can be found which everywhere satisfies equilibrium, and nowhere exceeds the material yield strength, the load is at or below the collapse load. This is the lower bound theorem of limit analysis which permits calculations of a lower bound to the collapse load.

NF-3220 DESIGN OF PLATE AND SHELL TYPE SUPPORTS BY ANALYSIS

NOTE: NF-3220 provides stress limits for elements of Class 1 supports other than bolts and welds, limits for which are given in NF-3280 and NF-3290. For general requirements as to stress determinations, definitions, derivations of stress intensities and classification of stresses, see NF-3210.

NF-3231.2 Limit Analysis. As an alternative to the linear elastic analysis method, limit analysis using the design requirements of XVII-4000 may be used.

NF-3214 Stress Analysis

A detailed stress analysis of all major structural components shall be prepared in sufficient detail to show that each of the stress limitations of NF-3220 is satisfied when the component support is subjected to the loadings of NF-3110.

NF-3215 Derivation of Stress Intensities

One requirement for the acceptability of a design (NF-3210) is that the calculated stress intensities shall not exceed specified allowable limits. These limits differ depending on the stress category (primary, secondary, etc.) from which the stress intensity is derived. This paragraph describes the procedure for the calculation of the stress intensities which are subject to the specified limits. The steps in the procedure are stipulated in (a) through (e) below.

(a) At the point on the component which is being investigated, choose an orthogonal set of coordinates such as tangential, longitudinal, and radial, and designate them by the subscripts t, l, and r. The stress components in these directions are then designated σ_t, σ_l, and σ_r for direct stresses and τ_{tl}, τ_{lr}, and τ_{rt} for shear stresses.

(b) Calculate the stress components for each type of loading to which the part will be subjected and assign each set of stress values to one or a group of the following categories:[2]

(1) general primary membrane stress, P_m (NF-3213.5 and NF-3213.7)

(2) primary bending stress, P_b (NF-3213.6 and NF-3213.7)

(3) expansion stress, P_e (NF-3213.11)

(4) secondary stress, Q (NF-3213.8)

(c) For each category, calculate the algebraic sum of the σ_t's which result from the different types of loadings and similarly for the other five stress components. Certain combinations of the categories must also be considered.

(d) Translate the stress components for the t, l, and r directions into principal stresses, σ_1, σ_2, and σ_3.

(e) Calculate the stress differences S_{12}, S_{23}, and S_{31} from the relations

$$S_{12} = \sigma_1 - \sigma_2$$
$$S_{23} = \sigma_2 - \sigma_3$$
$$S_{31} = \sigma_3 - \sigma_1$$

[2]See Tables NF-3217-1 and Note 1 of Fig. NF-3221-1.

STP (OUTSIDE BOUNDARY): Not applicable

COMMENTS: Not used at STP

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ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3230 DESIGN OF LINEAR TYPE SUPPORTS BY ANALYSIS **NF-3231 Stress Limits** **NF-3231.1 Elastic Analysis** *(a) Design and Level A and Level B Limits.* Design and Level A and Level B Limits are identical and are given in Appendix XVII. The allowable stress for the combined mechanical loads and effects which result from constraint of free-end displacements (NF-3213.10), but not thermal or peak stresses, shall be limited to three times the stress limits of XVII-2000. *(b) Level C Limits.* The stress values for Level C Limits may be increased by one-third over the values given in XVII-2000. Constrained free-end displacement and differential support motion effects need not be considered. *(c) Level D Limits.* If the Design Specifications specify any Service Loadings for which Level D Limits are designated the rules contained in F-1370 of Appendix F may be used in evaluating them independently of all other Design and Service Loadings. Constrained free end displacement and differential support motion effects and bearing type stresses need not be considered.	See "Loading Combination Allowables" pages 1 through 17.	

IV NF-3000 DESIGN

ASME (NF) | STP (OUTSIDE BOUNDARY) | COMMENTS

NF-3250 EXPERIMENTAL STRESS ANALYSIS

Component supports of all types may be designed by experimental stress analysis in accordance with Appendix II.

NF-3260 DESIGN BY LOAD RATING

NF-3261 Procedure for Load Rating

The procedure for load rating shall consist of imposing a total load on one or more duplicate full size samples of a component support equal to or less than the load under which the component support fails to perform its required function. A single test sample is permitted but, in that case, the load ratings shall be derated by 10%. Otherwise, tests shall be run on a statistically significant number of samples.

NF-3262 Load Ratings in Relation to Service Loadings

The load ratings for Service Loadings for which Level A, Level B or Level C Limits have been designated shall be determined by means of the equations in the following subparagraphs. For Level D Limits, see Appendix F.

NF-3262.1 Nomenclature. The symbols used in this paragraph are defined as follows:

T.L. = support test load equal to or less than the load under which the component support fails to perform its specified support function

F_{all} = allowable value for the type of stress in XVII-1100 of Appendix XVII

S = allowable stress value at the design temperature (NF-3112.1) from the applicable table of Appendix I

S_u = specified minimum tensile strength of the material used in the support as given in the applicable table of Appendix I

NF-3262.2 Plate and Shell Supports. The load ratings for plate and shell supports for the Service Loadings shall be determined by the following equations:

Level A Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{S}{S_u} \quad (1)$$

Level B Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{S}{S_u} \quad (2)$$

Level C Limits

$$\text{load rating} = \text{T.L.} \times 1.2 \frac{S}{S_u} \quad (3)$$

NF-3262.3 Linear Type Supports. The load ratings for linear type supports for the Service Loadings shall be determined by the following equations:

Level A Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{F_{all}}{S_u} \quad (4)$$

Level B Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{F_{all}}{S_u} \quad (5)$$

Level C Limits

$$\text{load rating} = \text{T.L.} \times 1.33 \frac{F_{all}}{S_u} \quad (6)$$

NF-3262.4 Component Standard Supports. The load ratings for component standard supports for the Service Loadings shall be determined by the following equations:

Level A Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{S \text{ or } F_{all}}{S_u} \quad (7)$$

Level B Limits

$$\text{load rating} = \text{T.L.} \times 1.0 \frac{S \text{ or } F_{all}}{S_u} \quad (8)$$

plate and shell

Level C Limits

$$\text{load rating} = \text{T.L.} \times 1.2 \frac{S}{S_u} \quad (9a)$$

linear type

Level C Limits

$$\text{load rating} = \text{T.L.} \times 1.33 \frac{F_{all}}{S_u} \quad (9b)$$

STP (OUTSIDE BOUNDARY): Not Applicable

COMMENTS: Supports are designed in accordance with linear support analysis outside the boundary.

NF-3350 DESIGN BY EXPERIMENTAL STRESS ANALYSIS

Component supports may be designed by experimental stress analysis in accordance with Appendix II.

NF-3360 DESIGN BY LOAD RATING

Component supports may be designed by load rating in accordance with the requirements of NF-3260.

IV NF-3000 DESIGN

	ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3280	DESIGN OF BOLTS	Complies with NF	
NF-3281	Design for Normal and Upset Conditions The number and cross sectional area of bolts required for the design conditions of NF-3112 shall be determined in accordance with the procedures of Appendix XVII. The allowable bolt design stress values shall be the yield strength values of Table I-13.3 of Appendix I multiplied by the applicable design factors of Table XVII-2461.1-1.		

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3290 DESIGN OF WELDED JOINTS **NF-3291 Permissible Types of Welded Joints in Plate and Shell Type Welded Supports** *(a)* All welded joints in plate and shell type supports shall be continuous and shall be one of the types shown in Fig. NF-3291(a)-1 and described in (1) through (8) below: *(1)* full penetration butt welded groove joint, sketch (a) *(2)* double fillet welded lap joint, sketch (b) *(3)* full penetration groove welded tee joint, sketch (c) *(4)* full penetration groove welded corner joint, sketch (d) *(5)* full fillet welded tee joints, sketch (e) *(6)* angle joints, sketch (f) *(7)* fillet welded joint between a surface and a closed tubular section or a closed section, sketches (g) and (h) *(8)* fillet welded joint between the edge of a plate and the end surface of a closed tubular section or a closed formed section, sketch (i). When angle joints are used for connecting a transition in diameter to a cylinder, the angle, α, of Fig. NF-3291(a)-1, sketch (f), shall not exceed 30 deg. *(b)* A tapered transition having a length not less than 3 times the offset between the adjacent surfaces of abutting sections, as shown in Fig. NF-3291(b)-1, shall be provided at joints between sections that differ in thickness by more than ¼ of the thickness of the thinner section or by more than ⅛ in., whichever is less. The transition may be formed by any process that will provide a uniform taper. The weld may be partly or entirely in the tapered section or adjacent to it. This paragraph also applies when there is a reduction in thickness within a spherical shell or cylindrical course or plate. *(c)* When the use of backing rings will result in undesirable conditions such as severe stress, corrosion, or erosion, the requirements of NF-4240 shall be met.	Not applicable	Plate and shell type supports are not used outside the NF boundary.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
	Same as NF	

NF-3292 Permissible Types of Welded Joints in Linear Type Welded Supports

The permissible types of welded joints used in linear type supports shall be as stipulated in XVII-2450.

NF-3292.1 Allowable Stress Limits. The allowable stress limits for welds in linear type supports shall be as set forth in Table NF-3292.1-1.

TABLE NF-3292.1-1
ALLOWABLE STRESS LIMITS FOR
LINEAR COMPONENT SUPPORT WELDS—ALL CLASSES

Kind of Stress	Stress Limits, ksi	Base Metal T.S. Range, ksi
Tension and compression parallel to axis of any complete penetration groove weld	Same as for base metal	1
Tension normal to effective throat of complete penetration groove weld	Same as allowable tensile stress for base metal	
Compression normal to effective throat of complete or partial penetration groove weld	Same as allowable compressive stress for base metal	
Shear on effective throat of complete penetration groove weld and partial penetration groove weld	Same as allowable shear stress for base metal	
Shear stress on effective throat of fillet weld regardless of direction of application of load; tension normal to the axis on the effective throat of a partial penetration groove weld and shear stress on effective area of a plug or slot weld. The given stresses shall also apply to such welds made with the specified electrode on steel having a yield stress greater than that of the *matching* base metal. The allowable stress, regardless of electrode classification used, shall not exceed that given in the table for the weaker *matching* base metal being joined.	18	45-60
	21	61-70
	24	71-80
	27	81-90
	30	91-100
	33	101-120
	36	121-135

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
	Not applicable	Complies with NF inside boundary.

NF-3293 Permissible Types of Welded Joints in Component Standard Supports

The permissible types of welded joints used in component standard supports and connections shall be as stipulated in NF-3291(a) and NF-3292.

NF-3293.1 Design Stress Intensity and Allowable Stress Limits for Welded Joints. The limit of design stress intensity or of allowable stress for welded joints for component standard supports shall not exceed the applicable design stress intensity value or allowable stress value for the base metal being joined. Temperature differences between the co[illegible]nent and its support and, where applicable, e[illegible]ans[illegible]n or contraction of a component produced [illegible]y intern[illegible]l or external pressure, shall be considered.

NF-3349 DE[illegible]GN OF COMPONENT S[illegible]ANDARD SUPPORTS BY ANALYSIS

The design of component standard supports shall be in accordance with NF-3320 or NF-3330.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3300 DESIGN OF CLASS 2 AND MC COMPONENT SUPPORTS **NF-3310 GENERAL REQUIREMENTS** **NF-3311 Acceptability** The requirements for acceptability of Class 2 and MC component support design are given in (a) through (d) below. *(a)* The design shall be such that the design stresses will not exceed the limits given in this Subarticle. Table NF-3132.1(b)-1 indicates the rules to be used for the various classes and types of design procedures. The applicable table of allowable stresses for a given material to be used with a specific design procedure is stipulated in Table NF-2121(a)-1. *(b)* The design procedure shall be one of those referenced in Table NF-3132.1(b)-1 applicable to Class 2 and MC component supports. *(c)* The design details shall conform to the rules of this Subarticle. *(d)* For configurations where compressive stresses occur, the potential for critical buckling shall be considered.	Complies with AISC for design, normal and upset conditions. STP has used 1.33 times AISC stress limits, but not more than 2/3 critical buckling, for the emergency and faulted conditions.	
NF-3330 DESIGN OF LINEAR TYPE SUPPORTS BY ANALYSIS The design rules and stress limits which must be satisfied for the Design and Service Loadings are as given in NF-3230.		

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
See below	Not applicable	Plate and shell type supports are not used outside the NF boundary.

NF-3320 DESIGN OF PLATE AND SHELL TYPE SUPPORTS BY ANALYSIS

NF-3321 Stress Limits

NF-3321.1 Design Conditions. The stress[1] limits are satisfied for the Design Conditions (NA-2142.1) stated in the Design Specifications if the requirements of Eqs. (1), (2), and (3) are met.

$$\sigma_1 \leq 1.0\,S \qquad (1)$$

$$\sigma_1 + \sigma_2 \leq 1.5\,S \qquad (2)$$

$$\sigma_3 \leq 0.5S \qquad (3)$$

where

σ_1 = membrane stress, which is the average stress across the solid section under consideration. It includes the effects of discontinuities but not local stress concentrations.

σ_2 = bending stress, which is the linear varying portion of the stress across the solid section under consideration. It excludes the effects of discontinuities and concentrations.

σ_3 = maximum tensile stress at the contact surface of a weld producing a tensile load in a direction through the thickness of plate and rolled shape elements, as shown in Fig. NF-3321.1(c)-1

S = allowable stress value from the applicable Table of Appendix I as referenced in Table NF-2121(a)-1

NF-3321.2 Service Conditions

(a) Normal Conditions. The stress limits are satisfied for the Normal Conditions [NA-2142.2(b)(1)] stated in the Design Specifications if the requirements of Eqs. (1), (2), and (3) of NF-3321.1 are met.

(b) Upset Conditions. The stress limits are satisfied for the Upset Conditions [NA-2142.2(b)(2)] stated in the Design Specifications if the requirements of Eqs. (1), (2), and (3) of NF-3321.1 are met.

(c) Emergency Conditions. The stress limits are satisfied for the Emergency Conditions [NA-2142.2(b)(3)] stated in the Design Specifications if the requirements of Eqs. (1) and (2) of NF-3321.1 are not exceeded by more than 20%, and if the requirement of Eq. (3) of NF-3321.1 is met.

(d) Faulted Conditions. **The stress limits are satisfied for the Faulted Conditions [NA-2142.2(b)(4)]** stated in the Design Specifications if the requirements of Eq. (3) of NF-3321.1, and Eqs. (4) and (5) below, are met.

$$\sigma_1 \leq \text{lesser of } 1.5S \text{ or } 0.4S_u \qquad (4)$$

$$\sigma_1 + \sigma_2 \leq \text{lesser of } 2.25S \text{ or } 0.6S_u \qquad (5)$$

where

S_u = specified minimum ultimate tensile strength of material, Table I-12.1

Other terms are as defined in NF-3321.1.

[1] *Stress* means the maximum normal stress.

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3390 WELDED JOINT DESIGN **NF-3391 Permissible Types of Welded Joints in Plate and Shell Type Supports** The types of welded joints shall be as stipulated in NF-3290 for Class 1 component supports, except that for groove welded T-joints, groove welded corner joints, and fillet welded T-joints, as shown in Fig. NF-3291(a)-1, sketches (c), (d), and (e), respectively, the welds may be intermittent instead of continuous. **NF-3391.1 Allowable Stress Limits** *(a)* Stresses in welds in plate and shell type supports shall not exceed the allowable tensile, compressive or shear stress value, as applicable, stipulated in Table NF-3292.1-1, for the base metal being joined. Temperature differences between the component and its support and, where applicable, expansion or contraction of a vessel produced by internal or external pressure shall be considered. *(b)* The maximum tensile stress at the contact surface of a weld transmitting a tensile load in the through thickness direction of plates and elements of rolled shapes shall be limited to 0.5*S*, as shown in Fig. NF-3321.1(c)-1.	Not applicable	Plate and shell type supports are not used outside the NF boundary.

IV NF-3000 DESIGN

ASME (NF)	STP OUTSIDE BOUNDARY	COMMENTS
NF-3392 Permissible Types of Weld Joints in Linear Type Supports The types of welded joints shall be as stipulated in Appendix XVII-2450. **NF-3392.1 Allowable Stress Limits** *(a)* Stresses in welds in linear type supports shall not exceed the values set forth in Table NF-3292.1-1. *(b)* The maximum tensile stress at the contact surface of a weld transmitting a stress in the through thickness direction of plates and elements of rolled shapes shall be limited to $0.3S_y$, but not more than ¾ of the minimum tensile strength of the steel, as shown in Fig. XVII-2211(c)-1.	Same as NF	

IV NF-3000 DESIGN

ASME (NF)	STP (OUTSIDE BOUNDARY)	COMMENTS
NF-3400 DESIGN OF CLASS 3 COMPONENT SUPPORTS The design of Class 3 component supports shall be in accordance with the requirements of NF-3300, using one of the design procedures indicated in Table NF-3132.1(b)-1 for Class 3 construction. The applicable table of allowable stresses for a given material to be used with a specific design procedure is stipulated in Table NF-2121-1.	Complies with AISC for design, normal and upset conditions. STP has used 1.33 times AISC stress limits, but not more than 2/3 critical buckling, for the emergency and faulted conditions.	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION NF-4111 Fabrication and Installation Component supports shall be fabricated and installed in accordance with the requirements of this Article and shall be manufactured from materials which meet the requirements of NF-2000.	SECT. 1.4 MATERIAL 1.4.1 Structural Steel 1.4.1.1 Material conforming to one of the following listing (latest date of issue) is approved for use under this Specification:	Materials the same as NF see materials Section NF-2120 Fabrication and installation addressed in following paragraphs this Section	
NF-4120 CERTIFICATION OF MATERIALS AND FABRICATION BY COMPONENT SUPPORT MANUFACTURER OR INSTALLER NF-4121 Means of Certification The Manufacturer or Installer of a component support shall certify that the materials used comply with all the requirements of NF-2000 and that the fabrication or installation complies with the requirements of NF-2000 and that the fabrication or installation complies with the requirements of NF-4000. NF-4121.1 Certification of Treatments, Tests, and Examinations. If the Manufacturer or Installer performs treatments, tests, repairs, or examinations required by other Articles of this Section, he shall certify that he has fulfilled that requirement (NA-3767.4(c)). Reports of all required treatments and the results of all required tests, repairs and examinations performed shall be available to the Inspector.	Structural Steel, ASTM A36 Welded and Seamless Steel Pipe, ASTM A53, Grade B High-Strength Low-Alloy Structural Steel, ASTM A242 High-Strength Low-Alloy Hot-Rolled Steel Sheet and Strip, ASTM A375 High-Strength Structural Steel, ASTM A440 High-Strength Low-Alloy Structural Manganese Vanadium Steel, ASTM A441 Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, ASTM A500 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing ASTM A501 Certified mill test reports or certified reports of tests made by the fabricator or a testing laboratory in accordance with ASTM A6 and the governing specification shall constitute sufficient evidence of conformity with one of the above ASTM specifications. Additionally, the fabricator shall, if requested, provide an affidavit stating that the structural steel furnished meets the requirements of the grade specified.	Material Certified as required See NF-2130	
NF-4121.2 Repetition of Tensile or Impact Tests. If during the fabrication or installation of the component support the material is subjected to heat treatment that has not been covered by treatment of the test coupons (NF-2200) and that may reduce either the tensile or impact tests shall be repeated by the manu-	1.4.5 Filler Metal for Welding Welding electrodes for manual shielded metal-arc welding shall conform to the specification for Mild Steel Covered Arc-Welding electrodes, AWS A5.5, latest edition.	No inprocess heat treatment. Impact tests not obtained at STP.	Materials utilized for pipe support construction outside the NF boundary do not require in process heat treatment or impact testing.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

FABRICATION & INSTALLATION

I-ASME NF

facturer or Installer on test specimens taken from test coupons which have been taken and treated in accordance with the requirements of NF-2000.

NF-4122 Material Identification

Material for component supports shall carry identification markings which will remain distinguishable until the component support is fabricated or installed. If the original identification markings are cut off or the material is divided, the marks shall be accurately transferred to the parts or a coded marking shall be used to assure identification of each piece of material during subsequent fabrication or installation, unless otherwise provided by NF-2150.

NF-4125 Testing of Welding Materials

All welding materials shall meet the requirements of NF-2400.

II-AISC

Bare electrodes and granular flux used in the submerged-arc process shall conform to F60 or F70 AWS-flux classifications of the Specification for Bare Mild Steel Electrodes and Fluxes for Submerged Arc Welding, AWS A5.17, latest edition, or the provisions of Sect. 1.17.3.

E60S or E70S electrodes used in the gas metal-arc process shall conform to the Specification for Mild Steel Electrodes for Gas Metal-Arc Welding, AWS A5.18, latest edition, or the provisions of Sect. 1.17.3; E60T or E70T electrodes used in the flux cored-arc process shall conform to the Specification for Mild Steel Electrodes for Flux-Cored-Arc Welding, AWS A5.20, latest edition, or the provisions of Sect. 1.17.3.

Manufacturer's certification shall conformity with the specifications.

SECT. 6 INSPECTION AND DELIVERY

(a) Test of Materials

Mill tests are performed to demonstrate material conformance to contract requirements. Unless special requirements. Unless special requirements are included in the invitation to bid, mill testing is limited to those tests required by the applicable ASTM material specifications. Mill test reports are furnished by the fabricator only if requested by the owner in either the invitation to bid or otherwise made in writing prior to the time the fabricator places his material orders with the mill.

III-STP PRACTICE OUTSIDE THE BOUNDARY

See Practice noted in NF 2150

For welding materials see NF-2400

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION	The fabricator customarily makes no tests of steel material. The owner must rely on mill tests required by contract and on such additional tests as he orders the fabricator to have made at the owner's expense. If tests other than mill tests are desired, the owner so specifies in the invitation to bid and should arrange for such testing through the fabricator. SECT. 5 STOCK MATERIALS (a) Many fabricators maintain stocks of steel products for use in their fabricating operations. Such materials as are taken from stock by the fabricator for use for structural purposes must be of a quality at least equal to that required by the specifications or the American Society for Testing and Materials applicable to the classifications covering the intended use. Mill test reports are accepted in the trade as sufficient record of the quality materials carried in stock by the fabricator. The fabricator checks and retains the mill test reports covering the materials he purchases for stock, but, because it is obviously impracticable to do so, he does not maintain records such as would identify individual pieces of stock material against individual mill test reports. Such records are not required if the fabricator purchases for stock under established specification as to grade and quality and the purchases can be checked against mill test reports. (b) It is common practice for the fabricator to use steel materials from his stock in his fabricating operations whenever he desires to do so, instead of ordering items from the mill for the specific use. Stock materials purchased under no particular specifications or under specifications		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION	less rigid than those mentioned above, or stock materials which have not been subject to mill or other recognized test reports, are not used without the express approval of the owner and then only under rigid inspection, except that such material may be used for small unimportant details where the quality of the material could not affect the strength of the structure.		
NF-4130 ELIMINATION AND REPAIR OF DEFECTS NF-4131 Rules Governing Elimination and Repair Defects in materials which were accepted on delivery or which are discovered during the process of fabrication or installation may be eliminated or repaired by welding, provided the defects are removed, repaired, and examined in accordance with the requirements of NF-2500 for the applicable product form.	Not addressed the Rules of the Material Specification would apply	Material repared in accordance with the material specification see NF-2510 and comments	
Material repairs in accordance with the material specification see NF-2510.			
NF-4200 FORMING, FITTING, AND ALIGNING NF-4210 CUTTING, FORMING, AND BENDING NF-4211 Cutting Materials may be cut to shape and size by mechanical means, such as machining, shearing, chipping or grinding, or thermal cutting.	1.23.2 Oxygen Cutting Oxygen cutting shall preferably be done by machine. Oxygen cut edges	All normal cutting processes are used. Ref.: CSP-82	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
Thermal cutting shall not be used on materials when the specified impact properties, if required, would be reduced below specified minimum values by the cutting operation unless the impact values can be be restored by subsequent heat treatment. Thermally cut edges that are to be welded shall be smooth and shall be free of all loose scale and slag accumulations.	which will be subjected to substantial stress or which are to have weld metal deposited on them shall be reasonably free from gouges; occasional notches or gouges not more than 3/16-inch deep will be permitted. Gouges greater than 3/16-inch that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 1/2-inch.	No Impact tested materials specified	
NF-4211.1 Preheating Before Thermal Cutting. When thermal cutting is performed to prepare weld joints or edges, to remove attachments on defective material, or for any other purpose, consideration shall be given to preheating the material using preheat schedules, such as suggested in Appendix D.	Not Addressed	Preheat as required by the applicable welding procedure are used Ref. CSP-82	
NF-4212 Forming and Bending Process Any process may be used to hot or cold form or bend materials, including weld metal, provided the specified impact properties of the materials, when required, are not reduced below the minimum specified values, or they are effectively restored by heat treatment following the forming with the material temperature higher than 100F below the lower critical temperature of the material.	Not Addressed The requirements for temperature control are addressed in welding and for straightening as shown below:	Hot and cold forming performed by NPSI in accordance with approved procedures: "Control of Forming 9.4.2" Site has the capability to perform hot or cold bending - Impact tested material is not involved	
NPSI performs hot and cold forming on these components in accordance with approved procedures, "Control of Forming 9.4.2" No impact tested material involved	SECT. 1.23 FABRICATION 1.23.1 Straightening Material Rolled material, before being laid off or worked, must be straight within the tolerances allowed by ASTM Specification A6. If straigthening is necessary, it may be done by mechanical		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
	means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 1100°F for A514 steel nor 1200°F for other steels.		
NF-4213 Qualification of Forming Processes and Acceptance Criteria for Formed Material	Not Addressed	Impact Testing not required.	Material utilized for pipe support construction outside the NF boundary do not require impact testing.
A procedure qualification test shall be conducted using specimens taken from materials of the same material specification, grade or class, heat treatment, and with similar impact properties as required for the material of the component support involved. These coupons shall be subjected to the equivalent forming or bending process and heat treatment as the material of the component involved. Applicable tests shall be conducted to determine that the required impact properties of NF-2300 are met after straining.			
NF-4213.1 Exemptions. Procedure qualification tests are not required for:		Impact Testing not required.	Materials utilized for pipe support construction outside the NF boundary do not require impact testing.
(a) Hot formed material, such as forgings, in which the hot forming is completed by the Material Manufacturer prior to removal of the impact test specimens; (b) Hot formed materials represented by test coupons required in either NF-2211 or NF-4121.2 which have been subjected to heat treatment representing the hot forming procedure and the heat treatments to be applied to the parts; (c) Materials which do not require impact tests in accordance with NF-2300;			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (d) Materials which have final strain after forming of less than 5%; (e) Material where the final strain is less than that of a previously qualified procedure for that material; (f) Material from which the impact testing required by NF-2300 is performed on each heat and lot (as applicable) after forming.			
NF-4213.2 Procedure Qualification Test. The procedure qualification test shall be performed in the manner stipulated in (a) through (f) below.	Not Addressed	Since impact testing is not required, procedure qualification is not required.	
(a) The tests shall be performed on three different heats of material both before and after straining to establish the effects of the forming and subsequent heat treatment operations. (b) Specimens shall be taken in accordance with the requirements of NF-2000 and shall be taken from the tension side of the strained material. (c) The percent strain shall be established by the following formulas: For cylinders: $\% \text{ Strain} = \frac{50t}{R_f}\left(1 - \frac{R_f}{R_o}\right)$ For spherical or dished surfaces: $\% \text{ Strain} = \frac{65t}{R_f}\left(1 - \frac{R_f}{R_o}\right)$			

I-ASME NF	II-AISC	III-SJP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

FABRICATION & INSTALLATION

For pipe:

$$\% \text{ Strain} = \frac{100r}{R}$$

Where

- t = nominal thickness
- R_f = final radius to centerline of shell
- R_o = original radius (equal to infinity for a flat part)
- R = nominal bending radius to the centerline of the pipe
- r = nominal radius of the pipe.

(d) The procedure qualification shall simulate the maximum percent surface strain, employing a bending process similar to that used in the fabrication of the material or by direct tension on the specimen.

(e) Sufficient Charpy V-notch specimens shall be taken from each of three heats of material to establish a transition curve showing in both the upper and lower shelves. On each of these three heats, tests consisting of three impact specimens shall be conducted at a minimum of five different temperatures distributed throughout the transition region. The upper and lower shelves may be established by the use of individual test specimens.

(f) From the impact test transition curves from each of three heats, both before and after straining, determine either:

(1) The maximum change in temperature considering various lateral expansion levels, or

(2) The maximum loss of lateral expansion.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4213.3 Acceptance Criteria for Formed Material. To be acceptable, the formed material used in the component shall have impact properties before forming sufficient to compensate for the maximum loss of the impact properties due to qualified forming procedure used.	Not Addressed	Impact testing is not required.	
NF-4213.4 Requalification. A new procedure qualification test is required when any of the following conditions occur:			
(a) The actual postweld heat treatment cycle is greater than previously qualified considering NF-2211. (If the material is not postweld heat treated, the procedure must be qualified without postweld heat treatment);			
(b) The maximum calculated strain of the material exceeds the previously qualified strain by more than 0.5%;			
(c) Where preheat over 250F is used in the forming or bending operation but not followed by a subsequent postweld heat treatment.			
NF-4220 FORMING TOLERANCES	Not Addressed		
NF-4221 Tolerances for Plate and Shell Type Supports	Prefabrication tolerances of Material Supplied is in accordance with ASTM A-6		
(a) The outer surface of a plate and shell type support shall not deviate from the specified shape by more than the greater of 1/4% of the overall design dimension. Such deviations shall not include abrupt changes.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (b) For plate and shell type supports which are skirts, the difference between the maximum and minimum outside diameters shall not exceed 1% of the nominal outside diameter.			
NF-4222 Tolerances for Linear Type Supports Tolerances for linear type supports fabricated from built-up members should be as recommended in Nonmandatory Appendix K, unless otherwise specified in the Design Specifications. Tolerances on Supplied material in accordance with SA-3	Tolerances as specified in ASTM A-6 on supplied Materials no Fabrication Tolerance except as defined in P.O. or on Drawings	Tolerances in accordance with ASTM A-6 for Supplied Material Ref. SS0026	NPSI has more restrictive tolerances as noted in Attachment (2)
NF-4223 Tolerances for component Standard Supports Tolerances for component standard supports should be as recommended in Nonmandatory Appendix K, unless otherwise specified in the Design Specifications.			
NF-4230 FITTING AND ALIGNING NF-4231 Fitting and Aligning Methods Parts that are to be joined may be fitted, aligned, and retained in position during the joining operation by the use of the bars, jacks, clamps, drift pins, tack welds, or temporary attachments. Mechanical devices shall be carefully used to avoid damage to surfaces of the parts and to avoid enlargement of bolt holes.	1.23.6 Welded Construction Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch. Parts to be fillet welded shall be brought in as close contact as prac-	Alignment is accomplished by use of the same methods specified in NF	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

FABRICATION & INSTALLATION

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
NF-4231.1 Tack Welds. Tack Welds used to secure alignment shall either be removed completely, when they have served their purpose, or their stopping and starting ends shall be properly prepared by grinding or other suitable means so that they may be satisfactorily incorporated into the final weld. Tack welds shall be made by qualified welders using qualified welding procedures. When tack welds are to become part of the finished weld, they shall be visually examined and defective tack welds removed.	ticable and in no event shall be separation is 1/16-inch or greater, the size of the fillet welds shall be increased by the amount of the separation. The separation between faying surfaces of lap joints and butt joints on a backing structure shall not exceed 1/16-inch. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt welded shall be carefully aligned. Misalignments greater than 1/8-inch shall be corrected, and making the correction, the parts shall not be drawn into a sharper slope than 2 degrees (7/16-inch in 12 inches). The work shall be positioned for flat welding whenever practicable.	Tack weld made by welders qualified in accordance with the requirements of AWS D1.1 or ASME IX. Tack Welds are inspected but need not be ground if incorporated into the final weld. Defective tack welds are removed.	Welders and procedures for Tack Welding qualified in accordance with either AWS D1.1 or ASME IX See: Attachment(1), for comparison of these codes.
NF-4231.2 Temporary Attachments and Their Removal. Attachments which are welded onto the component support or parts during the process of manufacturer or installation but which are not incorporated into the final support are permitted provided the requirements of (a) through (d) below are met. (a) The material is suitable and compatible for welding to the component support material (b) The welding material is compatible with the base material (c) The welding procedures are qualified in accordance with Section IX. (d) The surface of the support is visually examined after removal of the temporary attachment.	In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stesses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements. In the fabrication of cover-plated beams and built-up members, all shop splices in each component part is welded to other parts of the member Long girders or girder sections may be made by shop splicing not more than three subsections, each made in accordance with this paragraph. All complete penetration groove welds made by manual welding, except when produced with the aid of backing material or welded in the flat position from both sides in square-edge material not more than 5/16-inch thick with root openings not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back	(a) No requirement to use compatible material - Site practice is to use compatible material (b) Welding materal the same as for the root pass of the weld (c) Procedures qualified in accordance with AWS D1.1 or ASME IX (d) Surfaces are visually inspected after removal	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION	side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion thoughout the entire cross-section. Oxygen gouging shall not be permitted on ASTM A514 steel; all carbon deposits shall be removed by grinding after arc gouging A514 steel. Groovc welds made with use of a backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness. Groove welds shall be determinated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates, if used, shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts. Base metal shall be preheated as required to the temperature called for in Table 1.23.6 prior to welding, except tack welding which is to be remelted and incorporated into continuous submerged-arc welds. When base metal not otherwise required to be preheated is at a temperature below 32°F, it shall be preheated to at least 70°F prior to tack welding or welding. Preheating shall bring the surface of the base metal within 3 inches of the point of welding to the specified preheat temperature, and this temperature shall be maintained as a minimum interpass temperature while welding is in progress. Minimum preheat and interpass temperatures shall be as specified		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION	in Table 1.23.6. Heat input for the welding of ASTM A514 steel should not exceed the steel producer's recommendations or suggestions. Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling, or flaking of weld and base metal from over-peening Code of Standard Practice Section 6 (h) Tolerances Some variation is to be expected in the finished overall dimensions of structural steel frames. Such variations are deemed to be within the limits of good practice when they do not exceed the cumulative effect of the following: Rolling tolerances for cross-sectional dimensions, camber and sweep permitted under ASTM Specification A6, General Requirements for Delivery of Rolled Plates, Shapes, Sheet Piling and Bars for Structural Use. Fabricating tolerances for finished parts permitted in the current AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings unless otherwise specified in the bid documents or reference specifications.		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4232 Maximum Offset of Aligned Sections Alignment of butt joints shall be such that the maximum offset of the finished weld will not be greater than the applicable amount listed in Table NF-4232-1 where t is the nominal thickness of the thinner section of the joint.	See Page 10F&I - NF-4231 AISC Para 1.23.6	Offset not to exceed 10% of thickness of the thinner member being joined but in no case more than 1/8" . Ref. AWS D 1.1 Para 3.3.3.	NF will allow up to 0.187" mismatch AWS max. allowable is 0.125"

TABLE NF-4232.1
MAXIMUM ALLOWABLE OFFSET IN FINAL WELDED JOINTS

Section Thickness in.	Maximum Allowable Offset
Up to 3/4, incl.	1/4 t
Over 3/4 to 1 1/2, incl.	3/16 in.
Over 1 1/2 to 2, incl.	1/3 t
Over 2	Lesser of 1/3 or 3/4 in.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
NF-4232.1 Fairing of Offsets. Any offset within the allowabale tolerance of Table NF-4232-1 shall be blended uniformly over the width of the finished weld or, if necessary by adding additional weld metal beyond what would otherwise be the edge of the weld.		Not addressed in AWS	
NF-4240 REQUIREMENTS FOR WELDED JOINTS Butt welds may be made with or without backing or insert rings. When the use of permanent backing rings is undersirable (NF-3291(c)): (a) The backing ring shall be removed and the side of the joint grounded smooth, or	Not addressed must be detailed on drawings	The use of backing is limited to full penetration welds made from one side. Backing is only removed if required by drawing Ref. CSP-82	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
(b) The joint shall be welded without backing rings, or (c) Consumable insert rings shall be used.			
NF-4300 WELDING QUALIFICATIONS NF-4310 GENERAL REQUIREMENTS NF-4311 Types of Processes Permitted Only those welding processes which are capable of producing welds in accordance with the welding procedure qualification requirements of Section IX and this Subsection shall be used for welding Component Support materials or attachments thereto. Any process used shall be such that the records required by NF-4320 can be made with the exception of the stud welding processes which shall be restricted to the applications stipulated in NF-4311.1.	Welding in accordance with AWS D.1.1 which provides direction on processes to be used	Welding in accordance with AWS D.1.1 and ASME IX if used Ref. CSP-82 or CSP-84	See Attachment (1) for ASME IX and AWS D.1. comparison
NF-4311.1 Stud Welding Restrictions. Stud welding is acceptable for insulation supports, nameplates and locating lugs. When studs are 1/2 in. in diameter or less, postweld heat treatment, qualified welding procedures, and certified welding materials are not required.	Not spcifically addressed - Stud welding if used would logically be in accordance with AWS D 1.1	Stud welding not used in this application	
NF-4320 WELDING QUALIFICATION AND RECORDS NF-4321 Required Qualifications (a) Each Manufacturer or Installer is responsible for the welding done by his organization and shall establish the procedure and conduct the tests required by Section IX and as modified by this Article in order	Welding in accordance with AWS D.1.1 which provides the controls for these elements	Welding procedures and welders qualified per AWS D.1.1 or ASME IX as applicable Ref. CSP-82 or CSP-84	See attachment (1) and Form 84 Part F Appendix VII.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION to qualify both the welding procedures and the performance of welders and welding operators who apply these procedures. (b) Procedures, welders, and welding operators used to join support elements and to make permanent or temporary tack welds used in such welding shall also meet the qualification requirements of this Article. (c) When making procedure test plates for butt welds, it is recommended that consideration be given to the effect of angular, lateral, and end restraint on the weldment. This applies particularly to material and weld metal of 80,000 psi tensile strength or higher and heavy sections of both low and high tensile strength material. The addition of restraint during welding may result in cracking difficulties that otherwise might not occur.			
NF-4322 Maintenance and Certification of Records The Manufacturer or Installer shall maintain a record of his qualified welding procedures and of the welders and welding operators qualified and employed by him, showing the data and results of tests and the identification mark assigned to each welder. These records shall be accessible to the Owner (or his agent).	Welding in accordance with AWS D.1.1 provides requirements for records of welder qualifications	Records of welder qualification maintained on site Ref. CSP-81 Same system for ASME and AWS see CSP-81	This activity subject to regular audit.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION NF-4322.1 Identifiation of Joints (a) For Class 1 and plate and shell type and linear type supports, the welder or welding operator shall apply the identification mark assigned to him by the Manufacturer or Installer on or adjacent to all permanent welds, including fillet welds, at 3 ft intervals or less, with marking that meets the requirements of NF-2150 or, as an alternative, the Manufacturer or Installer shall keep a record of permanent welded joints in a component supports and of the welders and welding operators used in making each of the joints. (b) For all types of Class 2, 3, and MC supports and for all classes of component standard supports, the Manufactuer or Installer shall certify that only welders and welding operators qualified in accordance with NF-4321 were used a making all welds.		All welds stamped by Welders Ref. CSP-82	Inside the NF Boundary NF-Class 1 welds are stamped by welders, for other welds identification is through documentation.
NF-4323 Welding Prior to Qualification No welding shall be undertaken until after the welding procedures which are to be used have been qualified. Only welders and welding operators who are qualified in accordance with this Article and Section IX shall be used.	Welding in accordance with AWS D.1.1	Welding not performed prior to procedure and welder qualification	
NF-4324 Transferring Qualifications The performance qualification tests for welders and welding operators conducted by one Manufacturer or Installer shall not qualify welders or welding operators to weld for any other Manufacturer or Installer.		Qualifications not transferred	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4330 GENERAL REQUIREMENTS FOR WELDING PROCEDURE QUALIFICATION TESTS			
NF-4331 Conformance to Section IX Requirements All welding procedure qualification tests shall be in accordance with the requirements of Section IX as supplemented by the requirements of this Article.	Procedures in accordance with AWS D.1.1	Welding procedures qualified in accordance with AWS D.1.1 or ASME IX as applicable	See Attachment (1) and Form 84 Part F Appendix VII
NF-4332 Base Material to be Employed Welding procedure qualifications for materials which have specified impact test requirements shall be made using base materials in accordance with the applicable requirements of QW-403.4 and QW-403.5 of Section IX.		Impact testing not required.	
NF-4333 Heat Treatment of Qualification Welds for Ferritic Materials Postweld heat treatment of procedure qualification welds shall conform to the applicable requirements of NF-4600 and to Section IX of this Code. The postweld heat treatment time at temperature shall be at least 80% of the maximum time to be applied to the compoonent weld material. The postweld heat treatment total time may be applied in one heating cycle.	Not specifically addressed. However, welding in accordance with AWS D.1.1 will provide direction if requirement is involved by drawing or specification	Not Applicable.	Materials utilized for pipe support construction outside the NF boundary do require postweld heat treatment. Future applications involving whip restraints or Westinghouse components may require PWHT.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4334 Preparation of Test Coupons and Specimens			
Removal of coupons from the test weld and the dimensions of specimens made from them shall conform to the requirements of Section IX and the removal of the impact test coupons, when required, shall be in accordance with the following subparagraphs.		Test coupons removed in accordance with AWS D.1.1 or ASME IX as applicable impact tests not required	
NF-4334.1 Coupons Representing the Weld Deposits. Impact test specimen and testing methods shall conform to NF-2321. Each impact specimen shall be located so that the longitudinal axis of the specimen is at least 1/4 t from the surface of the test assembly and is transverse to the longitudinal axis of the weld with the area of the notch located in the weld. The length of the notch of the C_v specimen shall be normal to the surface of the weld.		Impact testing not required	
NF-4334.2 Coupons Representing the Heat-Affected Zone. Where impact tests of the heat-affected zone are required by NF-4335.2, specimens shall be taken from the welding procedure qualification test assemblies in accordance with (a), (b), and (c) below.		Impact testing not required	
(a) If the qualification test material is in the form of a plate or a forging, the axis of the weld shall be oriented in the direction parallel to the principal direction of rolling or forging.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (b) The heat-affected zone impact test specimens and testing methods shall conform to NF-2320. The specimens shall be removed from a location as near as practical to a depth midway between the surface and center thickness. The coupons for heat-affected zone impact specimens shall be taken transverse to the axis of the weld and etched to define the heat-affected zone. The notch of the C_v specimen shall be cut approximately normal to the material surface in such a manner as to include as much heat-affected zone as possible in the resulting fracture. Where the material thickness permits, the axis of a specimen may be inclined to allow the root of the notch to align parallel to the fusion line. (c) For the comparison of heat-affected zone values with base material values [NF-4335.2(b)], C_v specimens shall be removed from the unaffected base material at approximately the same distance from the base material surface as the heat-affected zone specimens. The axis of the unaffected base material specimens shall be parallel to the axis of the heat-affected zone specimens, and the axis of the notch shall be normal to the surface of the base material.			
NF-4335 Impact Test Requirements Impact tests of the weld metal and the heat-affected zone are required where impact tests are required for either of the base materials being joined (NF-2311). The specimens shall be in accordance with NF-2320. The requirements of the following subparagraphs shall be met.	Not Addressed	Impact testing not required	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION NF-4335.1 Impact Tests of Weld Metal (a) Impact tests of the weld metal shall be required for weld procedure qualification tests for production joints 5/8 in. in thickness except for austenitic and nonferrous filler metal. (b) Impact testing of the procedure qualification test weld deposit shall be performed at or below a temperature selected in accordance with the requirements of NF-2330. (c) the minimum requirements for the weld deposit impact tests shall be in accordance with NF-2331. NF-4335.2 Impact Tests of Heat-Affected Zone (a) C_v tests of the heat-affected zone of weld procedure qualification test are required for P-Numbers 4 (except SA-336, Class F12), 5, 6, 7, 9, 10A, 10B 10C, 10F, 10G, 10H, and 11 base materials when qualifying for thicknesses exceeding 5/8 in. C_v tests of the heat-affected zone of weld procedure qualification tests are required for P-Numbers 1 and 3 and SA-336, Class F12 base materials when qualifying for thicknesses exceeding 5/8 in., when the weld is made by the electroslag, electrogas, or thermal process; or when the joint is made by any process and is not postweld heat treated as permitted by NF-4620.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (b) Impact testing of the procedure qualification test heat-affected zone, where required by this paragraph, shall be conducted in accordance with (1) through (3) below. (1) For tests in accordance with NF-2331, the three C_v heat-affected zones and three C_v unaffected base material specimens shall be tested at a temperature in accordance with NF-2331(a). The C_v impact test of the unaffected base material shall meet the requirements of Table NF-2331(a)-1. If the average mils lateral expansion values of the three HAZ specimens is equal to or greater than the average value of the unaffected base material C_v specimens, the test shall be considered acceptable and the values and testing temperature shall be recorded on the Welding Qualification Record. (2) If the heat-affected zone C_v average lateral expansion values of (1) above are less than the unaffected base material and the qualification test meets the other criteria of acceptance, the C_v test results may be recorded on the Qualification test meets the other criteria of acceptance the C_v test results may be recorded on the Qualification Record. Data which will provide a testing temperature reduction below that of NF-2331(a) or an increase in the lowest service temperature for the base material for which the welding procedure is being qualified shall be included. Alternatively, the welding procedure qualification may be rewelded and retested.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (3) For tests in accordance with NF-2331, the test temperature reduction below the lowest service temperature for base material to be welded, or the increase in the lowest service temperature, shall be determined by performing additional C_v tests of the heat-affected zone (NF-2320). the purpose of this is to determine temperature at which the average lateral expansion for the heat-affected zone is equal to the average value for the unaffected base material at the test temperature at which the base material meets the requirements of Table NF-2331(a)-1. The amount by which this test temperature exceeds the temperature at which the base material meets the requirements of Table NF-2331(a)-1 shall be recorded on the Procedure Qualification Record as the corrective temperature increment.			
NF-4400 RULES GOVERNING MAKING, EXAMINING, REPAIRING, AND HEAT TREATING WELDS			
NF-4410 PRECAUTIONS TO BE TAKEN BEFORE WELDING			
NF-4411 IDENTIFICATION, STORAGE, AND HANDLING OF WELDING MATERIALS Each Manufacturer or Installer is responsible for control of the welding electrodes and other materials which are used in the fabrication and installation of components supports (NF-4120). Suitable identification, storage, and handling of electrodes, flux, and other welding materials shall be maintained. Precautions shall be taken to minimize absorption of moisture by electrodes and flux.	Not specifically addressed. However, welding in accordance with AWS D.1.1 provides controls for welding consumables	Welding consumables control is the same for ASME and AWS Ref. CSP-88	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4412 Cleanliness and Protection of Weld Surfaces The method used to prepare the base metal shall leave the weld preparation with reasonably smooth surfaces. The surfaces for welding shall be free of scale, rust, oil, grease, and other deleterious foreign material. The work shall be protected from deleterious contamination and from rain, snow, and wind during welding. Welding shall not be performed on wet surfaces.		AWS D.1.1. Para 3.1 & 3.2 provide similar requirements to NF-4412 in addition specific temperature limitations are involved, as well as welder exposure to inclement weather. Site procedures detail specific requirements for all welding Ref. CSP 82 for AWS and CSP-84 for ASME	
NF-4421 RULES FOR MAKING WELDED JOINTS The materials for backing strips, when used, shall be compatible with the base metal (NF-4240).	1.23.6 Similar requirement	AWS D1.1 requires the use of similar material for backing strips Ref. AWS A1.1 Para. 8.2.4	
NF-4422 Peening The weld metal may be peened when it is deemed necessary or helpful to control distortion.	1.23.6 Allowed to control distortion	Site procedures prohibit peening may only be used with permission of the engineer Ref. CSP-82 AWS provides same requirement Ref. AWS D1.1 Paragraph 4.10.8	
NF-4423 Miscellaneous Welding Requirements Before applying weld metal on the second side to be welded, the root of double welded joints shall be prepared by suitable methods, such as chipping, grinding, or thermal gouging to sound metal.	1.23.6 Similar requirement		
NF-4424 Surfaces of Welds As welded surfaces are permitted. However, the surface of welds shall be sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges, and valleys to meet the requirements of (a) through (d) below.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION NF-4424 (Continued) (a) The surface condition of the finished weld shall be suitable for the proper interpretation of radiographic and other required nondestructive examinations of the welds. In those cases where there is a question regarding the surface condition on the interpretation of a radiographic film, the film shall be compared to the actual weld surface for interpretation and determination of acceptability.		Surface must be adequate for visual inspection. Surfaces of full penetration welds, outside the NF boundary, will be suitable for dye penetrant examination for supports of ASME Class I piping systems.	No RT performed on welds outside the boundary.
(b) Reinforcements are permitted in accordance with NF-4426. (c) Undercuts shall not encroach on the required section thickness. (d) If the surface of the weld requires grinding to meet the above criteria, care shall be taken to avoid reducing the weld or base material below the required thickness. See Acceptance Criteria for Visual Inspection NF-5360. Ref. JS1002		See criteria for visual inspection NF-5360 Ref. SS0030	
NF-4426 Reinforcement of Butt Welds The surface of the reinforcement of all butt welded joints may be flush with the base material or may have uniform crowns. The height of reinforcement on each face of the weld shall not exceed the following thickness:	Recommended AWS practice for Workmanship	Reinforcement - Up to 1/8" for weld less than 5/8" thick - 20% of thickness for welds 5/8" and over. Ref. AWS D1.1	

Nominal Thickness, In.	Maximum Reinforcement, In.
Up to 1, incl.	3/32
Over 1 to 2, incl.	1/8
Over 2 to 3, incl.	5/32
Over 3 to 4, incl.	7/32
Over 4 to 5, incl.	1/4
Over 5	5/16

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4427 Shape and Size of Fillet Welds			
Fillet welds may vary from convex to concave. The size of the fillet weld shall be determined in accordance with Figure NF-4427-1.		Fillet weld shape-convex to concave within limits of AWS D1.1 Para. 3.6. Size determined by similar measurements	
NF-4429 Plug Welds			
When plug welds are used on component supports, a fillet weld shall first be deposited around the circumference at the bottom of the hole.		Plug welds not used	
NF-4440 EXAMINATION OF WELDS			
All welds shall be examined in accordance with the requirements of NF-5000. Class 1 requires RT or UT and MT for certain applications Class 2-3 requires visual	Must be specified in P.O.	All welds visually inspected prior to, during and on completion (Ref. QCP 10.12). No RT, UT, MT or PT, except that PT will be used on full penetration welds used to support an ASME Class 1 piping system.	
NF-4450 REPAIR OF WELD METAL DEFECTS			
NF-4451 General Requirements			
Unacceptable defects in weld metal detected by examinations required by NF-5000 shall be eliminated and, when necessary, repaired in accordance with the requirements of this subsubarticle.		Defects removed in the same manner as used for NF welds Weld repair in accordance with CSP-82	
NF-4452 Elimination of Surface Defects			
Weld metal surface defects may be removed by grinding or machining and need not be repaired by welding, provided that the requirements of (a), (b), and (c) are met. (a) The remaining of the section is not reduced below that required by NF-3000.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4452 (Continued)			
(b) The depression, after defect elimination, is blended uniformly into the surrounding surface. (c) The area is examined by a magnetic particle or liquid penetrant method after blending to ensure that the defect has been removed or in indication reduced to an acceptable limit.		Area visually inspected after defect removal-PT or MT only if indication was determined to be a crack Ref. CSP-82	
Weld repair in accordance with CSP-86.			
NF-4453 Requirements for Making Repairs to Welds			
Excavated cavities in weld metal, whose depths reduce the section thickness below the requirements of NF-3000, shall be repaired in accordance with the following paragraphs.	Not addressed	Weld repairs in accordance with CSP-82	
NF-4453.2 Defect Removal. Unacceptable defects detected by the examination or test required by NF-5000 shall be removed by mechanical means or by thermal gouging processes.		Removal of defects the same as NF	
NF-4453.2 Requirements for Welding Materials Procedures, and Welders. The weld repair shall be made using welding materials, welders, and welding procedures in accordance with NF-4125 and NF-4300.		Welding consumables the same as for NF. Welders and welding procedures qualified in accordance with AWS D.1.1 or ASME IX	See Appendix (1) for comparison of AWS D.1.1 and ASME IX.
NF-4453.3 Blending of Repaired Areas. After repair, the surface shall be blended uniformly into the surrounding surface.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4453.4 Examination of Repair Welds. The examination of weld repairs shall be repeated as required for the original weld.		The same examination required for repairs as for original weld	
NF-4453.5 Heat Treatment of Repaired Areas. The repaired area shall be heat treated when required by NF-4640.			
NF-4600 HEAT TREATMENT			
NF-4610 WELDING PREHEAT AND INTERPASS REQUIREMENTS			
NF-4611 When Preheat is Necessary			
The need for and temperature of preheat are dependent on a number of factors, such as the chemical analysis, degree of restraint of the parts being joined, elevated temperature, physical properties, and material thicknesses. Some practices used for preheating are given in Appendix D as a general guide for the materials listed by P-numbers of Section IX. It is cautioned that preheating suggested in Appendix D does not necessarily ensure satisfactory completion of the welded joint and that the requirements for individual materials within the P-number listing may have preheating more or less restrictive than this general guide. The welding procedure specification for the material being welded shall specify the minimum preheating requirements under the welding procedure qualification requirements of Section IX.	Table 1.23.6	Preheat is in accordance with approved welding procedures Ref. CSP-82	Preheat and interpass temperature limitations are detailed in the applicable approved welding procedures

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
NF-4612 Preheating Methods			
Preheat for welding or thermal cutting, when employed, may be applied by any method which does not harm the base material or any weld metal already applied or which does not introduce foreign material into the welding area which is harmful to the weld.		Same methods used as in NF	
NF-4613 Interpass Temperatures			
Consideration should be given to limitations of interpass temperatures for quenched and tempered materials to avoid detrimental effects on the mechanical properties.		Interpass temperature limited in accordance with approved welding procedures Ref. CSP-82	
Preheat and interpass controls in CSP-84.			
NF-4620 POSTWELD HEAT TREATMENT			
NF-4621 Heating and Cooling Methods			
Postweld heat treatment may be accomplished by any suitable methods of heating and cooling, provided the required heating and cooling rates, metal temperature, metal temperature uniformity, and temperature control are maintained.	1.23.6 Recommends AWS practice	No PWHT required	
NF-4622 PWHT Time and Temperature Requirements		No PWHT required	
NF-4622.1 General Requirements[1]. Except as otherwise permitted in NF-4622.4(c) and NF-4622.7, all welds shall be postweld heat treated. During postweld heat treatment, the metal temperature shall be maintained within the temperature		No PWHT required	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
ranges and minimum holding times specified in Table NF-4622.1-1. P-Number groups in Table NF-4622.1-1 are in accordance with QW-420 of Section IX. In addition, the requirements of the following subparagraphs shall apply.			
1 Any postweld heat treatment time which is anticipated to be applied to the material or item after it is completed shall be specified in the Design Specification. The Manufacturer shall include this time in the total time at temperature specified to be applied to the test specimens.			
NF-4622.2 Time-Temperature Recordings. Time-temperature recordings of all postweld heat treatments shall be made available for review by the Authorized Inspector. Identification on the time-temperature recording shall be to the weld, part, or component support. A summary of the time-temperature recording may be provided for permanent records in accordance with NA-4932.		No PWHT Required	
NF-4622.3 Definition of Nominal Thickness Governing PWHT Time at Temperature. The nominal thickness in Table NF-4622.1-1 and Table NF-4622.3-1 is the thickness of the weld, base material, or the thinner of the sections being joined, which ever is less. For fillet welds, the nominal thickness is the throat thickness and, for partial penetration and material repair welds, the nominal thickness is the depth of the weld groove or preparation.		No PWHT Required	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION NF-4622.4 Holding Times at Temperature (a) The holding time at temperature as specified in Table NF-4622.1-1 need not be continuous. It may be an accumulation of the times of multiple postweld heat treatment cycles. (b) Holding time at temperature in excess of the minimum requirements of Table NF-4622.1-1 may be used, provided that specimens so heat treated are tested in accordance with NF-2200, NF-2400, and NF-4300. (c) Alternatively, when it is impractical to postweld heat treat at the temperature range specified in Table NF-4622.1-1, it is permissible to perform the postweld heat treatment of certain materials at lower temperatures for longer periods of time in accordance with Table NF-4622.4(c)-1and (1), (2), and (3) below. (1) When welds in P-No. 3 materials are to be postweld heat treated at these lower minimum temperatures, the impact test specimens of the welding procedure qualification required by NF-4300 shall be made using the same temperatures and increased minimum holding time. Welding procedures, qualified at the temperatures and increased minimum holding time specified in Table NF-4622.1-1 and at the lower minimum temperature and increased minimum holding time permitted by Table NF-4622.4(c)-1 are also qualified for any temperature in between. When such an in-between temperature is used, the minimum holding time shall be extrapolated from Table NF-4622.1-1 and the alternative requirements of Table NF-4622.4(c)-1. Welds in P-No. 1 materials are exempted from this requirement.		No PWHT Required	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION (2) When welds in P-No. 3 materials are to be postweld heat treated at these lower minimum temperatures, the welding material certification required by NF-2400 shall be made using the same minimum temperatures and increased minimum holding time. Welding materials certified at the temperatures and minimum holding time specified in Table NF-4622.1-1 and at the lower minimumm holding time permitted by Table NF-4622.4(c)-1 are also certified for any temperature in between. Welds in P-No. 1 materials are exempted from this requirement. (3) Base materials certified in accordance with NF-2210 may be postweld heat treated at these lower minimum temperatures and increased minimum holding times without recertification. Postweld heat treatment at these lower minimum temperatures and increased minimum holding times may also be the tempering operation, provided a higher tempering temperature is not required by the material specification.			
NF-4622.5 PWHT Requirements when Different P-Number Materials Are Joined. When materials of two different P-number groups are joined by welding, the applicable postweld heat treatment shall be that specified in Table NF-4622.1-1 for the material requiring the higher PWHT temperature range.		No PWHT Required	
NF-4622.6 PWHT Requirements for Nonpressure Retaining Parts. When nonpressure retaining materials are welded to pressure retaining materials, the postweld heat treatment temperature range of the pressure retaining materials shall control.		No PWHT Required	

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FABRICATION & INSTALLATION			
NF-4622.7 Exemptions to Mandatory Requirements. Postweld heat treatment in accordance with this Subarticle is not required for: (a) Nonferrous materials (b) Welds exempted in Table NF-4622.3-1 (c) Welds subjected to temperatures above the PWHT temperature range specified in Table NF-4622.1-1, provided the welding procedure specification is qualified in accordance with Section IX and the base material and the deposited weld metal of the weld filler material has been heat treated at the higher temperature. (d) Postweld heat treatment is not required for component supports constructed to Type 405 material or of Type 410 material with carbon content not to exceed 0.08 percent welded with electrodes that produce an austenitic chromium-nickel weld deposit or a non-air-hardening nickel-chromium-iron weld deposit, provided the plate thickness at the welded joint does not exceed 3/8 in., provided a preheat of 450F is maintained during welding and the joints are completely radiographed.		No PWHT Required	
NF-4623 PWHT Heating and Cooling Rate Requirements Above 800 F the rate of heating and cooling shall not exceed 400 F/hr divided by the maximum thickness in inches of the material being heat treated, but in no case more than 400 F/hr. Regardless of thickness, the rate of heating and cooling need not be less than 100 F/hr. During the heating and cooling period there shall not be a greater variation in temperature than 250°F within any		No PWHT Required	

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FABRICATION & INSTALLATION

15 ft interval of weld length. The exceptions of (a) and (b) below are permitted.

(a) P-number 6 materials may be cooled in air from the postweld heat treatment holding temperature specified in Table NF-4622.1-1.

(b) For P-number 7 materials the cooling rate at temperatures above 1200F shall not exceed 100 F/hr, after which the rate of cooling shall be sufficiently rapid to prevent embrittlement.

NF-4624 Methods of Postweld Heat Treatment

The postweld heat treatment shall be performed in accordance with the requirements of one of the following subparagraphs.

NF-4624.1 Furnace Heating - One Heat. Heating the component support or part in a closed furnace in one heat is the preferred procedure and should be used whenever practical. The furnace atmosphere shall be controlled so as to avoid excessive oxidation and direct impingement of flame on the component support or part is prohibited.

NF-4624.2 Furnace Heating - More than one Heat. The component support or part may be heated in more than one heat in a furnace, provided the furnace atmosphere control requirements of NF-4624.1 apply and overlap of the heated sections of the component support or part is at least 5 feet. When this procedure is used, the portion of the component support or part outside the furnace shall be shielded so that the temperature gradient is not harmful. The cross section where the component support projects from the furnace shall not intersect a structural discontinuity.

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FABRICATION & INSTALLATION NF-4624.3 Local Heating. Welds may be locally postweld heat treated when it is not practical to heat treat the entire component support or part. Local postweld heat treatment shall consist of heating a circumferential band around the component support or part at temperatures within the ranges specified in this Subarticle. The width of the controlled band at each side of the weld, on the face of the greatest weld width, shall be not less than the thickness of the weld or 2 in., whichever is less. The temperature of the component support or part from the edge of the controlled band outward shall be gradually diminished so as to avoid harmful thermal gradients. This procedure may also be used for postweld heat treatment after repairs. NF-4624.4 Heating Components Internally. The component support or part may be heated internally by any appropriate means and with adequate indicating and recording temperature devices to aid in the control and maintenance of a uniform distribution of temperature in the component support. Previous to this operation, the component support should be fully enclosed with insulating material.			

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FABRICATION & INSTALLATION			
NF-4640 HEAT TREATMENT AFTER REPAIR BY WELDING			
NF-4641 Rules Governing Heat Treatment After Repair by Welding			
Components or portions of components including materials that have been repaired by welding shall be postweld heat treated in accordance with the requirements of NF-4620, except as permitted in NF-4642.	Recommends AWS Practice	No PWHT Requied	
NF-4642 Weld Repairs Without Required Postweld Heat Treatment			
Limited weld repairs to P-1 and P-3 materials and A-1 or A-2 weld filler metal (Table QW-442 of Section IX) may be made without PWHT or after the final PWHT, provided the requirements of the following subparagraphs are met:	Repair in accordance with Material Specification		
NF-4642.1 Examination of Area to be Repaired. Before a repair is made, the area shall be examined by magnetic particle or liquid penetrant methods in accordance with and shall meet the acceptance standards of NF-5340 or NF-5350.		All defects visually examined; for defects determined to be cracks the area is PT or MT inspected after defect removal	The repairs addressed in NF-46452 are directed to repair of material after PWHT where certain limitations are imposed to permit the repair without further PWHT. Although the requirements outside the Boundary are indicated as less restrictive they could be addressed as not applicable since no PWHT material is involved.
NF-4642.2 Maximum Extent of Repairs. A repair shall not exceed 10 sq. in. in surface area and shall not be greater in depth than 50% of the base metal or weld thickness or 1/2 in., whichever is the least.		Repair within the limits of A-6 defect in excess of A-6 must be reported and repaired in accordance with an approved procedure. Ref. SS0030 Para. 5.1.10	

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FABRICATION & INSTALLATION			
NF-4642.3 Repair Welding Procedure (a) The repairs shall be made using one or more procedures and welders qualified in accordance with Section IX using the shielded metal arc process and low hydrogen covered electrodes. (b) The largest electrode diameter shall be 5/32 in., and the bead width shall not exceed 4 times the electrode diameter. (c) The repair weld shall be made with a minimum of two layers of weld metal. the last layer shall be limited or ground off so that the weld surface does not extend above the base metal a greater distance than that allowed for reinforcement of butt welds (NF-4426). (d) A preheat and interpass temperature of 300 F minimum shall be used.		Repair in accordance with an approved procedure Ref. CSP-82 and 550030	
NF-4624.4 Examination of Repair Welds. Following the repair, and when the area has reached ambient temperature, the area shall again be examined by magnetic particle or liquid penetrant methods and accepted in accordance with NF-4642.1 above.		Visual inspection only, except for dye penetrant examination of full penetration welds on supports for ASME Class 1 piping outside the NF boundary. Ref. CSP-82	

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FABRICATION & INSTALLATION

I-ASME NF

NF-4700 REQUIREMENTS FOR BOLTED CONSTRUCTION

NF-4710 BOLTING AND THREADING

NF-4711 Thread Engagement

All bolts or studs shall be engaged for the full length of thread in the nut.

NF-4712 Thread Lubricants

Any lubricant or compound used in threaded joints shall be suitable for the service conditions and shall not react unfavorably with any support element material. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

NF-4713 Removal of Thread Lubricants

All threading lubricants or compounds shall be removed from surfaces which are to be welded.

II-AISC

SPECIFICATION FOR

Structural Joints Using

ASTM A325 or A490 Bolts

Approved by Research Council on Riveted and Bolted Structural Joints of the Engineering foundation, April 18, 1972
Andorsed by American Institute of Steel Construction, Inc. Endorsed by Industrial Fasteners Institute

COMMENTARY C-2

In order to determine the required bolt length, the value shown in Table 6 should be added to the grip (that is, the total thickness of all connected material, exclusive of washers).

Table 6

Bolt Size in Inches	To Determine Required Bolt Length Add to Grip, in Inches
1/2	11/16
5/8	7/8
3/4	1
7/8	1 1/8
1	1 1/4
1 1/8	1 1/2
1 1/4	1 5/8
1 3/8	1 3/4
1 1/2	1 7/8

III-STP PRACTICE OUTSIDE THE BOUNDARY

AISC requirements used for this application

IV-COMMENTS

Bolted connections outside the NF boundary are designed in accordance with the AISC Specification.

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The preceding values are generalized, with due allowance for manufacturing tolerances, to provide for full thread engagement of a heavy hex nut, when installed. For each hardened flat washer that is used, add 5/32-inch, and for each beveled washer add 5/16-inch. The length determined by the use of Table 6 should be adjusted to the next longer 1/4-inch.

C6 Inspection

Bolts, nuts and washers are normally received with a light residual coating of oil which should not be removed. This coating is not detrimental even to friction-type connections and need not be removed.

NF-4720 BOLTING

NF-4721 Bolt Holes

(a) Holes for nonfitted bolts shall be 1/16 in. larger than the nominal diameter of the bolt for bolt sizes up to and including 1 in. and 1/8 in. larger than the nominal diameter of the bolt for bolt sizes larger than 1 in.

(b) Thermal cutting shall not be used unless the load-bearing surfaces are machined or ground smooth. Except as otherwise specified in (d) below, holes may be punched provided the thickness of the material is not greater than the nominal diameter of the bolt plus 1/8 in. Holes shall be subpunched and reamed or drilled or thermally cut when the thickness of the material is greater than the nominal diameter of the bolt plus

C 3 Bolted Parts

Joints which must transmit the forces in adjacent parts by means of shear are divided into two categories in the current specification; friction-type and bearing-type. High initial bolt tension provides worthwhile advantages, therefore the same initial tensioning is recommended for bearing-type connections as for the friction-type. Among these benefits are overall joint rigidity, a better stress pattern and security against nut loosening.

Since its first publication the Specification has permitted the use of bolt holes 1/16-in. larger than the bolts installed in them. More recently research has shown that, where greater latitude is needed in meeting dimensional tolerances during erection, somewhat larger holes can be permitted

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

FABRICATION & INSTALLATION

1/8 in. Holes shall be subpunched and reamed or drilled or thermally cut when the thickness of the material is greater than the nominal diameter of the bolt plus 1/8 in.

(c) The die for all subpunched holes shall be at least 1/16 in. smaller than the nominal diameter of the bolt.

(d) Holes in material over 1/2 in. thick having a minimum specified yield strength greater than 80,000 psi shall be drilled.

NF-4722 Bolted Connections

(a) Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20, a beveled washer shall be used to compensate for the lack of parallelisum

(b) Bolts loaded in pure shear shall not have threads located in the load bearing part of the shank unless permitted by the Design Specifications.

NF-4723 Precautions Before Bolting

All parts assembled for bolting shall have contact surfaces free from scale, chips, or other deleterious foreign material. Surfaces and edges to be joined shall be smooth, uniform and free from fins, tears, cracks, and other defects which would degrade the strength of the joint.

for bolts 5/8-in. diameter and larger without adversely affecting the performance of shear connections assembled with high strength bolts. Provisions based upon these findings are now included in the specification. Since an increase in hole size geneally reduces the net area of a connected part, their use is subject to approval by the designer.

Tble 7
Oversize and Slotted Holes

Bolt Dia.(in.)	Maximum Hole Size (in.) Oversize Holes	Short Slotted Holes	Long Slotted Holes
5/8	13/16	11/16 x 7/8	11/16 x 1 9/16
3/4	15/16	13/16 x 1	13/16 x 1 7/8
7/8	1 1/16	1 1/16 x 1 1/8	15/16 x 2 3/16
1	1 1/4	1 1/16 x 1 5/16	1 1/16 x 2 1/2
1 1/8	1 7/16	1 3/16 x 1 1/2	1 3/16 x 2 13/16
1 1/4	1 9/16	1 5/16 x 1 5/8	1 5/16 x 3 1/8
1 3/8	1 11/16	1 7/16 x 1 3/4	1 7/16 x 3 7/16
1 1/2	1 13/16	1 9/16 x 1 7/8	1 9/16 x 3 3/4

3 Bolted Parts

(a) The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. Holes may be punched, subpunched and reamed, or drilled, as required by the applicable code or specification and, except as hereinafter provided, shall be a nominal diameter not mpre than 1/16-in. in excess of the nominal bolt diameter.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION	Where shown in the design drawings and at other locations approved by the designer, over-size, short-slotted, and long-slotted holes may be used with high strength bolts 5/8-in. in diameter and larger proportioned to meet the allowable working stresses given in Table 2 except as hereinafter restricted: (b) When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts or washers shall be free of scale, except light mill scale, and shall also be free of burrs, dirt and other foreign material that would prevent solid seating of the parts. (c) Contact surfaces within friction-type joints shall be free of oil, paint, lacquer or other coatings, except as listed below: 1. Hot-dip galvanizing, if contact surfaces are scored by wire brushing or blasting after galvanizing and prior to assembly. 2. Inorganic zinc rich paints as defined in those sections of the Steel Structures Painting Council Systems, SSPC PS 12.00, covering zinc righ points with inorganic vehicles. 3. Metallized zinc or aluminum applied in accordance with AWS C2.2 Recommended Practice for Metallizing with Aluminum and Zinc for Protection of Iron and Steel, except that subsequent sealing treatments, described in Section IV therein, shall not be used.		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

FABRICATION & INSTALLATION

NF-4724 Bolt Tension

All high strength structural bolts shall be tightened to a bolt torque not less than that given in the Design Specifications. Tightening shall be done by the turn of nut method or with properly calibrated wrenches. Bolts tightened by means of a calibrated wrench shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. Hardened washers are not required when bolts are tightened by the turn-of-nut method, except that hardened washers are required under the nut and bolt head when the bolts are used to connect material having a specified yield point less than 40,000 psi.

NF-4725 Locking Devices

All threaded fasteners, except high strength bolts, shall be provided with locking devices to prevent loosening during service. Elastic stop nuts (when compatible with service temperature), lock nuts, jam nuts and drilled and wired nuts are all acceptable locking devices. Disc and helical spring lock washers shall not be used as locking devices. Up set threads may serve as locking devices.

5. Installation

(a) Fastener Tension. Each fastener shall be tightened to provide, when all fasteners in the joint are tight, at least the minimum tension shown in Table 3 for the size and grade of fastener used.

Threaded bolts shall be tightened by methods described in subparagraphs (c), (d), or (e) of this section. If required because of bolt entering and wrength operation clearances, tightening by either procedure described in subparagraphs (c) or (d) may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches, if used, shall be of adequate capacity and sufficient supplied with air to perform the required tightening of each bolt in approximately ten seconds.

(b) Washers. A 325 fasteners meeting the provisions of Section 2 may be installed without hardened washers when tightening is by the turn-of-nut method except as noted in Section 3. A490 bolts installed without hardened washers when tightening is by the turn-of-nut method except as noted in Section 3 A490 bolts installed by the turn-of-nut method and A325 or A490 bolts tightened by the calibrated wrench method (i.e., by torque control) shall have a hardened washer under the element (nut or bolt head) turned in tightening and as provided in Section 3, if applicable. Two hardened washers shall be used with all A490 bolts used to connect material having a specified minimum yield point less than 40 ksi.

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FABRICATION & INSTALLATION			
	Where an outer face of the bolted parts has a slope greater than 1:20 with respect to a plane normal to the bolt axis, a beveled washer shall be used to compensate for the lack of parallelism. (c) Turn-of-Nut tightening. When the turn-of-nut method is used to provide the bolt tension specified in paragraph 5(a), there shall first be enough bolts brought to a "snug tight" condition to insure that the parts of the joint are brought into good contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table 4, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench. (d) Calibrated Wrench Tightening. When calibrated wrenches are used, they should be set to provide a tension at least 5% in excess of the minimum bolt tension specified in 5(a). The wrenches shall be calibrated at least once each working day for each bolt diameter being installed. Wrenches shall be recalibrated when significant changes are made in the		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
FABRICATION & INSTALLATION			
	equipment or when a significant difference is noted in the surface condition of the bolts, nuts or washers. Calibration shall be accomplished by tightening, in a device capable of indicating actual bolt tension, three typical bolts of each diameter from the bolts being installed. When adjusting the wrenches to provide the required tension, it shall be verified during actual installation in the assembled steel-work that the calibration selected does not produce a nut or bolt head rotation from snug tight greater than that permitted in Table 4. If manual torque wrenches are used, nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to "touch up" bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the prescribed amount. (e) Tightening by Use of a Direct Tension Indicator. Tightening by this means is permited provided it can be demonstrated by an accurate direct measurement procedure that the bolt has been tightened in accordance with Table 3.		

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION NF-5100 GENERAL REQUIREMENTS FOR EXAMINATION	CODE OF STANDARD PRACTICE SECTION 6 INSPECTION AND DELIVERY		
NF-5110 PROCEDURES, QUALIFICATIONS, AND EVALUATIONS NF-5111 General Requirements Nondestructive examinations shall be in accordance with examination procedures of Section V except as they may be modified by the requirements of this Article. Geometric unsharpness shall not exceed the limits of T-251 of Section V. All examinations shall be performed by personnel who have been qualified as required in this Article. The results of the examinations shall be evaluated in accordance with the acceptance standards of this Article. NF-5112 Nondestructive Examination Procedures All nondestructive examinations performed under this Subsection shall be executed in accordance with detailed written procedures which have been proven to be capable of detecting and locating discontinuities described in applicable Articles of this Subsection or other specifications as unacceptable (borderline) or as required to be reported. The procedure shall comply with the appropriate portion of Section V for the particular examination method. At least one copy of the procedure shall be readily available to all applicable nondestructive examination personnel for reference and use.	(a) Test of Materials Mill tests are performed to demonstrate material conformance to contract requirements. Unless special requirements are included in the invitation to bid, mill testing is limited to those tests required by the applicable ASTM material specifications. Mill test reports are furnished by the fabricator only if requested by the owner in either the invitation to bid or otherwise made in writing prior to the time the fabricator places his material orders with the mill. The fabricator customarily makes no tests of steel material. The owner must rely on mill tests required by contract and on such additional tests as he orders the fabricator to have made at the owner's expense. If tests other than mill tests are desired, the owner so specifies in the invitation to bid and should arrange for such testing through the fabricator. (b) Inspection If the owner wishes an inspection of the steel by someone other than the fabricator's own inspectors, he reserves the right to do so in his invitation to bid or the accompanying specifications. Arrangements may be made with the fabricator for inspection of materials at the fabricating shop by the owner's inspectors. When nondestructive testing of welding is required, the process, extent, technique and standards of acceptance	NDE procedures are in accordance with the same requirements as for NF Ref. Applicable Ebasco NDE procedures. Personnel Qualifications the same as for NF Ref. NDE-1 Procedures used are the same as for NF and are available to NDE personnel	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION NF-5113 Post Examination Cleaning Following any nondestructive examination in which examination materials are applied to the piece, the piece shall be thoroughly cleaned in accordance with applicable materials or procedure specifications.	shall be clearly defined in information furnished to the bidders. When the owner specifies shop inspection by a third party or by his own representatives, the owner has the obligation to see that such inspection is performed to the fullest extent possible in the fabricator's shop. The inspection will be performed in a manner to minimize disruptions in operations and to permit the repair of all nonconforming work while the material is in the fabricating shop.	Procedures have provisions for post examinations cleaning where applicable Ref. Applicable Ebasco NDE procedures	
NF-5120 TIME OF EXAMINATION OF WELDS Examinations of welds shall be performed at the following times during fabrication and installation: (a) Radiography of welds may be performed prior to any postwled heat treatment. (b) Magnetic particle or liquid penetrant examination shall be performed after any postweld heat treatment except examination of P-Number 1 material may be performed at any time.	Not addressed must be defined in PO	(a) RT not required (b) MT or PT not required	Pipe support inspection performed in accordance with QCP 10.12
NF-5200 REQUIRED EXAMINATION OF WELDS NF-5210 EXAMINATION OF CLASS 1 SUPPORT WELDS NF-5211 Class 1 Plate and Shell-type Support Welds (a) All longitudinal and circumferential full-penetration butt and groove joints, double fillet welded tee joints in primary members (NF-1211(b)) of plate and shell type supports, permitted by NF-3291(A) and shown in Fig. NF-3291(A)-1, shall be radiographed. When radiography does not yield meaningful examination results, ultrasonic examination shall	1.26.4 Inspection of Welding The inspection of welding shall be performed in accordance with the provisions of Section 6 of the Code for Welding in Building Construction, D1.0.-69, of the American Welding Society. When nondestructive is required, the process, extent, technique and standards of acceptance shall be clearly defined in information furnished to the bidders.	Visual inspection except that dye penetrant examination will be used on full penetration welds outside the NF boundary for pipe supports on ASME Class 1 Piping Systems Ref. SS0030 QCP10.12 No plate and shell supports	In-process inspection is performed on a surveillance basis per QCP 10.12

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
be performed. In addition, the adjacent base material for at least 1/2 in. on each side of the joint shall be examined by either the magnetic particle or liquid penetrant method.			
(b) When the requirements of (a) cannot be met, the welds including the adjacent base material for at least 1/2 in. on each side of the weld shall be examined by either the magnetic particle or liquid penetrant method.			
(c) All other welds shall be visually examined and evaluated by the acceptance standards of NF-5360.			
NF-5212 Class 1 Linear-type Support Welds	Not addressed Must be defined in P.O.	(a) No RT required	
(a) All full-penetration butt welded joints, full-penetration tee joints, corner joints, and full fillet welds in primary members as defined in NF-1211(b) shall be radiographed. When radiography does not yield meaningful examination results, ultrasonic examination shall be performed. In addition, the weld and the adjacent base material for at least 1/2 in. on each side of the joint shall be examined by either the magnetic particle or liquid penetrant method.			
(b) When the requirements of (a) cannot be met, the welds including the adjacent base material for at least 1/2 in. on each side of the weld shall be examined by either the magnetic particle or liquid penetrant method.		(b) No MT or PT required, except PT examination will be used on full penetration welds outside the boundary for pipe support on ASME Class 1 Piping Systems.	
(c) All other welds shall be visually examined to the acceptance standards specified in NF-5360.		(c) All welds inspected visually	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
NF-5213 Class 1 Component Standard Support Welds		Not applicable.	No component standards outside boundary
(a) All full-penetration butt joints in primary members as defined in NF-1211(b) shall be radiographed.			
(b) All fillet welds in primary members as defined NF-1211(b) that have a throat dimension greater than 1 in. shall be examined by either the magnetic particle or liquid penetrant method.		Not applicable.	No component standards outside boundary
(c) All other welds shall be visually examined to the acceptance standards specified in NF-5360.		Not applicable.	No component standards outside boundary
Note: All supports are either linear or component standards (Ref. FSAR 5.4.14.2)			
NF-5220 EXAMINATION OF CLASS 2 AND CLASS MC SUPPORT WELDS	Not Addressed Must be defined in P.O.		
NF-5221 Class 2 and Class MC Plate and Shell type Support Welds		Not applicable.	No plate and shell type supports outside the NF boundary.
(a) All longitudinal and circumferential full-penetration butt and groove joints, double-fillet welded lap joints and full-fillet welded tee joints in primary members as defined in NF-1211(b) of plate and shell type supports, permitted NF-3324.2 shall be examined by either the magnetic particle or liquid penetrant method. In addition, the adjacent base metal for at least 1/2 in. on each side of the joint shall be included in the examination.			
(b) Other welds in primary members of plate and shell-type supports shall be examined by either the magnetic particle or liquid penetrant method.			
(c) All other welds shall be visually examined to the acceptance standards of NF-5360.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
NF-5222 Class 2 and Class MC Linear Type Support Welds All welds of linear-type supports shall be visually examined to the acceptance standards of NF-5360.		All welds visually inspected	See Comparison in NF-5360 For FSAR acceptance criteria for Visual Inspection
NF-5223 Class 2 and Class MC Component Standard Support Welds All component standard support welds shall be visually examined and evaluated to the acceptance standards of NF-5360.		Not applicable.	No component standards outside the NF boundary.
NF-5230 EXAMINATION OF CLASS 3 SUPPORT WELDS			
NF-5231 Class 3 Plate and Shell-type Support Welds (a) All full-penetration butt welded joints exceeding 1-1/2 in. thickness in primary members of plate and shell-type supports as defined in NF-1211(b) shall be examined by either the magnetic particle or liquid penetrant method.		Not applicable.	No plate and shell supports outside the NF boundary
(b) All other welds shall be visually examined to the acceptance standards of NF-5360.		Not applicable.	No plate and shell supports outside the NF boundary
NF-5232 Class 3 Linear-type Support Welds All linear-type support welds shall be visually examined to the acceptance standards of NF-5360.		All welds visually inspected	
NF-5233 Class 3 Component Standard Support Welds All component standard support welds shall be visually examined to the acceptance standards of NF-5360.		Not applicable.	No component standards outside the NF boundary

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
NF-5300 ACCEPTANCE STANDARDS	Not addressed Must be defined in P.O.	No RT required	
NF-5310 GENERAL REQUIREMENTS			
Acceptance standards shall be as stated in this Subarticle.			
NF-5320 RADIOGRAPHIC ACCEPTANCE STANDARDS			
NF-5321 Evaluation of Indications			
Welds that are shown by radiography to have any of the following types of discontinuities are unacceptable: (a) Any type of crack or zone of incomplete fusion or penetration; (b) Any other elongated indication which has a length greater than: (1) 1/4 in. for T up to 3/4 in., inclusive (2) 1/3 T for T from 3/4 in. to 2-1/4 in., inclusive (3) 3/4 ih. for T over 2-1/4 in. where T is the thickness of the thinner portion of the weld; (c) Any group of indications in line that have an aggregate length greater than T in a length of 12 T, except where the distance between the successive indications exceeds 6L, where L is the longest indication in the group; (d) Porosity is not a factor in the acceptability of welds that are radiographed.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
NF-5330 ULTRASONIC ACCEPTANCE STANDARDS All indications which produce a response greater than 20% of the reference level shall be investigated to the extent that the operator can determine the shape, identity, and location of all such reflectors and evaluate them in terms of the acceptance-rejection standards as stipulated in (a) and (b) below. (a) Discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed: (1) 1/4 in. for T up to 3/4 in., inclusive (2) 1/3 T for T from 3/4 in. to 2-1/4 in., inclusive (3) 3/4 in. for T over 2-1/4 in. where T is the thickness of the weld being examined; if a weld joins two members having different thickness at the weld, T is the thinner of these two thickness; (b) Where discontinuities are interpreted to be cracks, lack of fusion, or incomplete penetration, they are unacceptable regardless of discontinuity or signal amplitude.	Not addressed Must be defined in P.O.	No UT required	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
NF-5340 MAGNETIC PARTICLE ACCEPTANCE STANDARDS	Not addressed Must be defined in P.O.	No MT required	
NF-5341 Evaluation of Indications			
(a) Mechanical discontinuities at the surface will be indicated by the retention of the examination medium. All indications are not necessarily defects, however, since certain metallurgical discontinuities and magnetic permeability variations may produce similar indications which are not relevant to the detection of unacceptable discontinuities.			
(b) Any indication which is believed to be nonrelevant shall be regarded as a defect and shall be reexamined to verify whether or not actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications and broad areas of pigmentation which would mask indications of defects are unacceptable.			
(c) Relevant indications are those which result from unacceptable mechanical discontinuities. Linear indications are those indications in which the length is more than 3 times the width. Rounded incations are indications which are circular or elliptical with the length less than 3 times the width.			
NF-5342 Acceptance Standards			
(a) Only indications with major dimensions greater than 1/16 in. shall be considered relevant.			
(b) Unless otherwise specified in this Subsection, the following relevant indications are unacceptable:			
(1) Any cracks or linear indications,			
(2) Rounded indications with dimensions greater than 3/16 in.,			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION (3) Four or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in a line and are separated by 1/16 in. or less edge to edge, (4) Ten or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in any 6 sq in. of surface with the major dimension of this area not to exceed 6 in., with the area taken in the most unfavorable location relative to the indications being evaluated.			
NF-5350 LIQUID PENETRANT ACCEPTANCE STANDARDS NF-5351 Evaluation of Indications (a) Mechanical discontinuities at the surface will be indicated by bleeding out of the penetrant; however, localized surface imperfections such as those that may occur from machining marks or surface conditions may produce similar indications which are nonrelevant to the detection of unacceptable discontinuities. (b) Any indication which is believed to be nonrelevant shall be regarded as a defect and shall be reexamined to verify whether or not actual defects are present. Surface conditioning may precede the reexamination. Nonrelevant indications and broad areas of pigmentation which would mask indications of defects are unacceptable. (c) Relevant indications are those which result from mechanical discontinuities. Linear indications are those indications in which the length is more than 3 times the width. Rounded indications are indications which are circular or elliptical with the length less than 3 times the width.	Not addressed Must be defined in P.O.	PT required only for full penetration welds on supports for ASME Class I Piping Systems. Acceptance standards in accordance with NF.	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION NF-5352 Acceptance Standards (a) Only indications with major dimensions greater than 1/16 in. shall be considered relevant. (b) Unless otherwise specified in this Subsection, the following relevant indications are unacceptable: (1) Any cracks or linear indications, (2) Rounded indications with dimensions greater than 3/16 in. (3) Four or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in a line and are separated by 1/16 in. or less edge to edge. (4) Ten or more rounded indications whose major dimensions are greater than 1/16 in. when the indications are in any 6 sq. in. of surface with the major dimensions of this area not to exceed 6 in., with the area taken in the most unfavorable location relative to the indications being evaluated.			
NF-5360 ACCEPTANCE STANDARDS FOR VISUAL EXAMINATION OF WELDS (a) Only indications with major dimensions greater than 1/16 in. shall be considered relevant. (b) Unless otherwise specified in this Subsection, cracks or other linear indications are unacceptable. JS1002 as committed in FSAR Appendix 3.8.B: 5.1.5.4.3 Acceptance standards for visual examination of weld shall be as follows: Only nonlinear indications with major dimensions greater than 1/16-inch shall be considered relevant. The following relevant indications are unacceptable.	Not addressed Must be defined in P.O.	As stated in SS0030 Category "B" joints: 2.2 CATEGORY B JOINTS Category B joints are not part of the main building frame, but rather provide auxiliary support or framing for systems, components, and equipment. These joints are within the miscellaneous steel category and shall include, but are not limited to, pipe supports (beyond the scope of ASME Codes), stairways, electrical tray and conduit supports, instrument supports and HVAC duct supports, and heavy-gauge HVAC duct inside RCB and its associated HVAC equipment. For connections of the foregoing items to main building frame, and/or auxiliary steel to embedded plates, when the connections consist of: (1) gusset	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

I-ASME NF

EXAMINATION

A. For welded joints 5/8 inch or less in thickness, an indication exceeding 1/16 inch.

B. For welded joints greater than 5/8 inch but less than or equal to 2 inches in thickness, an indication exceeding 3/16 inch.

C. For welded joints greater than 2 inches in thickness, an indication exceeding 3/16 inch.

D. Four or more indications in a line separated by 1/16 inch or less edge to edge.

E. Ten or more indications in any 6 sq. in. of surface with the major dimension of the area not to exceed 6 inches with the area taken in the most unfavorable location to the indication evaluated.

5.1.5.4.4 Rollover (overlap) not exceeding 1/8 inch is acceptable, provided the fusion line of the weld remains visible for examination.

5.1.5.4.5 There shall be no cracks or linear indications in the weld exceeding 1/16 inch.

5.1.5.4.6 Thorough fusion shall exist between the weld metal and base metal, except as permitted as rollover in paragraph 5.1.5.4.4.

III-STP PRACTICE OUTSIDE THE BOUNDARY

plates or flanges with fillet welds on both sides of the plate element, and (2) members which are end-welded by all-around fillet welds to the attachment surface, the undercut criterion for Category A joints shall apply for the whole connection.

Typical cases of these connections subject to the Category A criterion for undercut are shown in Figure 2.

Undersize Fillet Welds

The fillet leg dimension may not underrun the nominal fillet size by more than 1/16 inch, and the length of the underrun shall not be more than 20 percent of the weld length.

Porosity

The weld may contain a maximum of 5 percent by surface area of unaligned, unclustered porosity. For aligned porosity, the sum of the diameters of piping porosity shall not exceed 3/8 inch in any linear inch of weld nor 3/4 inch of any 12 inch length of weld.

Cracks

Cracks are unacceptable.

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION 5.1.5.4.7 Undercut (underfill) not exceeding 1/16 inch may be accepted for the full length of the weld, provided it does not encroach upon minimum design thickness. For members welded from both sides, the criteria shall be applied independently, except that the cumulative depth shall not encroach on the minimum design thickness.		Craters Underfilled groove weld craters are acceptable provided the depth of underfill is 1/16 inch or less. Underfill single-pass fillet weld craters are acceptable provided the crater length is less than 10 percent of the weld length. On multi-pass fillet welds a crater depth of 1/16 inch or less is acceptable.	
5.1.5.4.8 Underfilled groove-weld craters shall be accepted, provided the depth of underfill is 1/16 inch or less. Underfilled single-pass fillet weld craters shall be accepted, provided the crater length is less than 10 percent of the weld length. On multipass fillet welds, crater depth 1/16 inch or less shall be accepted.		Undercut Undercut not exceeding 1/32 inch may be acceptable for the full length of the weld. Undercut not exceeding 1/16 inch may be accepted provided the width is greater than the depth and the undercut does not have an acute intersection at its root. The cumulative length of 1/16 inch undercut the weld length. For members welded from both sides, the cumulative undercut depth or length for both sides shall not exceed the above criteria applied to one side.	
5.1.5.4.9 Adherent weld spatter, on structural members, not removable by wire brushing, is acceptable, unless its complete removal is required for further processing such as coating.		Weld Spatter Adherent weld spatter is acceptable unless its removal is required for further processing such as painting.	
5.1.5.4.10 Arc strikes are acceptable, provided that the craters, (1) do not contain cracks (as determined by visual examination), and (2) maximum size does not exceed 3/8 inch plan or 1/16 inch profile. Arc strikes shall be free of any foreign deposits which might interfere with the performance of visual examination.		Arc Strikes Arc strikes are acceptable provided that the craters do not contain cracks as determined by visual examination. For high-strength low-alloy steels (minimum yield strength greater than 60,000 psi), all arc strikes shall be removed by grinding. The ground area shall be visually inspected to assure complete removal of the arc strike.	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS

EXAMINATION

5.1.5.4.11 Welds specified as "NF" on supports for Section III Class 1 piping shall be identified in accordance with paragraph NF-4322.1a of Section III. The "NF" identification is given on Pipe Support Design Drawings.

A. Each weld shall be marked with welder's symbol in accordance with Code. Marking shall be done by a permanent method that will not result in harmful contamination or sharp discontinuities. (Reference paragraph 5.1.5.4.11.B)

B. Material equal to or greater than 1/4 inch thick may be marked by steel indentation stamping is used, it shall be done with a roundnose (radius limit of 1/32) or interrupted dot die. The maximum depth of the indentation shall not infringe upon the minimum wall thickness. Electric etch or vibra tool may be used in lieu of stamping. Materials less than 1/4 inch thick shall be marked by electric etch, vibra tool, or similar method approved by the Project Field Engineer

5.1.5.4.12 Welding shall meet or exceed specified size requirements except for the acceptable deviations that are noted in this specification. Either one or both fillet weld legs may exceed design size by 3/16 inch for welds up to and including 5/16 inch fillet, and 1/4 inch for

Weld Profile

Convexity height and butt weld reinforcement shall not exceed 1/8 inch, except for welds 5/8 inch and over, where the convexity height or butt weld reinforcement shall not exceed 20 percent of weld size or thickness as long as the profile is smooth and free of sharp transitions.

Misalignment

Misalignment in butt welds not exceeding one-half the thickness of the thinner member thickness or 1/4 inch, whichever is less, is acceptable.

Fusion

Incomplete fusion between weld metal and base metal is unacceptable. Overlap is acceptable only if full fusion at the weld toe is visible.

Oversize Fillet Welds

The weld meets or exceeds specified size requirements. Either or both fillet weld legs may exceed design size by 1/8 inch for welds up to and including 5/16 inch fillet, and 1/4-inch for welds larger than 5/16-inch

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION welds larger than 5/16 inch fillet. Welds may be longer than specified. Continuous welds may be accepted in place of intermittent welds. Additional welds may be made provided the pipe support function remains the same. The additional welds need not comply with minimum size requirements.		fillet. Fillet welds exceeding the above limits may be considered acceptable if (1) the weld oversize is localized, and cumulatively the length of the oversize weld does not exceed 20 percent of the weld length or 2 inches, whichever is longer, or (2) the fillet weld underwent prior repair that required deposition of additional weld metal. Scalloping (intermittent melting of the plate edge) shall not be a cause for rejection of the weld as long as enough plate edge remains such that the fillet weld size can be verified. Welds may be longer than specified. Continuous welds may be accepted in place of intermittent welds. Welds may have end returns of nominal length equal to 2X (weld size); maximum length of return shall not exceed 3X (weld size).	
5.1.5.4.13 Weld acceptance criteria not stated herein shall be in accordance with NF-5300. 5.1.5.4.14 Examination of "NF" welds shall be in accordance with NF-5212 for all Class 1 supports, NF-5222 for all Class 2 supports and NF-5232 for all Class 3 supports. Welding between members and component standards shall be considered as linear type support welds. All members shall be considered as primary for examination in accordance with NF-5200.			
5.1.5.4.15 Fillet welds shall meet fit-up requirements as follows: A. The maximum gap between the attachments shall be 1/8 inch at the weld joint.		Backing Fit-up The fit-up of a backing bar is not a basis for rejection.	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION			
B. For a gap equal to or exceeding 1/16 inch, increase the leg of the fillet weld by the gap dimension.			
NF-5400 EXAMINATION OF SPRINGS FOR CLASS 1 COMPONENT STANDARD SUPPORTS		Not applicable.	No springs outside the NF boundary
NF-5410 Required Examination and Acceptance Standards			
Springs for Class 1 component standard supports shall be examined after coiling by either the magnetic particle or liquid penetrant method. Springs with seams, slits, or quench cracks longer than 3% of the bar diameter shall be rejected.			
NF-5500 QUALIFICATIONS OF NON-DESTRUCTIVE EXAMINATION PERSONNEL	Not addressed Must be defined in P.O.		
NF-5510 General Requirements		Same as for NF Ref. NDE-1 Ebasco Procedure	
It shall be the responsibility of the Manufacturer or Installer to assure that all personnel performing nondestructive examination operations under this Subsection are competent and knowledgeable of the applicable examination requirements to the degree specified in NF-5520. All nondestructive examinations required by this Subsection shall be performed and the results evaluated by qualified nondestructive examination personnel. The assignment of responsibilities to individual personnel will be at the discretion of the Manufacturer or Installer.			

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION NF-5520 Personnel Qualification (a) Personnel performing nondestructive examination shall be qualified in accordance with SNT-TC-1A-1975,[1] except as required in (1), (2), and (3) below. (1) Certification of Level III nondestructive examination personnel by examination for technical competence is required. The procedure used for examination shall be described in the written practice which is required by SNT-TC-1A-1975. (2) The number of hours of training for nondestructive examination personnel who perform only one operation of a nondestructive examination method that consists of more than one operation, or perform nondestructive examinations of limited scope, may be less than that recommended in Table 6.2.1A of SNT-TC-1A-1975. Any limitations or restrictions placed on the certification shall be described in the written practice and on the certificate. (3) For visual examination, the Jaeger Number 1 letters shall be used in lieu of the Jaeger Number 2 letters specified in paragraphs 8.2(a)(1) of SNT-TC-1A-1975. For nondestructive examination methods not covered by SNT-TC-1A documents, personnel shall be qualified by the Manufacturer or Installer to comparable levels of competency by subjection to comparable examinations on the particular method involved: for example, leak testing. The practical portion of the qualification shall be performed using the Manufacturer's or Installer's procedure on parts representative of the Manufacturer's or Installer's products.		Same as for NF Ref. NDE-1 Ebasco Procedure	

I-ASME NF	II-AISC	III-STP PRACTICE OUTSIDE THE BOUNDARY	IV-COMMENTS
EXAMINATION (b) The emphasis shall be on the individual's ability to perform the nondestructive examination in accordance with the applicable procedure for the intended application. (c) For nondestructive examination methods that consist of more than one operation or type, it is permissible to use personnel qualified to perform one or more operations. As an example, one person may be used who is qualified to conduct the examination and another may be used who is qualified to interpret and evaluate the results. [1]SNT-TC-1A is a Recommended Practice for Nondestructive Testing Personnel Qualification and Certification published by the American Society for Nondestructive Testing, 915 Chicago Avenue, Evanston, Illinois 60202.			
NF-5530 Records Personnel qualification records shall be retained in accordance with NA-4800.		Same as for NF	

Comparison of ASME Section IX and AWS D 1.1 - Welding Codes.

ASME Section IX -

This section of the Boiler and Pressure vessel code provides direction for qualification of welding procedures and welders.

The code is primarily divided into two sections exclusive of brazing. The first section, "Procedure Qualification" is intended to require the manufacturer to demonstrate his capability to deposit weld metal of equal or greater strength than the base metal(s) involved. These materials range from plain carbon steel, to high strength quenched and tempered alloy materials, stainless steels, non-ferrous alloys and combinations of these materials.

It also covers a large range of welding processes. e.g. SMAW, GTAW, GMAW, SAW, ESW, PAW etc.

The second portion of this code provides direction to the manufacturers in the "Qualification of Welders" and "Welding Operators", wherein personnel demonstrate their ability to deposit sound weld metal using parameters and criteria from qualified procedures.

ASME IX was developed to support construction of vessels and piping in the pressure vessel industry and as such must support the maintenance of pressure boundaries in these components.

The scope of Section IX has been extended to provide a basis of qualification in other areas which come under the jurisdiction of the ASME Code in its entirety e.g. supports and attachments.

AWS D 1.1

This code in its present form has evolved from earlier efforts by AWS to establish a basic set of rules for use in the construction of buildings, bridges and tubular structures. It does not provide design criteria and as such is used in conjunction with design codes for particular structures such as AISC.

The materials and processes prescribed in D1.1 are those normally associated with carbon and low alloy steels encountered in the construction industry. D 1.1 has established a group of "Pre-Qualified" procedures that may be used in welding specific materials, with specific consumable in a limited number of joint configurations that have been thoroughly tested and have a long record of satisfactory performance.

It also provides for qualification of other joints, material and consumable combinations, the tests in this case are similar to those used in qualifying an ASME Section IX procedure.

D 1.1 does require personnel qualification in all cases and the tests used to demonstrate proficiency are similar to those required by ASME IX.

AWS D1.1 does not provide for construction with all materials, joint configurations and consumables. Normally where these variations are encountered the code allows the engineer to accept evidence of previous qualifications of the joint welding procedure to be used e.g. ASME or MIL-STD for similar AWS application.

The engineer has exercised this option in a number of areas associated with structural welding on STP, where ASME procedures are reviewed and if acceptable, use is allowed in lieu of an AWS procedure. The specific application is further controlled by Bechtel during review and approval of the "Form 84" which is a listing of the proposed welding procedures for specific applications submitted to Bechtel by the Contractor prior to use.

The use of AWS D1.1 is widely accepted for the fabrication of steel structures in the nuclear industry and when used in conjunction with a responsible design code will provide structures with a sound margin of safety adequate for the intended application.

ATTACHMENT (2)

I. DIMENSIONAL TERMINOLOGY

A. NOMINAL — Dimensions labeled "Nominal" are to identify size or shape and are not subject to tolerances or measurement.

B. REFERENCE — Dimensions labeled "Reference" are non-critical dimensions which may vary due to forming or fabrication. These dimensions are not subject to any tolerances.

C. MINIMUM — All dimensions labeled "Minimum" have a minus tolerance of zero.

D. MAXIMUM — All dimensions labeled "Maximum" have a plus tolerance of zero.

NOTE: Normal "plus" tolerances on minimum, and normal "minus" tolerances on maximum, may be exceeded by any amount which allows proper assembly and installation of the completed support.

E. HOLD — Any dimension labeled "Hold" indicates that this dimension is critical to the function or geometry of the part and should be given priority over other dimensions.

F. N/A — Any dimension labeled "N/A" (Not Applicable) indicates that this dimension has been inspected and verified at an earlier stage of fabrication and is not subject to tolerances at this inspection.

ATTACHMENT (2)

II. CUT DIMENSIONS (LENGTH OR WIDTH)

A. Round Bar (length) . . . . ± 1/8"

B. Plate or Sheet (length and width) . . . . ± 1/8"

C. Flat Bar or Strip (length) . . . . ± 1/8"

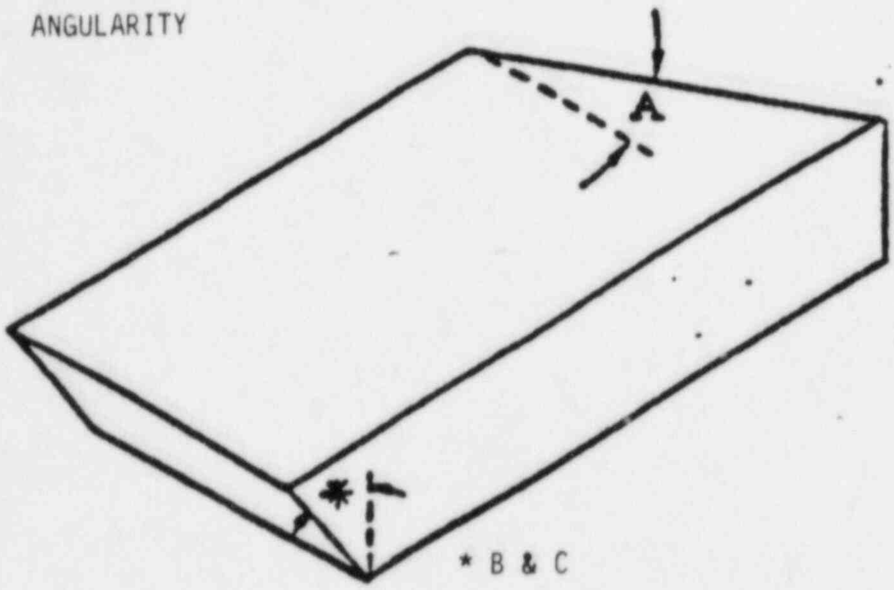
D. Structural Shapes and Structural Tubing . . . . ± 1/8"

E. Pipe and Tubing (length) . . . . ± 1/8"

F. Threaded Round Bar (length) . . . . ± 1/8"

G. Hanger Rod (length) . . . . ± 1/2"

III. ANGULARITY



A. Angle of Cut . . . . ± 4°

B. Sawed or Burned Edges . . . . ± 4°

C. Sheared Edges . . . . ± 10°

ATTACHMENT (2)

IV. MANUFACTURING TOLERANCES

A. Holes Center to Edge . . . . ± 1/16"

B. Holes Center to Center . . . . ± 1/16"

C. Drilled (or Machined) Hole Dimater . . . . ± 1/32"

D. Punched Hole Diameter

Burnish Dimension (Punch Side of Hole) . . . . ± 1/32"

Breakout Dimension All Thicknesses . . . . ± .25 times
(Die Side of Hole) . . . . material thickness

E. Thread Length

Hanger Rod (all sizes) . . . . ± 2 Diameters

\- 1/2"

Threaded Round Bar (1" Ø and under) . . . . ± 1/2"
(Over 1" Ø) . . . . ±1"

\- 1/2"

V. FABRICATION

A. Forming

1. Angles . . . . ± 2"

2. Bend Radii (Other than Clamps)

a. Up to 6" . . . . ± 1/6"

b. Over 6" to 12" . . . . ± 1/8"

c. Bend Radii Over 12" to 24" . . . . ± 3/16"

d. Bend Radii Over 24" and Up . . . . ± 1/4"

ATTACHMENT (2)

V. FABRICATION (Cont'd)

B. Weldments

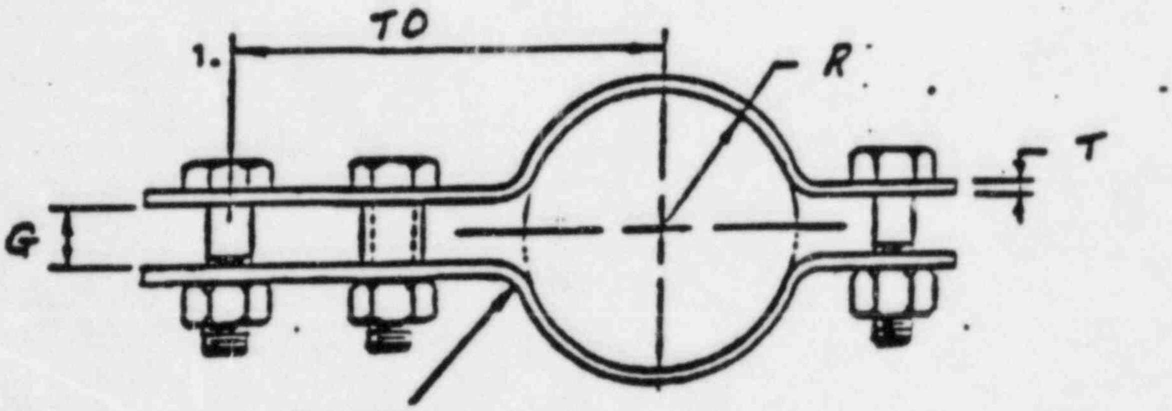
1. Angles . . . . ± 1°

2. Lengths . . . . ± 1/8"

3. Welds Lenght (When Specified) . . . . ± Weld Size

4. Weld Size (Callout) . . . . Plus Only
No Minus

C. Clamp Tolerances



Pipe Size	R	G	TO (TAKE OUT)
1/2-1 1/2	± 1/16	± 1/8	± 1/8
2-3 1/2	± 1/8	± 1/8	± 1/8
4-10	± 3/16	± 1/8	± 1/4
12-18	± 1/4	± 1/8	± 3/8
20-30	± 3/8	± 1/8	± 1/2
Over 30	± 1/2	± 1/8	± 3/4

2. Bend Radius (Hot Form) . . . . 1 x T (min.)
(Cold Form) . . . . .1 1/2 x T (min.)

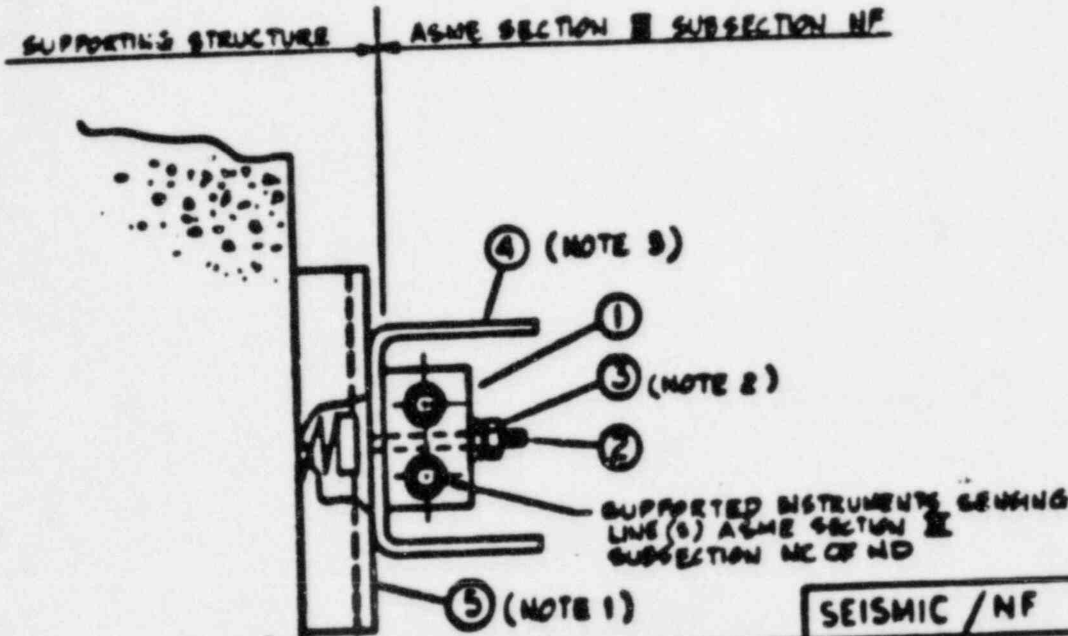
ATTACHMENT (3) - NOT USED

ATTACHMENT (4) - NOT USED

ATTACHMENT (5)

NOTES

1. GLOBESTRUT SHOWN - MAY BE ANY APPROVED SEISMIC SUPPORT.
2. OTHER FASTENING OPTIONS ALLOWED BY ASME III NF 4725 ARE ACCEPTABLE IN LIEU OF DOUBLE NUTS.
3. TUBE TRAY CHANNEL SHOWN - ALSO APPLIES TO TUBE TRAY ANGLE.



ITEM	DESCRIPTION	SEISMIC / NF JURISDICTION
1	CLAMP	NF
2	SPRING STUD OR BOLT	NF
3	NUT(S) (NOTE 2)	NF
4	TUBE TRAY (NOTE 3)	SUPPORTING STRUCTURE
5	GLOBESTRUT (NOTE 1)	SUPPORTING STRUCTURE

NO.	REVISION
0	ISSUED FOR CONSTRUCTION

RESP. ENGR. R.P. Cain

BECHTEL ENERGY CORPORATION
HOUSTON, TEXAS

HOUSTON LIGHTING & POWER CO.
SOUTH TEXAS PROJECT

ASME SECTION III JURISDICTIONAL BOUNDARIES FOR SUPPORTS

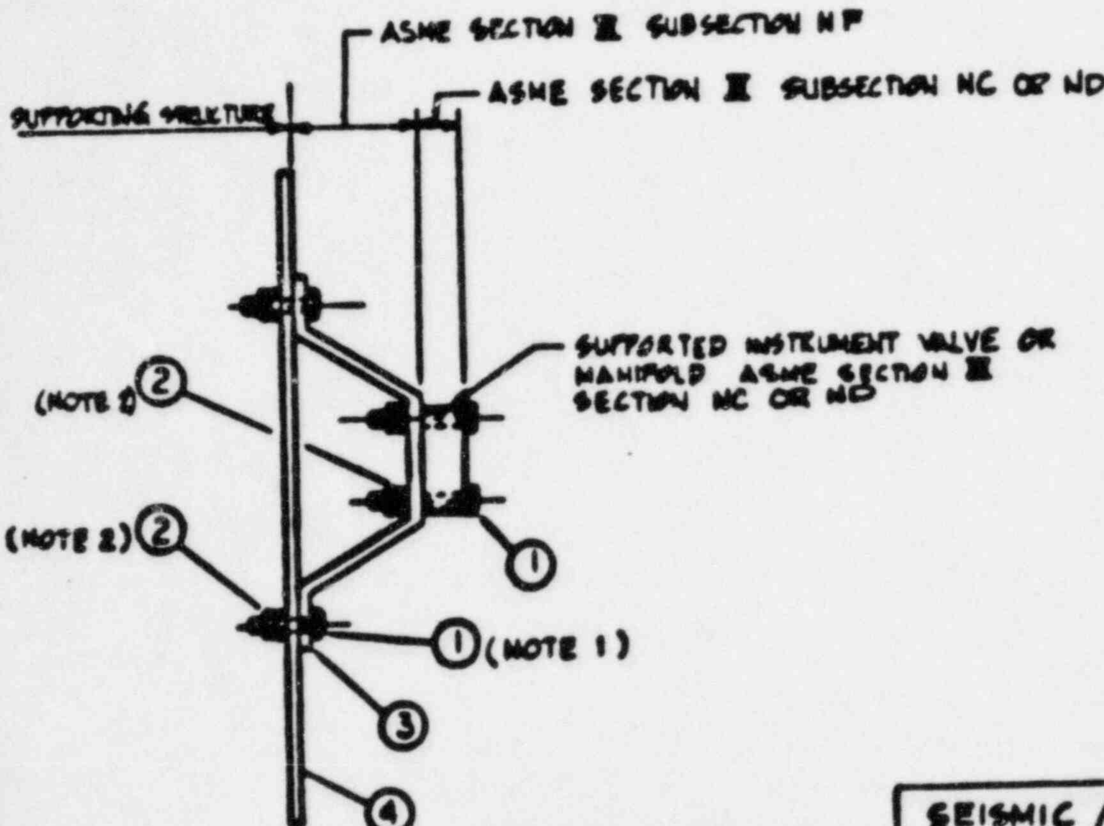
DRAWING NO. 4201-92-45000 SH. 3 REV. 0

OPERATOR SUPERVISOR

ATTACHMENT (5)

NOTES :

1. BOLT MAY BE INSTALLED IN REVERSE OF AS SHOWN (i.e. NUTS ON BRACKET & HEAD BEHIND PLATE).
2. OTHER FASTENING OPTIONS ALLOWED BY ASME SECTION III NF 4725 ARE ACCEPTABLE IN LIEU OF DOUBLE NUTS.



ITEM	DESCRIPTION	SEISMIC / NF JURISDICTION
1	BOLT (NOTE 1)	NF
2	NUT(S) (NOTE 2)	NF
3	BRACKET	NF
4	MOUNTING PLATE	SUPPORTING STRUCTURE

NO.	REVISION	DFT	CHK	QA	DES	PGM	DATE
0	ISSUED FOR CONSTRUCTION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CHIEF ENGR. AP CAINE

BECHTEL ENERGY CORPORATION
HOUSTON, TEXAS

HOUSTON LIGHTING & POWER CO.
SOUTH TEXAS PROJECT

ASME SECTION III JURISDICTIONAL BOUNDARIES FOR SUPPORTS

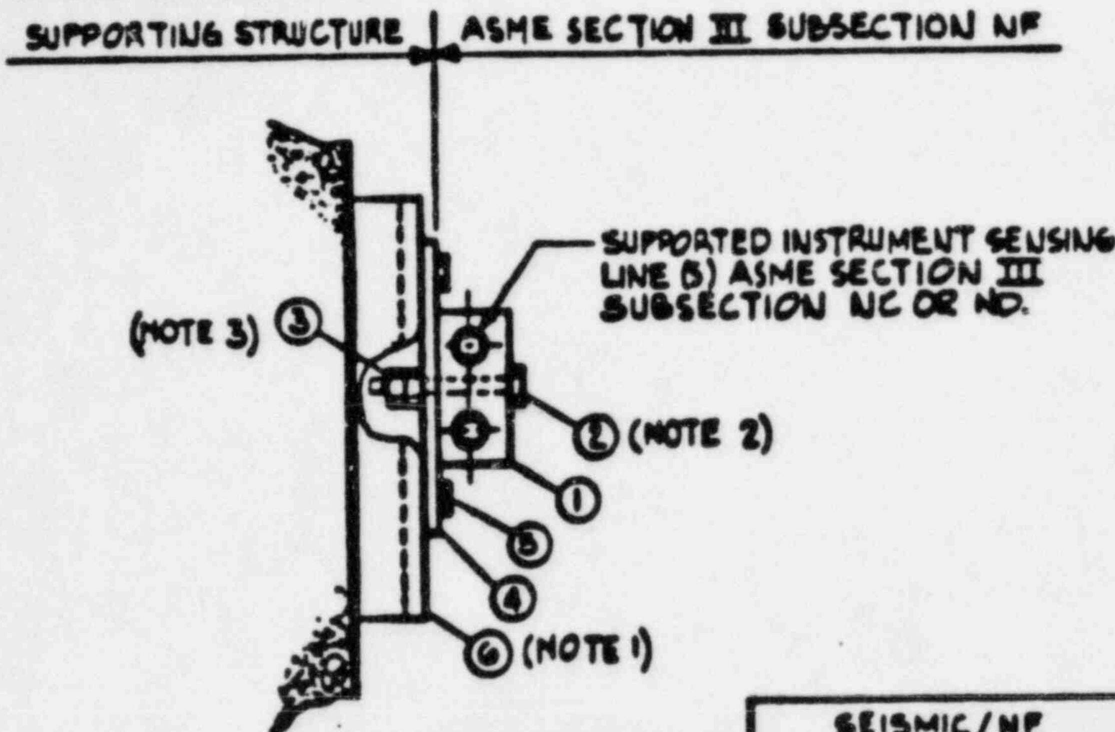
SCALE	JOB NO.	DRAWING NO.	REV.
—	[illegible]	4201-9-2-45000 SH. 5	0

I certify that [illegible]

ATTACHMENT (5)

NOTES:

1. GLOBESTRUT SHOWN- MAY BE ANY APPROVED SEISMIC SUPPORT.
2. BOLT MAY BE INSTALLED IN REVERSE OF AS-SHOWN (I.E. NUTS ON CLAMP SIDE & HEAD IN GLOBESTRUT).
3. OTHER FASTENING OPTIONS ALLOWED BY ASME III NF4725 ARE ACCEPTABLE IN LIEU OF DOUBLE NUTS.



ITEM	DESCRIPTION	SEISMIC/NF JURISDICTION
1	CLAMP	NF
2	BOLT (NOTE 2)	NF
3	NUT (S) (NOTE 3)	NF
4	FITTING PLATE	SUPPORTING STRUCTURE
5	BOLT & [illegible] NUT	SUPPORTING STRUCTURE
6	GLOBESTRUT (NOTE 1)	SUPPORTING STRUCTURE

NO.	REVISION
0	ISSUED FOR CONSTR.

A.P. CAINE

BECHTEL ENERGY CORPORATION

HOUSTON LIGHTING & POWER CO.
SOUTH TEXAS PROJECT

ASME SECTION III JURISDICTIONAL BOUNDARIES FOR SUPPORTS

SCALE	DRAWING NO.	REV.
NONE	4201-9-2-43000 SH. 4	0