BELLEFONTE NUCLEAR PLANT

WELDING PROJECT REINSPECTION PLAN

REVISION 2

Preparer — 9/17/87 Date

Welding Project Engineer — 9-17-87 Date

BLEP Project Engineer — 9-17-87 Date

REVISION 1

Preparer — 9/3/87 Date

Welding Project Engineer — 9/3/87 Date

BLEP Project Engineer — 9/3/87 Date

REVISION 0

Preparer — 10/1/86 Date

Welding Project Engineer — 10/1/86 Date

BLEP Project Engineer — 10/1/86 Date

096272.01

DIVISION OF NUCLEAR ENGINEERING
WELDING PROJECT
PROJECT MANUAL

| Revision | Date | Purpose and Scope of Change |
|---|---|---|
| 0 | 10/1/86 | Initial issue of WP Manual |
| 1 | 9/3/87 | General revision and incorporation of NRC comments from site visit during the week of August 17-21, 1987. |
| 2 | 9/17/87 | Change reinspection procedure and forms for AISC supports, pages 9 and 10 and Attachments 4 and 5. |

WELDING PROJECT
PHASE 2, PART 2
BELLEFONTE REINSPECTION OF SELECTED WELDS

# REINSPECTION PLAN

## OBJECTIVE

The objective of the program described in this reinspection plan is to provide additional data addressing the adequacy of the Bellefonte weld program and to provide indicators regarding the suitability of welding in relation to continued construction and licensing the BLN units and to address nonspecific employee concerns related to welding.

## BACKGROUND

Employee concerns from Watts Bar have possible generic implications to the Bellefonte plant. Some of these concerns relate to: quality of weld filler materials, control of weld filler materials, welder qualifications, inspector qualifications, falsification of records, weld adequacy, and record keeping. A reinspection of hardware to design requirements and comparison to the records package cuts across these and other issues to address the concerns and the welding program adequacy. Nonspecific employee concerns are best addressed by reestablishing confidence in the original programs. Inadequacies in the welding program in the areas of these concerns would be reflected in the hardware quality and the relevant records. Due to an employee concern about the quality of TVA butt welds in duct work made from spiral welded pipe at Watts Bar Nuclear Plant and its subsequent investigation, TVA will reexamine a portion of a like system at BLN to verify that field welded joints meet the design requirements.

A review of the items reinspected at Watts Bar was performed to assure that all general and special populations were considered in selecting items to be reinspected at Bellefonte. Additionally the Lessons Learned from Watts Bar were considered in selecting items to be reinspected at Bellefonte.

Due to normal construction sequence at a job site, the selection of different systems at various elevations and various units of the plant will cut across different timeframes of plant construction. The reinspection effort will include only work performed by Construction since no modifications have been performed by Nuclear Operations on safety related systems or components.

SCOPE

The reinspection of the safety-related features described in the groups below addresses the concerns described above for various installation crafts and various timeframes and encompasses the general and special populations identified at Watts Bar. It will also provide data to determine if problem areas (lessons learned) identified at Watts Bar exist at Bellefonte.

1. Selected process and instrumentation piping and attachment welds in ASME Class 1, 2, 3, and MC, and ANSI B31.1 safety related systems at various units and elevations in the Reactor, Auxiliary, Control, and Diesel Generator Buildings, and in the ERCW pumping station. The sample will include carbon and stainless steel piping components.

SCOPE (Continued)

2. Welds of supports for piping and instrumentation lines for the classes identified in Group 1 above (applicable weld criteria-ASME-NF or AISC as appropriate).
3. Welds of cable tray supports, conduit supports, and electrical components and mountings.
4. Structurally significant welds on miscellaneous and/or structural steel in the Reactor, Control, Auxiliary and Diesel Generator Buildings, and in the ERCW pumping station.
5. HVAC support welds in the Reactor, Control, Auxiliary, and Diesel Generator Buildings and in the ERCW pumping station.
6. Welded ductwork either rectangular or round pipe welded by TVA.
7. Reactor building containment liner welds made to the requirements of specification N4C-871.
8. Threaded studs attached by the automatic, timed arc welding process.
9. Stainless steel liner plate in the fuel pools and transfer canal.

Welds to be reinspected will be as designated by the Welding Project from the categories and locations as listed in Groups 1 thru 9 above. Additional welds in other plant features may also be selected for reinspection at the option of the Welding Project. Weld selection will utilize BLN's computerized weld and component accountability program to the maximum extent practical to provide random selection of reinspection items. The scope of this reinspection is limited to visual, surface (magnetic particle or liquid penetrant) methods, torque test, and review of radiographic film.

SCOPE (Continued)

The reinspections to be performed are, as a minimum, those given in the Criteria section of this plan. Any additional inspections or examinations required of completed welds by applicable drawings shall be performed unless exceptions are identified in this work plan. It is not the intent of this work plan to require reinspection by any method not explicitly required by applicable codes, specifications, and drawings. It is not the intent of this work plan to re-perform any volumetric examination or vacuum box leak testing. When welds which received radiography at installation are selected for reinspection, a review of radiographic film for conformance to applicable criteria will constitute the reinspection. Approximately 400 piping welds, 20 HVAC duct welds, 170 welded structural items, 50 one foot sections of containment liner welds, 10 one foot sections of stainless steel fuel pool and transfer canal liner welds, and 20 threaded studs will be reinspected as outlined in the above Groups 1 through 9. The items to be reinspected will be selected to provide a representative look at each of the above groups to cover work that has been performed during construction. Welds which require removal of supports or equipment for inspection access will be excluded. Any existing coatings will be removed from all welds or portions of weld to be reinspected. For all welds, the generic type, carbon steel as opposed to austenitic stainless steel will be checked by magnetic means.

CRITERIA

All inspections will be conducted in accordance with inspection procedures and the reporting requirements of Table 1. The additional data and exceptions to current criteria as indicated in Attachments 1, 2, 8, and 9 will be used in the review of historical performance of the welding program

CRITERIA (Continued)

at BLN. This review will assess the welding in terms of the acceptance criteria used at the time of acceptance inspection. Any additional examination or reinspection required for finished welds by applicable drawings shall also be performed unless the exception has been identified in this work plan. The following examinations are required inspections in accordance with the code or standard mentioned.

A. ASME Section III, Class 1 Welds

1. All complete penetration circumferential butt welds and welds attaching branch connections larger than 4" nominal pipe size

   method - re-interpretation of radiographic film.

2. All welds in or to Class 1 Systems (including those in A.1 above)

   method - PT or MT, and visual examination. The method used (PT or MT) should be that used originally.

B. ASME Section III, Class 2 Welds

1. All complete penetration circumferential butt welds and welds attaching branch connection larger than 4" nominal pipe size.

   method - re-interpretation of radiographic film to N-RT-1(R6) and visual examination.

2. All other welds in or to Class 2 systems

   method - PT or MT, and visual examination

C. ASME Section III Class 3 Welds

1. Circumferential butt welds in pipe greater than 4" nominal pipe size and welds attaching branch connections greater than 4" nominal pipe size.

   method - PT or MT, and visual examination

2. All other welds in or to Class 3 systems

method - Visual examination

D. ASME Section III, Class MC Welds

1. All welds

method - Visual examination and, for welds which were originally examined by MT or PT, a re-examination by that method. For welds which were originally radiographed, a re-interpretation of the film shall be performed.

E. ANSI B31.1 Welds

1. All welds

method - Visual examination

F. Containment Liner Welds

1. Welds which received spot radiography during construction per Construction Specification N4C-871.

method - re-interpretation of radiographic film. Appendix H of Attachment 3 was used for the evaluation of root conditions in these welds and shall be used during reinterpretation.

2. All welds (including those in F.1 above).

method - MT and visual examination

G. Support welds (ASME Section III, NF)

1. All welds

method - Visual examination.

2. Welds which required PT, MT, or RT during construction. (Refer to applicable drawings and construction records.)

   method - PT, MT or re-interpretation of radiographic film as applicable. PT examination of NF class 1 and 2 welds shall include at least 1/2 inch of base material on either side of the weld. Porosity in radiographs shall not be cause for rejection of the weld.

H. Structural and Support Welds (AISC)

1. All welds

   Method - Structural steel and support welds which were fabricated to the AISC specification will be reinspected visually.

   Criteria - Welds meeting the criteria of N-VT-2(R6) for AISC welds are acceptable. The reporting form is included in attachment 2. Note: Additional information as stated in Attachment 2 will be required for certain attributes irrespective of acceptability or unacceptability of the weld.

2. Welds requiring MT or PT examination per applicable drawings

   Method - MT or PT (as applicable).

I. Ductwork Welds

   Method - Perform visual examination

   Criteria - The acceptance criteria for duct welds will be the presence of weld. The reporting form is included in Attacbment 2.

J. Stud Welds

Method - Perform torque test as detailed in Attachment 7.

Criteria - Acceptance criteria shall be as stated in Attachment 7.

K. All Welds

The generic filler metal type for all welds will be checked by the use of magnets. The acceptability will be based upon the weld metal being of the correct type; carbon steel (magnetic), stainless steel (not magnetic or slightly magnetic) as appropriate for the materials being joined. The confirmation of generic filler material type does not require a special procedure, as it is an accept/reject test. The results of filler metal type shall be recorded on the respective visual examination records.

Any base material defects found during this reinspection shall be reported via the site QA program requirements but shall not be cause for rejection of the weld to the requirements of this reinspection program.

TABLE 3
WELD PROJECT
BLN WELD REINSPECTION

WORK PLAN
REQUIREMENT

| Code | Reinspection Procedure PMP 1502.07 | Report Form |
|---|---|---|
| ASME III Class 1 | N-RT-1 (R6) as amended by Attachment 3 | Standard form used in N-RT-1 |
| | N-PT-1 (R7) as modified by Attachment 9 | Standard form used in N-PT-1 |
| | N-MT-1 (R5) as modified by Attachment 8 | Standard form used in N-MT-1 |
| | N-VT-3 (R8) as modified by Attachment 1 | Attachment 1 form |
| ASME III Class 2 and MC | N-RT-1 (R6) as amended by Attachment 3 | Standard form used in N-RT-1 |
| | N-PT-1 (R7) as modified by Attachment 9 | Standard form used in N-PT-1 |
| | N-MT-1 (R5) as modified by Attachment 8 | Standard form used in N-MT-1 |
| | N-VT-3 (R8) as modified by Attachment 1 | Attachment 1 form |
| ASME III Class 3 | N-PT-1 (R7) as modified by Attachment 9 | Standard form used in N-PT-1 |
| | N-MT-1 (R5) as modified by Attachment 8 | Standard form used in N-MT-1 |
| | N-VT-3 (R8) as modified by Attachment 1 | Attachment 1 form |
| B31.1 | N-VT-3 (R8) as modified by Attachment 1 | Attachment 1 form |
| Containment Liner | N-RT-1 (R6) as modified by Attachment 3 including Appendix H | Standard form used in N-RT-1 |
| | N-MT-1 (R5) as modified by Attachment 8 | Standard form used in N-MT-1 |
| | N-VT-3 (R8) as modified by Attachment 1 | Attachment 1 form |
| NF Supports | N-RT-1 (R6) as amended by Attachment 3 | Standard form used in N-RT-1 |
| | N-PT-1 (R7) as modified by Attachment 9 | Standard form used in N-PT-1 |
| | N-MT-1 (R5) as modified by Attachment 8 | Standard form used in N-MT-1 |
| | N-VT-3 (R8) as modified by Attachments 1&2 | Attachment 2 form |
| AISC Supports | PT-G-29C P.S.3.C.1.1 (R1) | Attachment 4 form R2 |
| | MT-G-29C P.S.3.C.2.1 (R3) | Attachment 5 form |
| | N-VT-2 (R6) as amended by Attachment 2 | Attachment 2 form |
| Special Reinspections not included with PMP procedures | | |
| Duct Welds | Weld Presence | Attachment 2 form |
| Stud Welds | Torque Test of Attachment 7 | Attachment 7 form |
| Reinspection Records | Weld discrepancies identified in the reinspection shall be noted on Attachment 6 form | |

REINSPECTION PERSONNEL

For visual inspection of AISC structural and support welds, inspection personnel shall be AWS-Certified Welding Inspectors (CWIs). The CWIs will be from TVA's Procurement Quality Assurance Branch (Vendor Surveillance). R2

For MT or PT examination of AISC structural and support welds, performance of the examination shall be by DNQA Level 2 inspectors with evaluation and acceptance/rejection performed by a CWI. For piping and ASME NF support welds, inspection personnel shall be qualified in accordance with SNT-TC-1A or equivalent (certification program for visual patterned after the format for NDE established in SNT-TC-1A) Level II or III. R2

QUALITY ASSURANCE

Overview of this reinspection effort will be provided by a person or persons independent of TVA who have current certification as AWS Certified Welding Inspectors (CWIs) for structural steel, AISC supports, studs, and duct and SNT-TC-1A Level III for piping, containment penetrations (Class MC), and ASME NF support welds. The independent inspector(s) will provide a written report to the Welding Project Engineer summarizing the overview activity and their concurrence or reason for disagreement with the results.

RECORDS

For each weld there will be a record of acceptability as to presence, size, length, location of defects, and the generic type of filler metal. Weld discrepancies shall additionally be reported on a Weld Discrepancy Report (attachment 6).

PLANT SAFETY & SECURITY

Plant safety and security procedures shall apply.

DISCREPANT CONDITION EVALUATIONS AND DISPOSITIONS

Discrepancies will be documented on attached forms and in accordance with the TVA quality assurance program and dispositioned by the design organization using engineering justification for "use as-is" dispositions or to provide corrective action. Determination of generic importance of discrepancies to the welding program will be performed by the Welding Project and adjustments in scope of reinspection and/or project specific programs will be developed to address concerns. The NRC will be notified immediately if significant discrepancies are identified during the reinspection and/or evaluations. Root causes will be investigated and actions to prevent recurrence will be implemented. All defects which require design disposition will be reported along with the ultimate disposition and the findings and actions taken will be included in the Phase 2 Final Report.

INSPECTION REPORT

The results of this reinspection will be forwarded to TVA Management and will subsequently be included in the overall report on the Welding Project activities on BLN to be submitted to the NRC.

Attachment 1

Exceptions to N-VT-3(R8) for reinspection of piping and ASME NF support welds are tabulated below:

1. Para 8.2.1.2 - The provisions for relevance of indications in ASME NF supports do not apply. All indications in NF support welds shall be considered relevant.

2. Para 8.2.2.4 - The provisions of this paragraph for O.D. concavity in autogenous welds do not apply. Reinforcement criteria for autogenous welds shall be the same as for other piping butt welds.

3. Figure 5, detail (c) and notes to Figure 5 - The minimum weld size for socket weld fittings shall be as indicated in detail(b), i.e. 1.09+ but not less than 1/8".

4. Documentation of pipe weld examinations shall be on the attached form. Documentation of NF support welds shall be on the form included with Attachment 2.

5. A magnetic check is to be performed by touching a small permanent magnet to the weld deposit and noting whether the weld deposit is strongly magnetic, weakly magnetic, or non-magnetic.

6. Base material defects, judged not to be the result of welding, shall be reported and handled separately via site QA requirements.

ATTACHMENT 1

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV___ | WELD/ITEM NO. _____ Page_____ of_____ |
|---|---|

RECORD OF VISUAL WELD REEXAMINATION

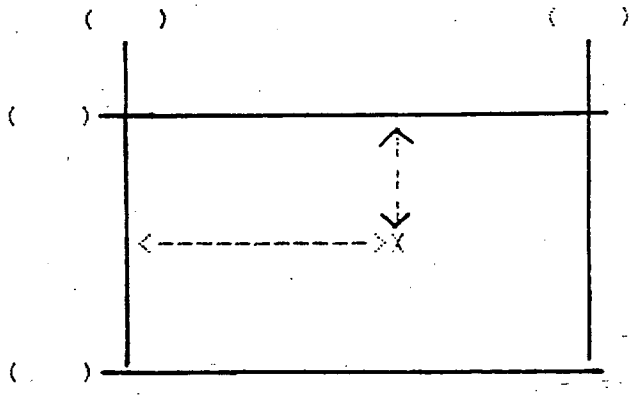
PROCEDURE NO. N-VT- , REV_____

REF. DRAWING_____

ITEM/SYS. DESCRIP._____

| CRITERIA | WELD NO. _____ _____ ACC.REJ.NA |
|---|---|
| WELD DEFECTS | |
| CRACKS | |
| OVERLAP | |
| LACK OF FUSION | |
| INCOM PENETRA | |
| SLAG | |
| POROSITY | |
| CONTOUR/TRANSITION | |
| OFFSET/ALIGNMENT | |
| UNDERCUT | |
| REINFORCEMENT | |
| WELD SIZE | |
| SPATTER/ARC STRIKES | |
| BASE METAL | O STAINLESS<br>O CARBON<br>O ALUMINUM<br>O OTHER |
| WELD TYPE | O BUTT<br>O SOCKET<br>O FILLET<br>O AUTOGEN<br>O SOC-O-LET<br>O WEL-O-LET<br>O OTHER |
| COMPONENT | O P TO P<br>O P TO F<br>O P TO V<br>O F TO F<br>O F TO V<br>O A TO P<br>O F TO V |
| WELD METAL (MAGNETIC ATTRACTION) | O NONE<br>O STRONG<br>O WEAK |

LOCATION




BLDG _____UNIT _____

FLOOR EL. _____

APPROX WELD EL. _____

NOTE : DESCRIBE REJECTABLE CONDITION(S) IN DETAIL WITH NOTES AND SKETCHS ON ATTACHED PAGE

EXAMINED BY:_____LEVEL____DATE_____

RECORDED BY:_____ DATE_____

RRS1A

ATTACHMENT 1

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV___ | WELD/ITEM NO. _____ Page_____ of____ |
|---|---|

RECORD OF VISUAL WELD REEXAMINATION

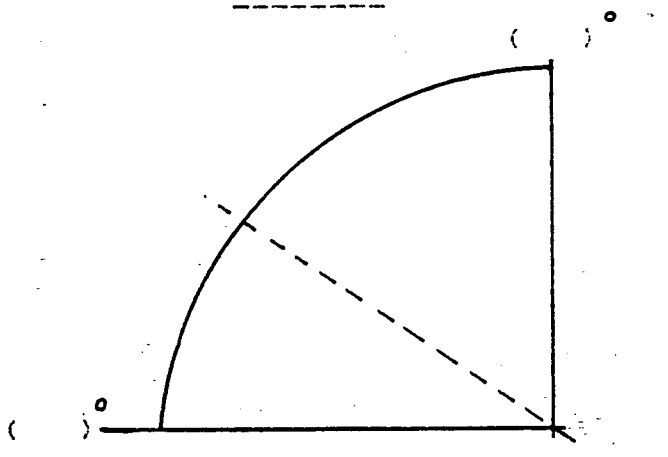
PROCEDURE NO. N-VT- , REV_____

REF. DRAWING_____

ITEM/SYS. DESCRIP._____

| CRITERIA | WELD NO. _____ ACC.REJ.NA |
|---|---|
| WELD DEFECTS | |
| CRACKS | |
| OVERLAP | |
| LACK OF FUSION | |
| INCOM PENETRA | |
| SLAG | |
| POROSITY | |
| CONTOUR/TRANSITION | |
| OFFSET/ALIGNMENT | |
| UNDERCUT | |
| REINFORCEMENT | |
| WELD SIZE | |
| SPATTER/ARC STRIKES | |
| BASE METAL | O STAINLESS<br>O CARBON<br>O ALUMINUM<br>O OTHER |
| WELD TYPE | O BUTT<br>O SOCKET<br>O FILLET<br>O AUTOGEN<br>O SOC-O-LET<br>O WEL-O-LET<br>O OTHER |
| COMPONENT | O P TO P<br>O P TO F<br>O P TO V<br>O F TO F<br>O F TO V<br>O A TO P<br>O F TO V |
| WELD METAL (MAGNETIC ATTRACTION) | O NONE<br>O STRONG<br>O WEAK |

LOCATION




BLDG _____ UNIT ____

FLOOR EL. _____

APPROX WELD EL. _____

NOTE : DESCRIBE REJECTABLE CONDITION(S) IN DETAIL WITH NOTES AND SKETCHS ON ATTACHED PAGE

EXAMINED BY:_____LEVEL____DATE_____

RECORDED BY:_____ DATE_____

RR518

ATTACHMENT 1

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV____ | WELD/ITEM NO. _____ Page_____of___ |
|---|---|

RECORD OF WELD REEXAMINATION
CONTINUATION SHEET

PROCEDURE NO. , REV_____
REF. DRAWING_____
ITEM/SYS. DESCRIP._____

SKETCH/NOTES:

EXAMINED BY:_____DATE_____
RECORDED BY:_____DATE_____

RRS3

ATTACHMENT 2

Exceptions to N-VT-2(R6) for reinspection of structural welds and N-VT-3(R8) for NF supports are tabulated below:

AISC AND NF

Inspect and accept/reject for all attributes on the documentation form included in this attachment.

The inspector should attempt to manually remove or have removed surface slag prior to rejecting a weld for slag.

The magnetic check is to be performed by touching a small permanent magnet to the weld deposit and noting whether it is strongly magnetic, weakly magnetic, or non-magnetic.

AISC

A. The following information is to be reported, irrespective of the acceptability or unacceptability of a weld to the criteria of N-VT-2(R6):

   1. The length of any undercut of less than 1/32 inch depth but greater than 0.010 inch depth when such undercut is oriented transverse to the primary tensile stress.

ATTACHMENT 2

AISC

2. The size and number of pores in complete penetration groove butt welds oriented transverse to the direction of computed tensile stress.

3. The length of fillet weld having a convexity exceeding the quantity 0.1 times the size of the weld plus 0.03 inch.

4. The length of fillet weld exceeding the specified size by more than 3/16 inch.

ATTACHMENT 2

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV___ | WELD/ITEM NO. _____ Page___of___ |
|---|---|

RECORD OF VISUAL WELD REEXAMINATION

PROCEDURE NO. N-VT- , REV_____
REF. DRAWING_____
ITEM/SYS. DESCRIP._____
STRUCTURE TYPE O NF O AISC O OTHER _____

| CRITERIA | WELD NO. | WELD NO. | WELD NO. | WELD NO. |
|---|---|---|---|---|
| | ACC.REJ.NA | ACC.REJ.NA | ACC.REJ.NA | ACC.REJ.NA |
| WELD CRACKS | | | | |
| WELD SIZE | | | | |
| INCOMP FUSION | | | | |
| WELD OVERLAP | | | | |
| UNDERCUT | | | | |
| CONVEXITY | | | | |
| SURF POROSITY | | | | |
| ARC STRIKES | | | | |
| CRATERS | | | | |
| LENGTH/LOCA | | | | |
| SURFACE SLAG | | | | |
| WELD SPATTER | | | | |
| WELD SIZE(in.) | | | | |
| WELD LENGTH(in.) | | | | |
| WELD METAL (MAGNETIC ATTRACTION) | O NONE O STRONG O WEAK | O NONE O STRONG O WEAK | O NONE O STRONG O WEAK | O NONE O STRONG O WEAK |
| BASE METAL | O STAINL O CARBON | O STAINL O CARBON | O STAINL O CARBON | O STAINL O CARBON |
| PAINT REMOVED | O YES O NO O NA | O YES O NO O NA | O YES O NO O NA | O YES O NO O NA |
| WELD TYPE | | | | |
| PT, MT, UT, RT REQUIRED | O NO O YES TYPE | O NO O YES TYPE | O NO O YES TYPE | O NO O YES TYPE |
| BUILDING FLOOR ELEV | | | | |

NOTE: DESCRIBE REJECTABLE CONDITION(S) IN DETAIL ON ATTACHMENT

EXAMINED BY:_____LEVEL_____DATE_____
RECORDED BY:_____DATE_____

ATTACHMENT 2

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV____ | WELD/ITEM NO.<br>_____<br>Page_____of___ |
|---|---|

RECORD OF WELD REEXAMINATION
CONTINUATION SHEET

PROCEDURE NO. , REV_____
REF. DRAWING_____
ITEM/SYS. DESCRIP._____

SKETCH/NOTES:

EXAMINED BY:_____DATE_____
RECORDED BY:_____DATE_____

RRS3

TABLE 2
PENETRAMETER SELECTION TABLE

| Class | Code | Applicable Section of ASME Code | Single Wall Exposure | Double Wall Exposure |
|---|---|---|---|---|
| 1,2,3,CS | ASME III NB,NC,ND VIII Divisions 1 and 2 | V Article 2 | Table 4 | Table 6 |
| MC | ASME III NE | ASME III, Appendix X | Table 5 | Table 5 |
| -- | ANSI B31.1 ASME I, III NF | V Article 3 | Table 3 | Table 3 |
| Liner | TVA N4C-871 ASME III CC | V Article 3[1], Appendix H of this specification | Table 3 | NA |

[1] Penetrameters used for radiography of liner plates may be in accordance with Figure A2.

## TABLE 3

## THICKNESS, PENETRAMETER DESIGNATIONS, AND ESSENTIAL HOLES FOR SINGLE-WALL RADIOGRAPHIC TECHNIQUE

Applicable to ANSI B31.1*, ASME I*, III (NF), III (Division 2), and TVA N4C-871 (ASME III, CC)*, **

| Single-Wall Material Thickness Range, (Inches) | Penetrameter | | | |
|---|---|---|---|---|
| | Source Side | | Film Side | |
| | Desig | Essential Hole | Desig | Essential Hole |
| Up to 1/4 inclusive | 10 | 4T | 7 | 4T |
| Over 1/4 through 3/8 | 12 | 4T | 10 | 4T |
| Over 3/8 through 1/2 | 15 | 4T | 12 | 4T |
| Over 1/2 through 5/8 | 15 | 4T | 12 | 4T |
| Over 5/8 through 3/4 | 17 | 4T | 15 | 4T |
| Over 3/4 through 7/8 | 20 | 4T | 17 | 4T |
| Over 7/8 through 1 | 20 | 4T | 17 | 4T |
| Over 1 through 1-1/4 | 25 | 4T | 20 | 4T |
| Over 1-1/4 through 1-1/2 | 30 | 2T | 25 | 2T |
| Over 1-1/2 through 2 | 35 | 2T | 30 | 2T |
| Over 2 through 2-1/2 | 40 | 2T | 35 | 2T |
| Over 2-1/2 through 3 | 45 | 2T | 40 | 2T |
| Over 3 through 4 | 50 | 2T | 45 | 2T |
| Over 4 through 6 | 60 | 2T | 50 | 2T |
| Over 6 through 8 | 80 | 2T | 60 | 2T |
| Over 8 through 10 | 100 | 2T | 80 | 2T |
| Over 10 through 12 | 120 | 2T | 100 | 2T |
| Over 12 through 16 | 160 | 2T | 120 | 2T |
| Over 16 through 20 | 200 | 2T | 160 | 2T |

*Penetrameters shall be as specified in this table for either single or double wall radiography.

**Penetrameters used for radiography of liner plates may be in accordance with Figure A2.

TABLE 4

THICKNESS, PENETRAMETER DESIGNATIONS, AND ESSENTIAL HOLES FOR SINGLE-WALL RADIOGRAPHIC TECHNIQUE*

Applicable to ASME III (NB, NC, ND) ASME VIII

| Single-Wall Material Thickness Range (Inches) | Penetrameter | | | |
|---|---|---|---|---|
| | Source Side | | Film Side | |
| | Desig | Essential Hole | Desig | Essential Hole |
| Up to 1/4 inclusive | 5 | 4T | 5 | 4T |
| Over 1/4 through 3/8 | 7 | 4T | 7 | 4T |
| Over 3/8 through 1/2 | 10 | 4T | 10 | 4T |
| Over 1/2 through 5/8 | 12 | 4T | 12 | 4T |
| Over 5/8 through 3/4 | 15 | 4T | 12 | 4T |
| Over 3/4 through 7/8 | 17 | 4T | 15 | 4T |
| Over 7/8 through 1 | 20 | 2T | 17 | 2T |
| Over 1 through 1-1/4 | 25 | 2T | 20 | 2T |
| Over 1-1/4 through 1-1/2 | 30 | 2T | 25 | 2T |
| Over 1-1/2 through 2 | 35 | 2T | 30 | 2T |
| Over 2 through 2-1/2 | 40 | 2T | 35 | 2T |
| Over 2-1/2 through 3 | 45 | 2T | 40 | 2T |
| Over 3 through 4 | 50 | 2T | 45 | 2T |
| Over 4 through 6 | 60 | 2T | 50 | 2T |
| Over 6 through 8 | 80 | 2T | 60 | 2T |
| Over 8 through 10 | 100 | 2T | 80 | 2T |
| Over 10 through 12 | 120 | 2T | 100 | 2T |
| Over 12 through 16 | 160 | 2T | 120 | 2T |
| Over 16 through 20 | 200 | 2T | | |

*For double wall exposure, single or double wall viewing, use Table 6 for penetrameter and essential hole selection.

TABLE 5
STANDARD PENETRAMETER SIZES
FOR ASME SECTION III, NE CLASS MC

| Weld Thickness[1] Range, Inches | Thickness of Penetrameter on Source Side, Inch | Designation on Penetrameter | Thickness of Penetrameter on Film Side, Inch | Designation on Penetrameter |
|---|---|---|---|---|
| Up to 1/4 inclusive | 0.005 | 5 | 0.005 | 5 |
| Over 1/4 thru 3/8 | 0.0075 | 7 | 0.0075 | 7 |
| Over 3/8 thru 1/2 | 0.010 | 10 | 0.010 | 10 |
| Over 1/2 thru 5/8 | 0.0125 | 12 | 0.010 | 10 |
| Over 5/8 thru 3/4 | 0.015 | 15 | 0.012 | 12 |
| Over 3/4 thru 7/8 | 0.0175 | 17 | 0.015 | 15 |
| Over 7/8 thru 1 | 0.020 | 20 | 0.017 | 17 |
| Over 1 thru 1-1/4 | 0.025 | 25 | 0.020 | 20 |
| Over 1-1/4 thru 1-1/2 | 0.030 | 30 | 0.025 | 25 |
| Over 1-1/2 thru 2 | 0.035 | 35 | 0.030 | 30 |
| Over 2 thru 2-1/2 | 0.040 | 40 | 0.030 | 30 |
| Over 2-1/2 thru 3 | 0.045 | 45 | 0.035 | 35 |
| Over 3 thru 4 | 0.050 | 50 | 0.040 | 40 |
| Over 4 thru 6 | 0.060 | 60 | 0.050 | 50 |
| Over 6 thru 8 | 0.080 | 80 | 0.060 | 60 |
| Over 8 thru 10 | 0.100 | 100 | 0.080 | 80 |
| Over 10 thru 12 | 0.120 | 120 | 0.100 | 100 |
| Over 12 thru 16 | 0.160 | 160 | 0.120 | 120 |
| Over 16 thru 20 | 0.200 | 200 | 0.160 | 160 |

[1] Including any weld reinforcement or backing strip thickness, if not removed. In the case of double wall tube radiography, the thickness of the weld next to the film.

[2] The images of the identifying numbers of the penetrameter outline and of the 2T hole are all essential indexes of image quality on the radiograph, except that for penetrameters 5, 7, and 10, the slit shall appear clearly; and the hole need not appear.

## TABLE 6

### THICKNESS, PENETRAMETER DESIGNATIONS, AND ESSENTIAL HOLES FOR DOUBLE-WALL RADIOGRAPHIC TECHNIQUE

(For ASME Section III, NB, NC, ND; ASME Section VIII)

| Nominal Single-Wall Material Thickness Range Inches | Penetrameter Film or Source Side | |
|---|---|---|
| | Designation | Essential Hole |
| 0 through 0.375 | 10 | 4T |
| Over 0.375 through 0.625 | 12 | 4T |
| Over 0.625 through 0.875 | 15 | 4T |
| Over 0.875 through 1.00 | 17 | 4T |
| Over 1.00 through 1.50 | 25 | 2T |
| Over 1.50 through 2.50 | 30 | 2T |
| Over 2.50 through 3.00 | 35 | 2T |
| Over 3.00 through 4.00 | 40 | 2T |
| Over 4.00 through 6.00 | 50 | 2T |

## APPENDIX A

## PENETRAMETER REQUIREMENTS

1. Penetrameters shall be procured to Purchase Specification PF-1058 which meets the requirements of ASME SE-142, which is identical to ASTM E 142, 1977. In addition penetrameters 5 through 10 may be procured to the requirements of ASME, Section III, Appendix X.

2. Penetrameters shall be fabricated of radiographically similar material to the weld material or weld metal to be examined. Radiographically similar material is a material or alloy having the same radiation absorption as that being examined.

3. Penetrameters shall be fabricated in accordance with Figure A1 and/or A2 as applicable.

4. Penetrameters shall be identified by permanently attached lead numbers at least 3/32-inch wide. The numbers shall indicate the penetrameter thickness in accordance with Table A1 in thousandths of an inch.

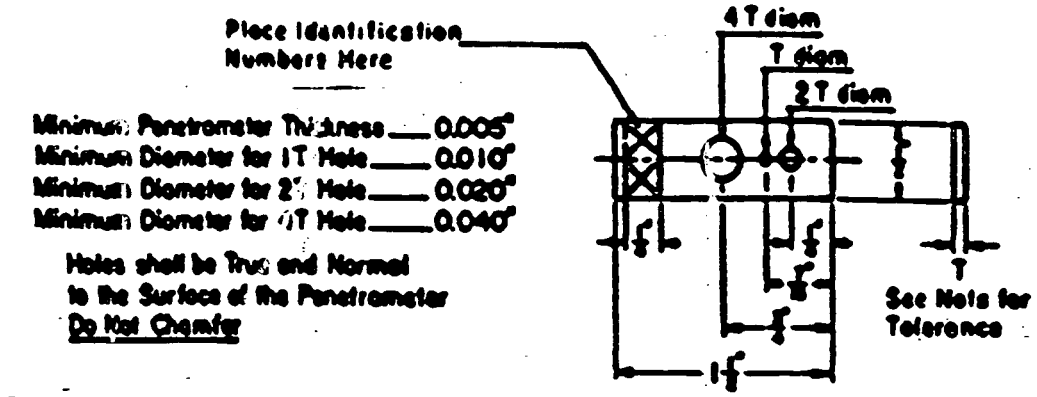
5. Penetrameters which otherwise conform to the requirements of this specification method, but do not have the proper identification, may be used provided the lead numbers indicating penetrameter thickness are placed adjacent to the penetrameter.

### TABLE A1

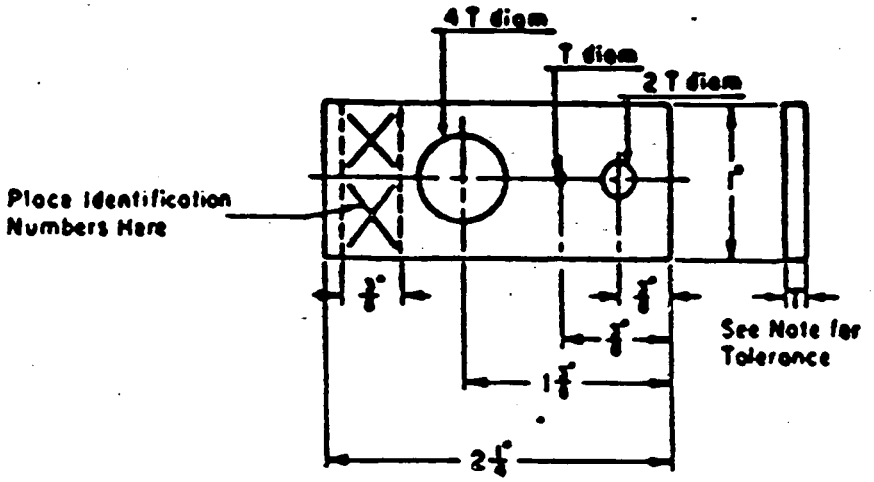
### PENETRAMETER DESIGNATION AND ESSENTIAL HOLES

| Penetrameter Designation | Penetrameter Thickness | 1 T Hole Diameter | 2 T Hole Diameter | 4 T Hole Diameter |
|---|---|---|---|---|
| 5 | 0.005 | 0.010 | 0.020 | 0.040 |
| 7 | 0.007 | 0.010 | 0.020 | 0.040 |
| 10 | 0.010 | 0.010 | 0.020 | 0.040 |
| 12 | 0.012 | 0.012 | 0.025 | 0.050 |
| 15 | 0.015 | 0.015 | 0.030 | 0.060 |
| 17 | 0.017 | 0.017 | 0.035 | 0.070 |
| 20 | 0.020 | 0.020 | 0.040 | 0.080 |
| 25 | 0.025 | 0.025 | 0.050 | 0.100 |
| 30 | 0.030 | 0.030 | 0.060 | 0.120 |
| 35 | 0.035 | 0.035 | 0.070 | 0.140 |
| 40 | 0.040 | 0.040 | 0.080 | 0.160 |
| 45 | 0.045 | 0.045 | 0.090 | 0.180 |
| 50 | 0.050 | 0.050 | 0.100 | 0.200 |
| 60 | 0.060 | 0.060 | 0.120 | 0.240 |
| 80 | 0.080 | 0.080 | 0.160 | 0.320 |
| 100 | 0.100 | 0.100 | 0.200 | 0.400 |
| 120 | 0.120 | 0.120 | 0.240 | 0.480 |
| 160 | 0.160 | 0.160 | 0.320 | 0.640 |
| 200 | 0.200 | 0.200 | 0.400 | 0.800 |

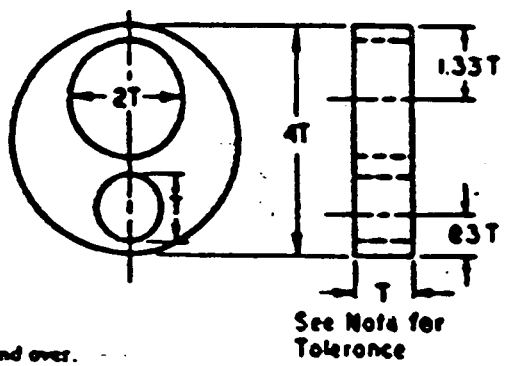
## APPENDIX A (Continued)




Design for penetrameter thickness from 0.005 in. and including 0.050 in.



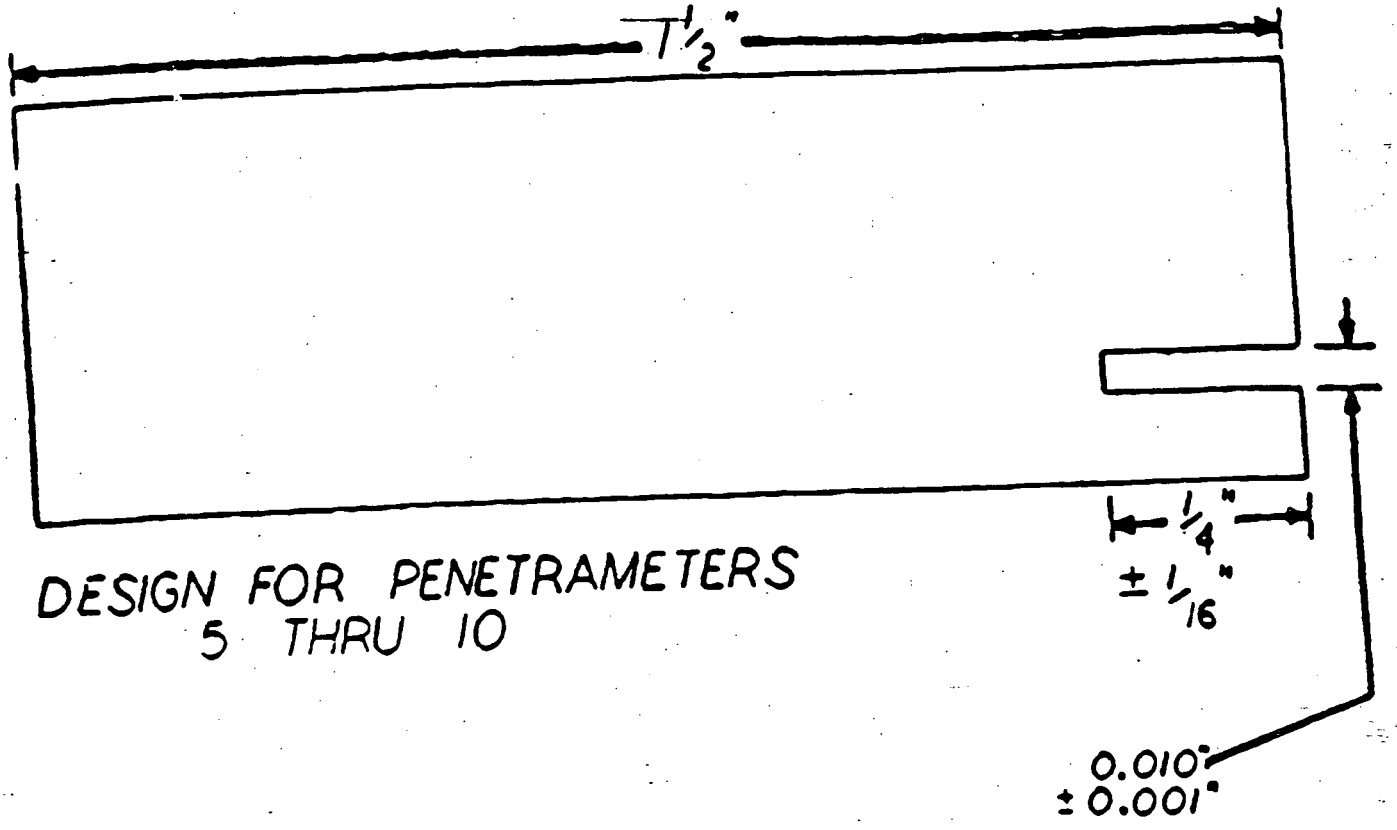

Design for penetrameter thickness from 0.060 in. to 0.160 in. incl.
Made in 0.010-in. increments.



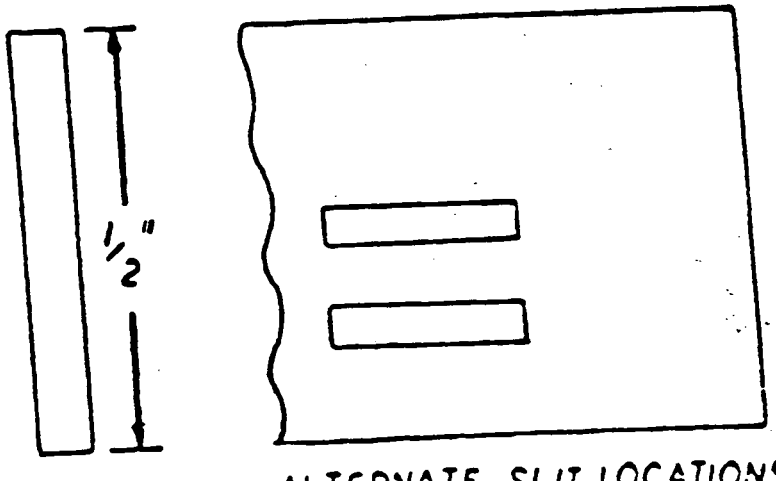

Design for penetrameter thickness of 0.180 in. and over.
Made in 0.020-in. increments.

NOTE 1 - Tolerances on penetrameter thickness and hole diameter shall be ±10 % or one half of the thickness increment between penetrameter sizes, whichever is smaller.

FIGURE A1. PENETRAMETER DESIGN




DESIGN FOR PENETRAMETERS
5 THRU 10




ALTERNATE SLIT LOCATIONS

NOTE: ALL OTHER PENETRAMETER DIMENSIONS SHALL BE IN ACCORDANCE WITH APPENDIX A

FIGURE A2. PENETRAMETER DESIGN - LINER PLATES

## APPENDIX E

### BELLEFONTE NUCLEAR PLANT DENSITY REQUIREMENTS

| Applicable Codes | RT Performed Par | Minimum Density for Single Film Viewing | Minimum Density for Composite Viewing | Maximum Density for Single or Double Film Viewing |
|---|---|---|---|---|
| ASME III NB, NC, ND VIII DIVISIONS 2 AND 2 | Section V Article 2 | 2.0 | 2.6* | 3.8 |
| Linear plate (TVA N4C-871) ASME I, III NF, III Division 2 ANSI B31.1 | Section V Article 3 | 1.3 | 1.8 | 3.8 |
| NE | Appendix X | 1.3 | 1.8 | No maximum |

*Each radiograph of a composite set shall have a minimum density of 1.3.

## APPENDIX B

## ACCEPTANCE CRITERIA FOR ROOT CONDITIONS IN BACKING RING WELDS

1.0 Scope

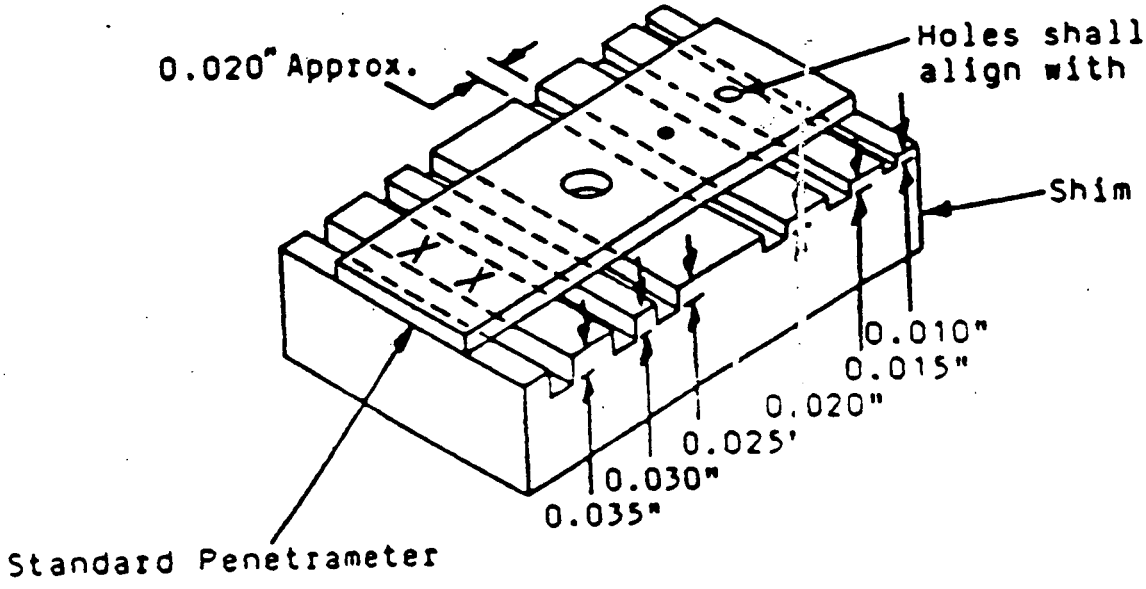
1.1 This appendix will not be used unless invoked by OI. The criteria specified in this appendix shall be used when interpreting radiographs of backing ring welds when such radiographs show indications that can be attributed to a condition along the root of the weld. This criteria shall apply only to such root conditions and indications accepted must be clearly identifiable to this area.

2.0 The film interpreter shall record which figure most closely represents the weld root condition shown on the radiograph. The completed joint is then ajudged acceptable or unacceptable according to the acceptance criteria of this procedure.

3.0 The following figures show shim geometry and diagrams of root conditions most commonly found in backing ring welds.

3.1 Figure 1 gives the size and location of the grooves in the shim. This appendix provides the limits for undercuts or depressions allowed in a weld. The interpreter must evaluate the depth of a depressed area by visually comparing the density of the image of the grooves with the density of the depressed weld area.

3.1.1 The penatrameter should be positioned as shown in the diagram to avoid distortion of required sensitivity. If an ungrooved shim is inadvertently used and the weld does not contain any questionable root conditions, use of the ungrooved shim shall not be cause for rejection the radiographs.



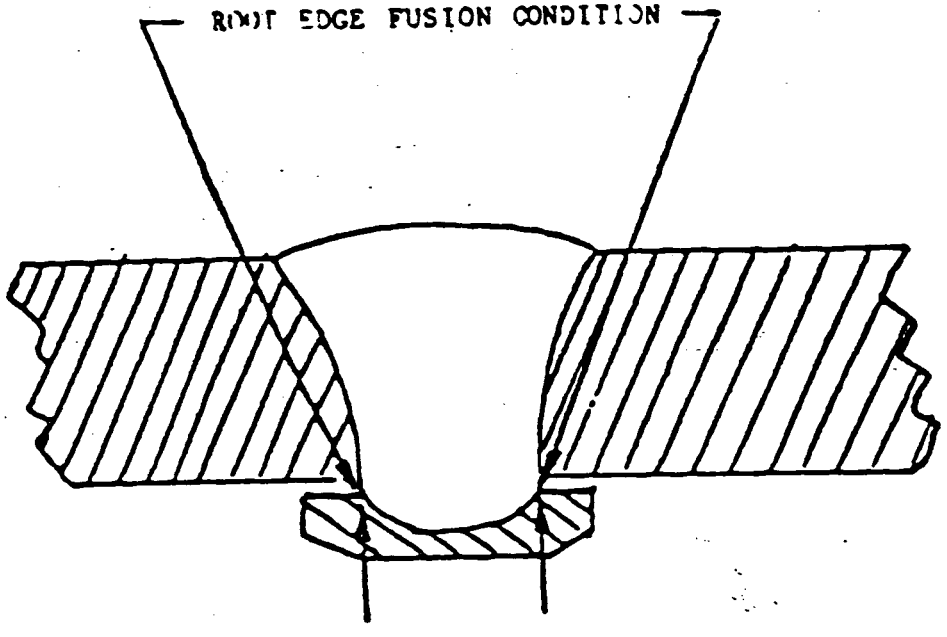
ACCEPTABLE WELD JOINT

3.2 Weld Root

The weld joint illustrated in Figure 2 meets the requirements of this procedure. The weld metal is fused to the backing ring and fills the root gap without any harmful depressions, grooves, etc.

3.2.1 Description of Radiograph

Because the root face is free of depressions, grooves, etc., just two different photographic densities are apparent; the lighter density of the weld deposit contrasts with the darker base metal. The line of demarcation between the two areas is usually distinctive, but normally not straight.




CHANGE IN DENSITY OF IMAGE
OCCURS HERE AS A RESULT
OF ROOT EDGE FUSION

FIGURE 2 - ACCEPTABLE WELD JOINT

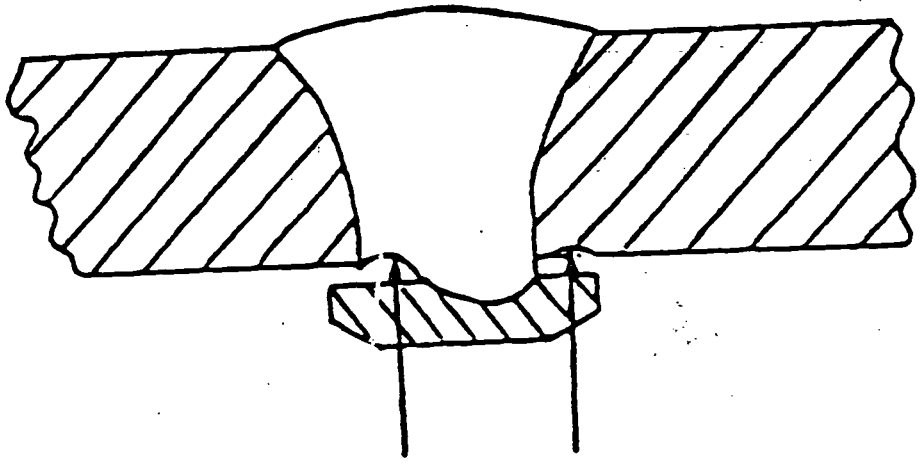
CONDITIONALLY ACCEPTABLE WELD JOINT

3.3 Weld Root

The weld joint illustrated in Figure 3 could meet the requirements of this procedure, even though some cavity is evident in the weld deposit or the base metal at the root. As long as these cavities do not present any sharp edges, do not exceed 1/32-inch, and do not encroach on the minimum wall thickness, they may be accepted. Cavities (or depressions) in both the weld deposit and base metal may coexist.

3.3.1 Description of Radiograph

Cavities (or depressions) appear in radiographs as areas of greater density (darker) because the part is thinner at these locations, i.e., there is less material for the radiation to penetrate. The change in density from one area to another is gradual. The radiographic density of this area should not exceed the density of the image of the applicable groove in the shim. The density of the image of the shim groove should be compared to the portion of the groove not covered by the penetrameter.



TYPICAL ROOT UNDERCUT

FIGURE 3 - CONDITIONALLY ACCEPTABLE WELD JOINT

UNACCEPTABLE WELD JOINT

3.4.1 Weld Root

The weld joint illustrated in Figure 4 does not meet the requirements of this procedure. The cavities (or depressions) at the edge of the weld root in either the weld deposit or base metal are sharper but not necessarily deeper than those in Figure 3; they may or may not exceed 1/32-inch and/or encroach on the minimum wall thickness. In this case, the primary criterion is the sharpness of the edges of the weld root rather than depth of the cavities.

NOTE: The cavity (or depression) at the right edge of the weld root (Figure 4) often occurs in tack welding. The cavity at the left shows part of the root face still unmelted.

3.4.2 Description of Radiograph

Cavities (or depressions) are depicted as darker areas (more dense). The transition in density from the defect to the adjoining area appears sharp and usually narrow. The length of the defect is usually short and generally occurs intermittently along the weld.

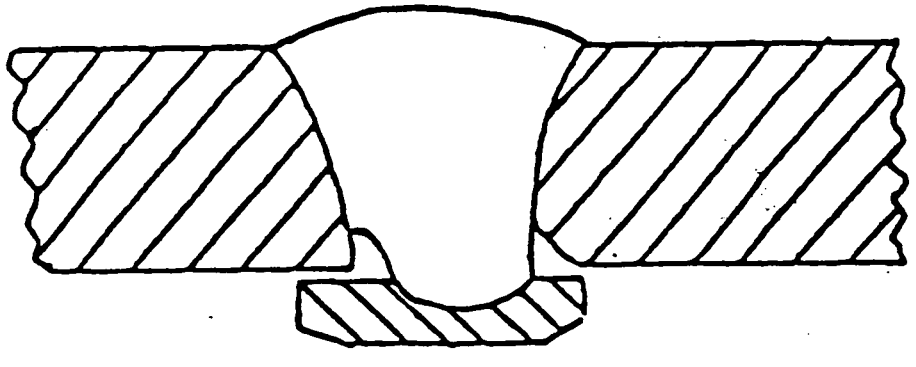


FIGURE 4 - UNACCEPTABLE WELD JOINT

APPENDIX B (Continued)

4.0 Workmanship samples( WS) may be used as an aid in evaluation of Figure 3 conditions in radiographs. If there is any doubt if a WS is needed, one should be used.

4.1 A WS consists of a joint of the same design and same nominal thickness and material as the production weld and may be a welder or procedure qualification test assembly. Radiograph the area of a weld to be used for a WS and prove it acceptable by visual or macro examination.

4.2 The radiograph of a WS used to evaluate a condition in a production weld must be made using the same radiographic technique as is used to make the production radiograph.

4.2.1 The parameters of the radiographic technique which should have the same nominal values for both the WS and the production radiograph are: type source, source intensity, source-to-film distance, film, intensifying screen type and thickness, whether source-side or film-side penetrameter used, whether single- or double-wall exposure, and whether for single-double-wall viewing.

4.2.2 The film density of the WS radiograph must be acceptable and within -10 to +30% of the density of the questionable area of the production weld radiograph so that an accurate comparison may be made.

4.3 Method of Manufacture of a WS

4.3.1 Select an area of a test assembly containing a Figure 3 indication.

4.3.2 Identify for radiography the area selected using a unique WS number.

4.3.3 Radiograph this area using the same technique and parameters as will be used in production.

APPENDIX H (Continued)

4.3.4 Make a section through the questionable area, polish and etch for macro examination.

4.3.5 If the macro section is proven to be acceptable, the radiograph and macro should be saved for a workmanship sample.

4.4 Workmanship samples, radiographs, and macros must be numbered and retained for future use.

4.4.1 Each time the WS is used for evaluating a questionable condition, record the WS number used for evaluation.

ATTACHMENT 4

R2

## Record of Liquid Penetrant Examination

Date of Examination: _____ Report No.: _____

Procedure No.: _____ Revision: _____

Original Examination ☐ Re-examination ☐

Weld Joint No.: _____ R - ¼ - ½ - F - FF

Item or System Description: _____

_____

Ref. Drawing No: _____

Part Temperature: _____ Surface Thermometer S/N _____

Penetrant Materials

Brand Name: Magnaflux Spot Check ☐

Sherwin Double Check ☐

Other: _____

| | Type | Lot or Batch No.: |
|---|---|---|
| Penetrant | | |
| Remover | | |
| Developer | | |

Results of Examination: Satisfactory ☐ Unsatisfactory ☐

Explaination of Unsatisfactory Results: _____

_____

Examined By: _____ Level: _____

Evaluated By: _____ Level: _____

ATTACHMENT 5

R2

## Record of Magnetic Particle Examination

Date of Examination: _____ Report No.: _____

Procedure No.: _____ Revision: _____

Original Examination ☐ Re-examination ☐

Weld Joint No.: _____ R - ¼ - ½ - F - FF

Item or System Description: _____

Referenced Drawing: _____

Method of Magnitization (Check if Applicable):

Yoke Y-5 ☐ Y-6 ☐

Other ☐ _____

AC ☐ DC ☐

Equipment S/N: _____

Test Weight S/N: _____

Pole Spacing: _____

Prods ☐

AC ☐ DC ☐

Equipment Type _____

Equipment S/N _____

Magnetizing Current _____

Prod Spacing _____

Particles Brand & Color: _____

Examination Results: ☐ Satisfactory ☐ Unsatisfactory

Explanation of Unsatisfactory Results: _____

Examined By: _____ Level: _____

Evaluated By: _____ Level: _____

ATTACHMENT 6

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV____ | WELD/ITEM NO. _____ Page_____of___ |
|---|---|

WELD DISCREPENCY REPORT

WELD MAP/SKETCH NO._____

I. DESCRIPTION OF DISCREPANCY (ATTACH SKETCH/PHOTOGRAPH).

_____

_____

_____

_____

REPORTED BY_____ _____
INSPECTOR DATE

II. DISPOSITION

_____

_____

_____

_____

DNE REPRESENTATIVE_____ _____
DATE

III. CORRECTIVE ACTION TAKEN

_____

_____

_____

_____

BLN CONST PERSONNEL_____ _____
DATE

RRS4

ATTACHMENT 7

Torque testing of automatically welded threaded studs

1. Method

Existing nut and washer shall be removed. All exposed threads of the stud shall be cleaned of any lubricant and other foreign matter. A new (unused) flat washer and nut shall be installed without lubricant and torqued to the values given below. Torqueing shall be done with a calibrated wrench. After testing, the permanent installation shall be restored to drawing requirements.

2. Criteria

Studs shall be torqued to the values shown below for the applicable size and thread series. Do not torque beyond these values. Studs sustaining the indicated torque value without failure of the weld are acceptable. The test shall be recorded on the form accompanying this attachment.

Required Torque for Testing Threaded Studs
(FROM AWS D 1.1)

| Nominal Diameter of Studs in. | Threads per Inch and Series Designated | Testing Torque ft/lb |
|---|---|---|
| 1/4 | 28 UNF | 5.0 |
| 1/4 | 20 UNC | 4.2 |
| 5/16 | 24 UNF | 9.5 |
| 5/16 | 18 UNC | 8.6 |
| 3/8 | 24 UNF | 17.0 |
| 3/8 | 16 UNC | 15.0 |
| 7/16 | 20 UNF | 27.0 |
| 7/16 | 14 UNC | 15.0 |
| 1/2 | 20 UNF | 42.0 |
| 1/2 | 13 UNC | 37.0 |
| 9/16 | 18 UNF | 60.0 |
| 9/16 | 12 UNC | 54.0 |
| 5/8 | 18 UNF | 84.0 |
| 5/8 | 11 UNC | 74.0 |
| 3/4 | 16 UNF | 147.0 |
| 3/4 | 10 UNC | 132.0 |
| 7/8 | 14 UNF | 234.0 |
| 7/8 | 9 UNC | 212.0 |
| 1.0 | 12 UNF | 348.0 |
| 1.0 | 8 UNC | 318.0 |

ATTACHMENT 7

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV____ | WELD/ITEM NO. _____ Page___of___ |
|---|---|

RECORD OF WELDED STUD TORQUE TEST

REF. DRAWING_____
ITEM/SYS. DESCRIP._____

| CRITERIA | ID NO. | ID NO. | ID NO. | ID NO. |
|---|---|---|---|---|
| STUD SIZE (*) | | | | |
| APLD TORQ (**) | | | | |
| TORQ WREN ID | | | | |
| WREN CAL DUE DATE | | | | |
| DATE OF TEST | | | | |
| RESULTS | | | | |

SKETCH/LOCATION:

NOTE: DESCRIBE REJECTABLE CONDITION(S) IN DETAIL ON ATTACHMENT
(*) DIAMETER AND THREADS PER INCH
(**) SEE ATTACHMENT 7 WP-09, PAGE 1, PARA 2

EXAMINED BY:_____LEVEL_____DATE_____
RECORDED BY:_____ DATE_____

RRSS

ATTACHMENT 7

| NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV____ | WELD/ITEM NO. _____ Page_____of___ |
|---|---|

RECORD OF WELD REEXAMINATION
CONTINUATION SHEET

PROCEDURE NO. , REV_____
REF. DRAWING_____
ITEM/SYS. DESCRIP._____

SKETCH/NOTES:

EXAMINED BY:_____DATE_____
RECORDED BY:_____DATE_____

ATTACHMENT 8

Exceptions to N-MT-1(R5)

1. Para 7.3.2 - Linear indications are defined as those having a length exceeding 2 times their width.

2. Para 8.1.1 - All indications will be considered relevant.

ATTACHMENT 9

Exceptions to N-PT-1(R7)

1. Para 5.2.2 - Linear indications are defined as those having a length exceeding 2 times their width.

2. Para 5.3 - All indications will be considered relevant.