

BELLEFONTE NUCLEAR PLANT
WELDING PROJECT REINSPECTION PLAN

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DIVISION OF NUCLEAR ENGINEERING
WELDING PROJECT
PROJECT MANUAL

<u>Revision</u>	<u>Date</u>	<u>Purpose and Scope of Change</u>
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 Attachment 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

<u>Code</u>	<u>Reinspection Procedure</u> <u>PMP 1502.07</u>	<u>Report Form</u>
ASME III Class 1	N-RT-1 (R6) as amended by Attachment 3 N-PT-1 (R7) as modified by Attachment 9 N-MT-1 (R5) as modified by Attachment 8 N-VT-3 (R8) as modified by Attachment 1	Standard form used in N-RT-1 Standard form used in N-PT-1 Standard form used in N-MT-1 Attachment 1 form
ASME III Class 2 and MC	N-RT-1 (R6) as amended by Attachment 3 N-PT-1 (R7) as modified by Attachment 9 N-MT-1 (R5) as modified by Attachment 8 N-VT-3 (R8) as modified by Attachment 1	Standard form used in N-RT-1 Standard form used in N-PT-1 Standard form used in N-MT-1 Attachment 1 form
ASME III Class 3	N-PT-1 (R7) as modified by Attachment 9 N-MT-1 (R5) as modified by Attachment 8 N-VT-3 (R8) as modified by Attachment 1	Standard form used in N-PT-1 Standard form used in N-MT-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 N-MT-1 (R5) as modified by Attachment 8 N-VT-3 (R8) as modified by Attachment 1	Standard form used in N-RT-1 Standard form used in N-MT-1 Attachment 1 form
NF Supports	N-RT-1 (R6) as amended by Attachment 3 N-PT-1 (R7) as modified by Attachment 9 N-MT-1 (R5) as modified by Attachment 8 N-VT-3 (R8) as modified by Attachments 1&2	Standard form used in N-RT-1 Standard form used in N-PT-1 Standard form used in N-MT-1 Attachment 2 form
AISC Supports	PT-G-29C P.S.3.C.1.1 (R1) MT-G-29C P.S.3.C.2.1 (R3) N-VT-2 (R6) as amended by Attachment 2	Attachment 4 form Attachment 5 form 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). 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

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 ____

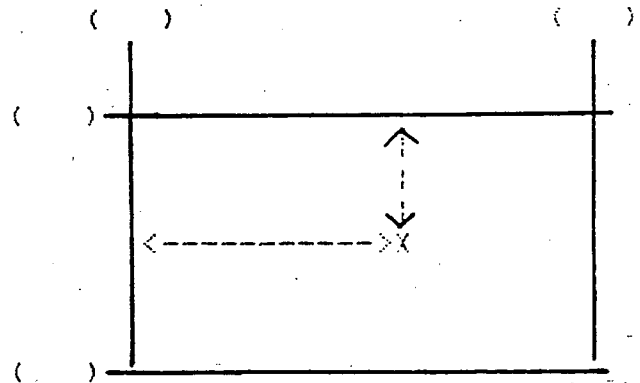
WELD/ITEM NO. _____

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	<input type="checkbox"/> STAINLESS <input type="checkbox"/> CARBON <input type="checkbox"/> ALUMINUM <input type="checkbox"/> OTHER
WELD TYPE	<input type="checkbox"/> BUTT <input type="checkbox"/> SOCKET <input type="checkbox"/> FILLET <input type="checkbox"/> AUTOGEN <input type="checkbox"/> SOC-O-LET <input type="checkbox"/> WEL-O-LET <input type="checkbox"/> OTHER
COMPONENT	<input type="checkbox"/> P TO P <input type="checkbox"/> P TO F <input type="checkbox"/> P TO V <input type="checkbox"/> F TO F <input type="checkbox"/> F TO V <input type="checkbox"/> A TO P <input type="checkbox"/> F TO V
WELD METAL (MAGNETIC ATTRACTION)	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> 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 _____

ATTACHMENT 1

NONDESTRUCTIVE REEXAMINATION PROCEDURE
WP-09 REV ____

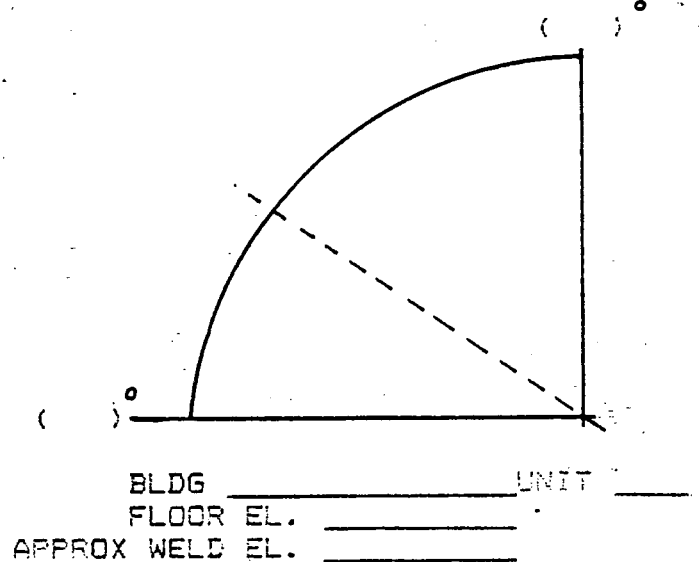
WELD/ITEM NO. _____

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	<input type="checkbox"/> STAINLESS <input type="checkbox"/> CARBON <input type="checkbox"/> ALUMINUM <input type="checkbox"/> OTHER
WELD TYPE	<input type="checkbox"/> BUTT <input type="checkbox"/> SOCKET <input type="checkbox"/> FILLET <input type="checkbox"/> AUTOGEN <input type="checkbox"/> SOC-O-LET <input type="checkbox"/> WEL-O-LET <input type="checkbox"/> OTHER
COMPONENT	<input type="checkbox"/> P TO P <input type="checkbox"/> P TO F <input type="checkbox"/> P TO V <input type="checkbox"/> F TO F <input type="checkbox"/> F TO V <input type="checkbox"/> A TO P <input type="checkbox"/> F TO V
WELD METAL (MAGNETIC ATTRACTION)	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> WEAK

LOCATION



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

EXAMINED BY: _____ LEVEL _____ DATE _____
RECORDED BY: _____ DATE _____

ATTACHMENT 1

NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV _____	WELD/ITEM NO. _____ Page _____ of _____
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**RECORD OF WELD REEXAMINATION
CONTINUATION SHEET**

PROCEDURE NO. _____, REV _____

REF. DRAWING _____

ITEM/SYS. DESCRIP. _____

SKETCH/NOTES:

EXAMINED BY: _____	DATE _____
RECORDED BY: _____	DATE _____

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 $\frac{3}{16}$ inch.

ATTACHMENT 2

NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV ____	WELD/ITEM NO. _____ Page ____ of ____
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RECORD OF VISUAL WELD REEXAMINATION
 PROCEDURE NO. N-VT- , REV ____
 REF. DRAWING _____
 ITEM/SYS. DESCRIP. _____
 STRUCTURE TYPE ☐ NF ☐ AISC ☐ 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)	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> WEAK	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> WEAK	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> WEAK	<input type="checkbox"/> NONE <input type="checkbox"/> STRONG <input type="checkbox"/> WEAK
BASE METAL	<input type="checkbox"/> STAINL <input type="checkbox"/> CARBON	<input type="checkbox"/> STAINL <input type="checkbox"/> CARBON	<input type="checkbox"/> STAINL <input type="checkbox"/> CARBON	<input type="checkbox"/> STAINL <input type="checkbox"/> CARBON
PAINT REMOVED	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> NA	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> NA	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> NA	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> NA
WELD TYPE				
PT, MT, UT, RT REQUIRED	<input type="checkbox"/> NO <input type="checkbox"/> YES TYPE _____	<input type="checkbox"/> NO <input type="checkbox"/> YES TYPE _____	<input type="checkbox"/> NO <input type="checkbox"/> YES TYPE _____	<input type="checkbox"/> NO <input type="checkbox"/> 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. _____ Page _____ of _____
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RECORD OF WELD REEXAMINATION
CONTINUATION SHEET

PROCEDURE NO. _____, REV _____

REF. DRAWING _____

ITEM/SYS. DESCRIP. _____

SKETCH/NOTES:

EXAMINED BY: _____ DATE _____
RECORDED BY: _____ DATE _____

**TABLE 2
PENETRAMEETER SELECTION TABLE**

<u>Class</u>	<u>Code</u>	<u>Applicable Section of ASME Code</u>	<u>Single Well Exposure</u>	<u>Double Well Exposure</u>
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 1, III NF	V Article 3	Table 3	Table 3
Liner	TVA N4C-871 ASME III CC	V Article 3, ¹ Appendix R of this specification	Table 3	NA

¹ Penetrimeters used for radiography of liner plates may be in accordance with Figure A2.

TABLE 3

THICKNESS, PENETRATOR DESIGNATIONS, AND ESSENTIAL HOLES

FOR SINGLE-WALL RADIOGRAPHIC TECHNIQUE

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

Single-Wall Material Thickness Range, (Inches)	Penetrator			
	Source Side		Film Side	
	Design	Essential Hole	Design	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

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

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

TABLE 4
THICKNESS, PENETRATOR DESIGNATIONS, AND ESSENTIAL HOLES
FOR SINGLE-WALL RADIOGRAPHIC TECHNIQUE*
Applicable to ASME III (NB, NC, ND) ASME VIII

Single-Wall Material Thickness Range (Inches)	Penetrator			
	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	15	2T
Over 1 through 1-1/4	25	2T	17	2T
Over 1-1/4 through 1-1/2	30	2T	20	2T
Over 1-1/2 through 2	35	2T	25	2T
Over 2 through 2-1/2	40	2T	30	2T
Over 2-1/2 through 3	45	2T	35	2T
Over 3 through 4	50	2T	40	2T
Over 4 through 6	60	2T	45	2T
Over 6 through 8	80	2T	50	2T
Over 8 through 10	100	2T	60	2T
Over 10 through 12	120	2T	80	2T
Over 12 through 16	160	2T	100	2T
Over 16 through 20	200	2T	120	2T

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

TABLE 5
STANDARD PENETRATOR SIZES
FOR ASME SECTION III, MC CLASS MC

Weld Thickness ¹ Range, Inches	Thickness of Penetrator on Source Side, Inch	Designation on Penetrator	Thickness of Penetrator on Film Side, Inch	Designation on Penetrator
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 penetrator outline and of the 2T hole are all essential indexes of image quality on the radiograph, except that for penetrators 5, 7, and 10, the slit shall appear clearly; and the hole need not appear.

TABLE 6

**THICKNESS, PENETRATOR 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	Penetrator	
	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

PENETRATOR REQUIREMENTS

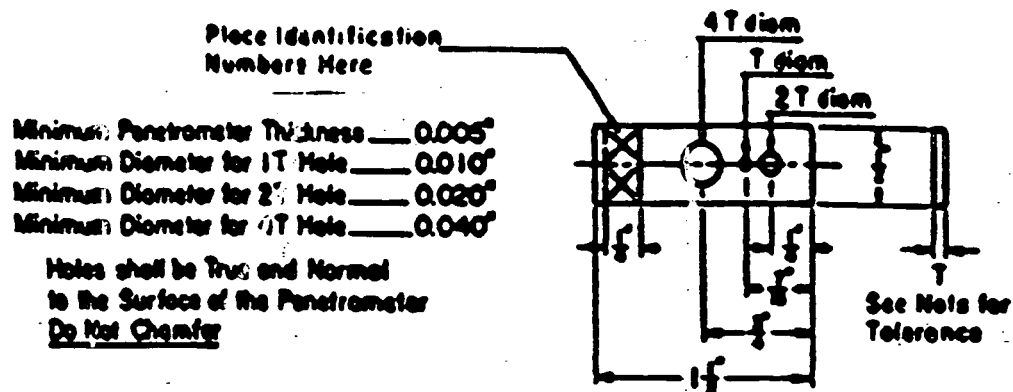
1. Penetrators shall be procured to Purchase Specification PF-1058 which meets the requirements of ASME SE-142, which is identical to ASTM E 142, 1977. In addition penetrators 5 through 10 may be procured to the requirements of ASME, Section III, Appendix X.
2. Penetrators shall be fabricated of radiographically 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. Penetrators shall be fabricated in accordance with Figure A1 and/or A2 as applicable.
4. Penetrators shall be identified by permanently attached lead numbers at least 3/32-inch wide. The numbers shall indicate the penetrator thickness in accordance with Table A1 in thousandths of an inch.
5. Penetrators 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 penetrator thickness are placed adjacent to the penetrator.

TABLE A1

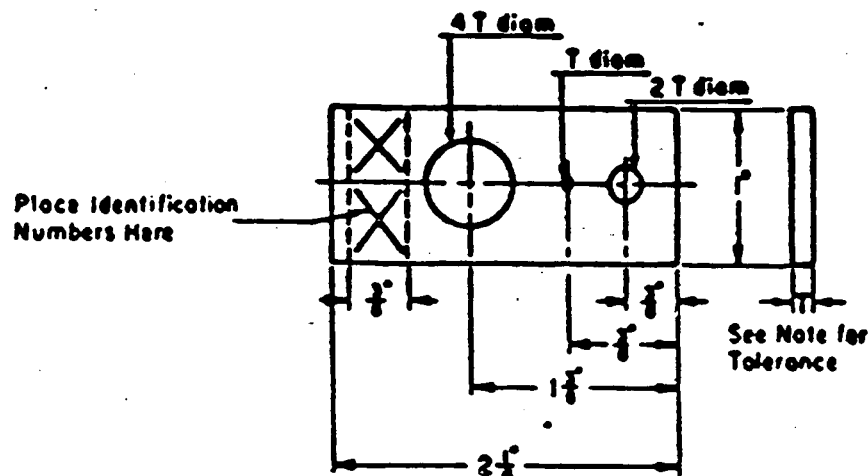
PENETRATOR DESIGNATION AND ESSENTIAL ROLES

<u>Penetrator Designation</u>	<u>Penetrator Thickness</u>	<u>1 T Hole Diameter</u>	<u>2 T Hole Diameter</u>	<u>4 T Hole Diameter</u>
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

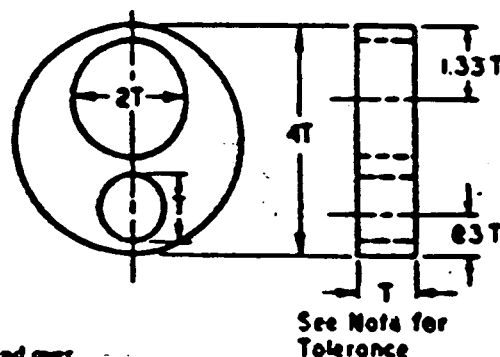
APPENDIX A (Continued)



Design for penetrator thickness from 0.005 in. and including 0.009 in.



Design for penetrator thickness from 0.050 in. to 0.160 in. incl.
 Made in 0.010-in. increments.

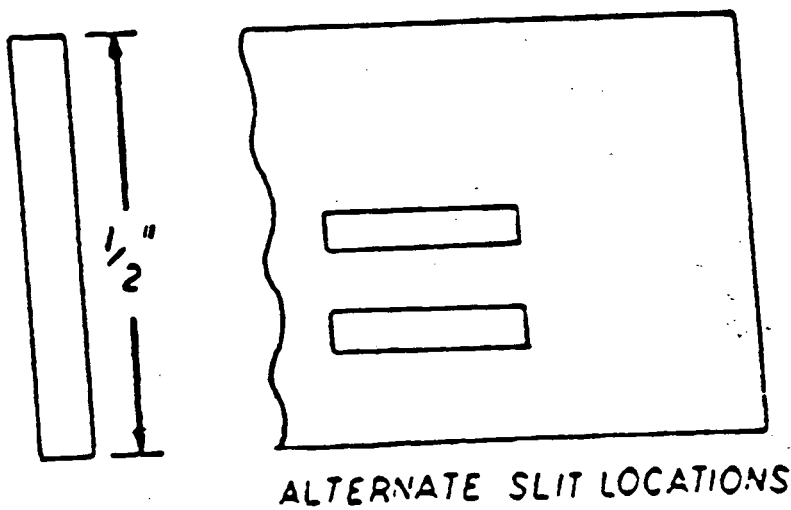
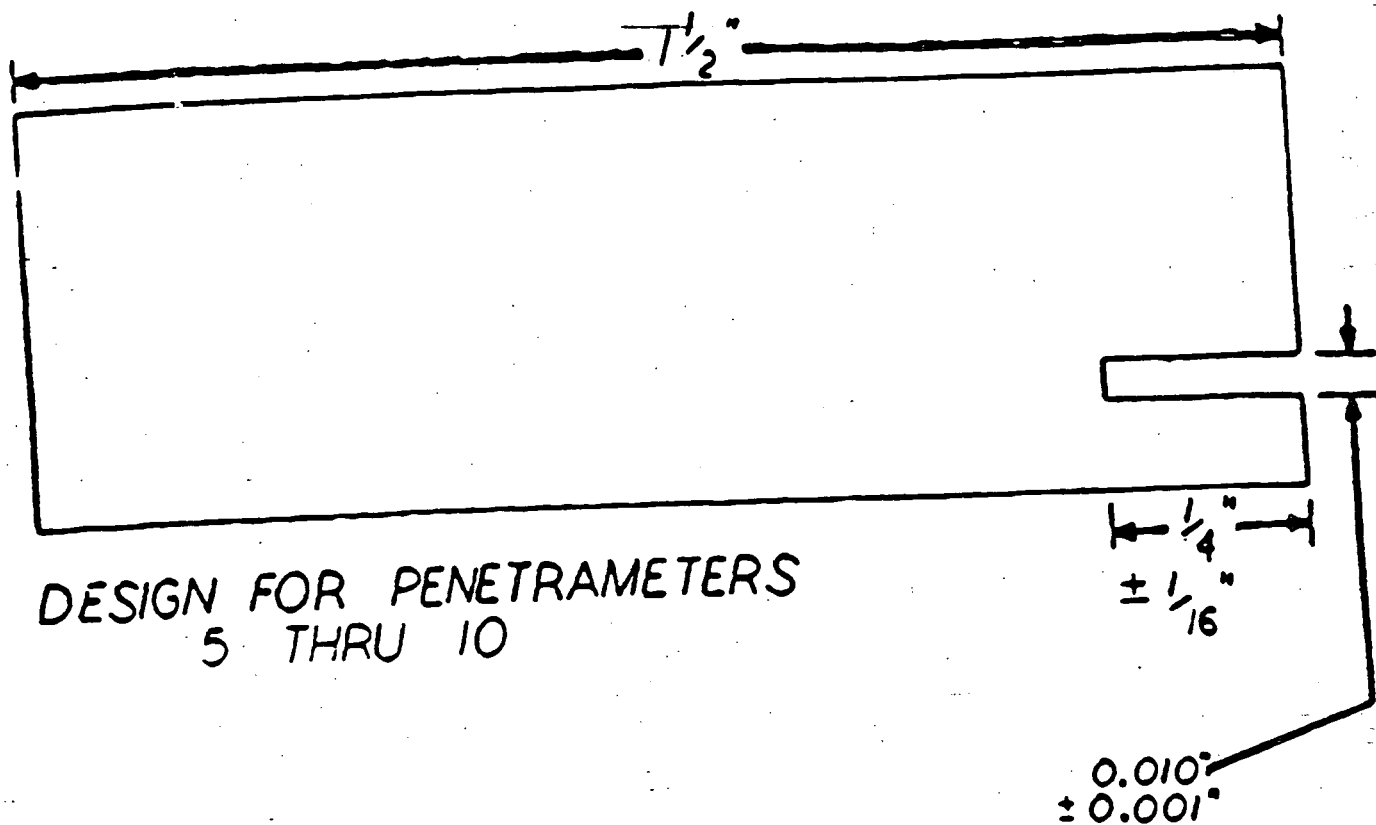


Design for penetrator thickness of 0.180 in. and over.
 Made in 0.020-in. increments.

Note 1 - Tolerances on penetrator thickness and hole diameter shall be $\pm 10\%$ or one half of the thickness increment between penetrator sizes, whichever is smaller.

FIGURE A1. PENETRATOR DESIGN

APPENDIX A (Continued)



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

FIGURE A2. PENETRATOR DESIGN - LINER PLATES

APPENDIX E

BELLEFONTE NUCLEAR PLANT DENSITY REQUIREMENTS

<u>Applicable Codes</u>	<u>RT Performed Per</u>	<u>Minimum Density for Single Film Viewing</u>	<u>Minimum Density for Composite Viewing</u>	<u>Maximum Density for Single or Double Film Viewing</u>
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 NP, 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

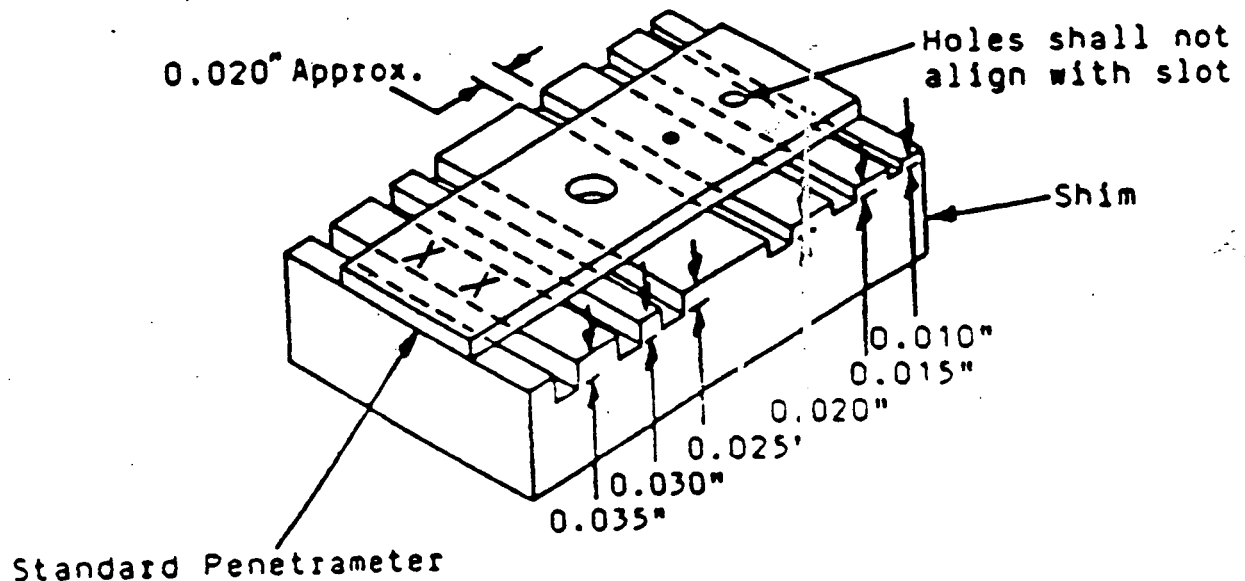
*Each radiograph of a composite set shall have a minimum density of 1.3.

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 OW. 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 adjudged 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 penetrameter 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.



APPENDIX H (Continued)

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.

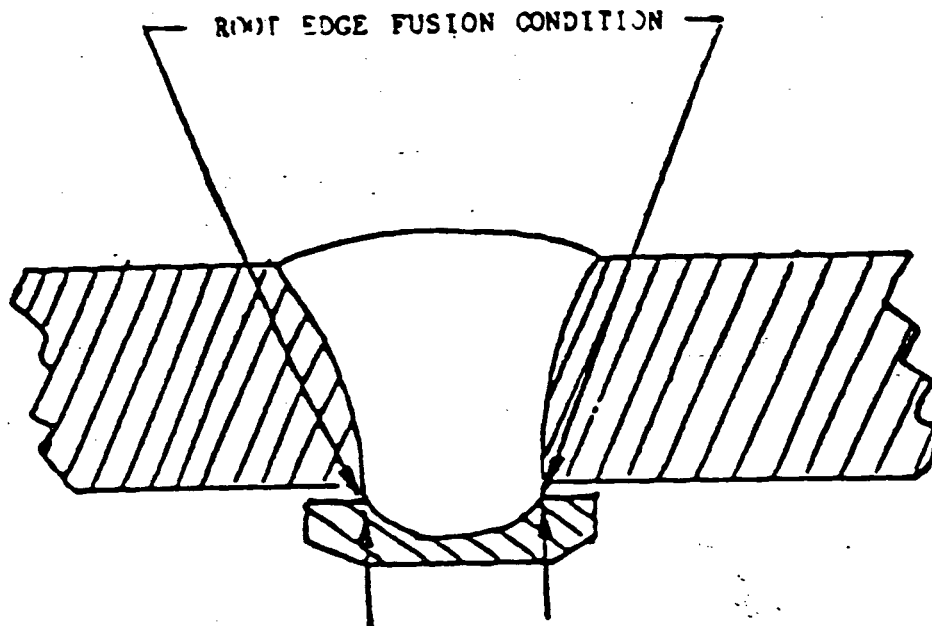


FIGURE 2 - ACCEPTABLE WELD JOINT

APPENDIX B (Continued)

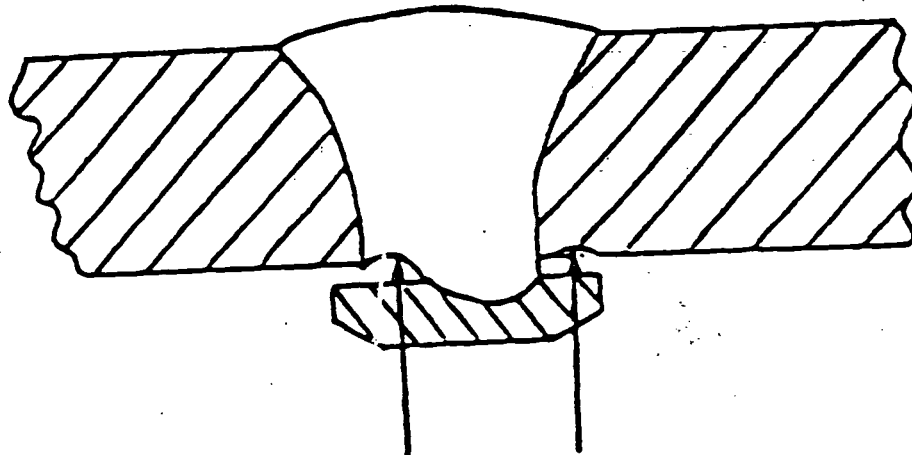
CONDITIONALLY ACCEPTABLE WELD JOINT

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 penetrometer.



TYPICAL ROOT UNDERCUT

FIGURE 3 - CONDITIONALLY ACCEPTABLE WELD JOINT

APPENDIX H (Continued)

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 edges 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.

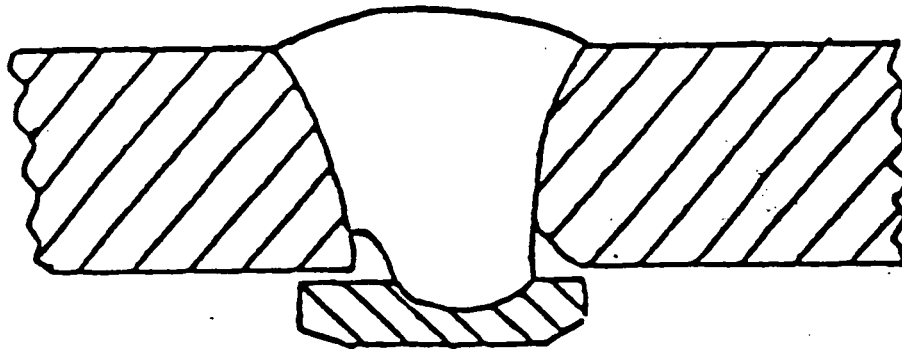


FIGURE 4 - UNACCEPTABLE WELD JOINT

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.

Record of Liquid Penetrant Examination

Date of Examination: _____ Report No.: _____

Procedure Nr: _____ 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 ☐Explanation of Unsatisfactory Results: _____

Examined By: _____ Level: _____

Evaluated By: _____ Level: _____

Record of Magnetic Particle Examination

Date of Examination: _____ Report No.: _____

Procedure No.: _____ Revision: _____

Original Examination ☐Re-examination ☐Weld Joint No.: _____ R - $\frac{1}{4}$ - $\frac{1}{2}$ - F - FF

Item or System Description: _____

Referenced Drawing: _____

Method of Magnetization (Check if Applicable):

Yoke Y-5 ☐ Y-6 ☐Other ☐ _____AC ☐ DC ☐Prods ☐AC ☐ DC ☐

Equipment S/N: _____

Test Weight S/N: _____

Pole Spacing: _____

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 DISCREPANCY 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 _____

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. Torquing 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)

<u>Nominal Diameter of Studs</u> in.	<u>Threads per Inch and Series Designated</u>	<u>Testing Torque</u> 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 _____
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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 _____

ATTACHMENT 7

NONDESTRUCTIVE REEXAMINATION PROCEDURE WP-09 REV _____	WELD/ITEM NO. _____ Page _____ of _____
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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.