División de Educación Continua, Facultad de Ingeniería, UNAM.

CURSOS ABIERTOS

DIPLOMADO DE RECIPIENTES A PRESIÓN

MÓDULO VI

INSPECCIÓN Y PRUEBAS DE RECIPIENTES A PRESIÓN CONFORME A LA SECCIÓN VIII, DIV. 1 DEL CÓDIGO ASME

CA 270

TEMA

APUNTES GENERALES

INGENIERIA MECANICA

EXPOSITOR: ING. ORLANDO R. RIVERA MENDOZA

DEL 06 AL 10 DE AGOSTO DE 2007
PALACIO DE MINERÍA

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO
FACULTAD DE INGENIERIA
DIVISION DE EDUCACION CONTINUA

CURSO / MODULO

INSPECCION Y PRUEBAS DE RECIPIENTES A PRESION

CONFORME A LA SECCION VIII, DIV.1 DEL CODIGO ASME

Instructor: Ing. Orlando R. Rivera
Duración Total: 20 Horas
Lunes a Viernes de 17:00 a 21:00 Horas

UNIVERSIDAD NACIONAL AUTONOMA DE MÉXICO

FACULTAD DE INGENIERIA
DIVISIÓN DE EDUCACIÓN CONTINUA

DATOS DEL INSTRUCTOR

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Es Ingeniero Mecánico Titulado egresado de la Escuela Superior de Ingeniería Mecánica y Eléctrica del Instituto Politécnico Nacional. Cuenta con una experiencia profesional de más de 20 años en diseño, fabricación, inspección, prueba, certificación, montaje y reparación de calderas, recipientes a presión, sistemas de tubería y componentes nucleares. Ha calificado ante el Gobierno de Texas, Ohio, Pennsylvania y The National Board of Boiler and Pressure Vessel Inspectors de Norte America como Inspector Autorizado, Supervisor de Inspectores Autorizados e Inspector Nuclear Autorizado de ASME.
Ha sido asesor de más de 40 empresas en México, Colombia, Venezuela, Brasil y Argentina en Sistemas y Certificaciones de ASME y National Board.
Ha impartido el Diplomado de Ingeniería de Calderas y Recipientes a Presión en la División de Educación Continua de la Facultad de Ingeniería de la Universidad Nacional Autónoma de México, y ha presentado ponencias en Talleres Internacionales de Capacitación en Calderas, Recipientes a Presión y Temas Afines de la Asociación Mexicana de Ingenieros Mecánicos y Electricistas, A.C. (AMIME). Actualmente es Presidente del Comité de Calderas y Recipientes a Presión de AMIME y Consultor de varias compañías nacionales e internacionales.

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

OBJECTIVES

THE OBJECTIVES OF THE NATIOAL BOARD ARE TO PROMOTE:

- UNIFORM ADMINISTRATION AND ENFORCEMENT OF BOILER AND PRESSURE VESSEL LAWS.
- STANDARDIZE CONSTRUCTION.
- STANDARDIZE OPERATION.
- STANDARDIZE INSPECTOR QUALIFICATION.
- SAFETY VALVE TESTING FOR VALVES BUILT TO THE A.S.M.E.

NATIONAL BOARD COMMISSION

THE COMMISSION OBTAINED BY AUTHORIZED INSPECTORS IS ISSUED BY THE NATIONAL BOARD. IT IS ISSUED BASED ON A WRITTEN EXAMINATION. THE THE COMMISSION IS RENEWED ANNUALLY. VARIOUS ENDORSEMENTS MAY BE OBTAINED AFTER FURTHER TESTING. EXAMPLES OF THESE ENDORSEMENTS ARE THE N, THE B AND S ENDORSEMENTS.

This Is To Verify

Orlando R Rivera

N B Comm No 9266 Expires 12/31/98

Arkwright Mutual Insurance Co

Employer

having fulfilled the requirements therefore under the National Board Rules has been issued a current commission, as an inspector of boilers and other pressure vessels, by

The National Board of Boiler and Pressure Vessel Inspectors

Chairman Executive Director

Valid while the holder is in the regular employ of an Authorized Inspection Agency

B N A

1998 THIS IS TO CERTIFY THAT 1998

Orlando Rivera **1052**

NAME TX COMM. NO.

Arkwright Mutual Insurance Co.

EMPLOYED BY

IS AUTHORIZED TO MAKE INSPECTIONS OF BOILERS AND OTHER PRESSURE VESSELS IN ACCORDANCE WITH THE STATE OF TEXAS, BOILER LAW, CHAPTER 755 OF THE HEALTH AND SAFETY CODE, AND ASSOCIATED RULES ISSUED BY THE TEXAS DEPARTMENT OF LICENSING AND REGULATION.

Jerry V. Smith

EXECUTIVE DIRECTOR CHIEF INSPECTOR

IN THE NAME AND BY AUTHORITY OF

THE STATE OF OHIO

To all to whom these presents shall come, Greetings:

Know Ye, That by virtue of the power vested in me, and in accordance with the provisions of the laws of the State of Ohio, I here by COMMISSION ORLANDO R RIVERA To be *Special Inspector of* BOILERS & PRESSURE VESSELS for STATE OF OHIO authorized and empowering him/her to execute and discharge the duties apertaining to said office

Dated 7-1-97 to 7-1-98 Carol-Ann Drake

Superintendent, Division of Industrial Compliance

LOSS OF THE N.B.
NATIONAL BOARD COMMISSION

NATIONAL BOARD COMMISSIONS MAY BE LOST BY AN INSPECTOR FOR:

- FALSIFICATION OF ANY INFORMATION ON THE APPLICATION.
- NEGLECT OF DUTIES SPELLED OUT IN ANY A.S.M.E. CODE.
- FALSIFICATION OF ANY DATA REPORT.

CERTIFICATE OF COMPETENCY
(ISSUED BY THE STATES)

A CERTIFICATE OF COMPETENCY MAY BE ISSUED BY JURISDICTION BASED ON THE SUCCESSFUL COMPLETION OF THE NATIONAL BOARD EXAMINATION. SOME JURISDICTIONS HAVE ADDITIONAL REQUIREMENTS SUCH AS AN ORAL EXAMINATION. THIS CERTIFICATE IS GENERALLY REQUIRED TO PERFORM INSERVICE INSPECTIONS IN A JURISDICTION.

IN THE NAME AND BY THE AUTHORITY OF

THE STATE OF TEXAS

To all whom these presents shall come – Greetings:

KNOW YE that Orlando R. Rivera is

hereby Commissioned as in INSPECTOR OF BOILERS FOR

Delta Lloyds Insurance Company

under the laws of the State of Texas with all the rights and privileges appertaining thereto.

IN TESTIMONY WHEREOF, I hereunto signed my name and caused the seal of the Texas Department of Labor and Standards to be affixed hereto at the City of Austin, this the

13th day of February A.D., 19 81

Chief Inspector

Commissioner

Commission No 1052

AUTHORIZED INSPECTION AGENCY (A.I.A.)

AN AUTHORIZED INSPECTION AGENCY MAY BE EITHER:

- AN INSURANCE COMPANY AUTHORIZED TO WRITE BOILER AND PRESSURE VESSEL INSURANCE WITHIN A PARTICULAR JURISDICTION.
- THE JURISDICTION CHARGED WITH THE ENFORCEMENT OF SAFETY RULES FOR OPERATION OF BOILERS AND PRESSURE VESSELS.

DUTIES OF THE A.I.A.

THE DUTIES OF THE AUTHORIZED INSPECTION AGENCY AS OUTLINED IN THE NATIONAL BOARD BY-LAWS ARE:

- PARTICIPATE IN JOINT REVIEWS.
- EMPLOY A.I. SUPERVISORS TO MONITER THE ACTIVITIES OF THE AUTHORIZED INSPECTORS.
- PROVIDE ALL A.I.'s THE NAME AND TELEPHONE NUMBER OF THEIR SUPERVISOR.
- PROVIDE WRITTEN INSTRUCTIONS TELLING THE A.I.'s TO CONTACT THEIR SUPERVISOR WHEN CODE PROBLEMS CANNOT BE RESOLVED AND WHEN NEW CODE REQUIREMENTS MAY AFFECT THEM.

DUTIES OF THE AUTHORIZED INSPECTOR

THE SPECIFIC DUTIES OF THE A.I. ARE DESCRIBED IN THE VARIOUS CODES AS WELL AS IN THE NATIONAL BOARD BY-LAWS. THEY INCLUDE, BUT ARE NOT LIMITED TO:

- VERIFY THAT THE MANUFACTURER HAS A VALID CERTIFICATE OF AUTHORIZATION.
- MONITERING THE IMPLEMENTATION OF THE QUALITY CONTROL SYSTEM AND TO ACCEPT CHANGES TO THAT SYSTEM.
- VERIFY THAT THE MANUFACTURER HAS THE APPROPRIATE CODE BOOKS, ADDENDA AND ANY APPLICABLE CODE CASES.
- VERIFY THAT THE APPLICABLE DESIGN CALCULATIONS ARE AVAILABLE.
- VERIFY THAT ALL MATERIALS MEET CODE REQUIREMENTS.
- VERIFY MATERIAL IDENTIFICATION.
- VERIFY ALL CUT EDGES ARE EXAMINED.
- VERIFY THAT THE W.P.S. AND P.Q.R. MEET CODE REQUIREMENTS.
- VERIFY THAT ALL WELDERS ARE PROPERLY QUALIFIED.
- VERIFY ONLY QUALIFIED WELDERS AND PROCEDURES ARE USED.

DUTIES OF THE AUTHORIZED INSPECTOR

(CONTINUED)

VERIFY ANY WELD REPAIRS ARE MADE USING QUALIFIED PROCEDURES AND WELDERS.

VERIFY THAT REQUIRED HEAT TREATMENTS MEET THE CODE AND ARE RECORDED PROPERLY.

VERIFY THAT REQUIRED N.D.E. IS PERFORMED PROPERLY BY QUALIFIED PERSONNEL AND RECORDED AS REQUIRED.

PERFORM AN INTERNAL INSPECTION PRIOR TO CLOSURE.

WITNESS THE PRESSURE TEST IF REQUIRED.

VERIFY ALL CODE NONCONFORMANCES ARE PROPERLY CLOSED.

VERIFY THAT THE NAMEPLATE DATA IS CORRECT AND ATTACHED TO THE PROPER VESSEL.

REVIEW THE DATA REPORT FOR CLARITY AND CORRECTNESS AND IF ACCEPTABLE, SIGN THE REPORT AFTER THE CERTIFICATE HOLDER.

TYPES OF TESTS REQUIRED BY SECTION II

HE TYPES OF TESTING AND EXAMINATIONS REQUIRED BY SECTION II ARE:

- CHEMICAL -- ALL MATERIALS
- MECHANICAL -- ALL MATERIALS
- HYDROSTATIC -- TUBULAR PRODUCTS
- ULTRASONIC -- QUENCHED & TEMPERED MATERIALS
- EDDY CURRENT -- TUBULAR PRODUCTS AND CASTINGS
- MAGNETIC PARTICLE -- QUENCHED & TEMPERED FORGINGS AND SOME CASTINGS

MECHANICAL TESTS REQUIRED BY SECTION II

THE TYPES OF MECHANICAL TESTS REQUIRED BY SECTION II ARE:

- TENSILE, YIELD AND ELONGATION -- ALL PRODUCTS EXCEPT SOME CARBON STEELS
- HARDNESS -- FORGINGS, TUBES & BARS
- BEND TESTS -- TUBULAR OR BAR
- FLATTENING -- TUBULAR PRODUCTS
- GUIDED BEND -- WELD FILLER METAL AND WELDED PRODUCTS
- CHARPY IMPACTS -- MILD STEELS AND LOW

SA-20 SUMMARY

SA-20 IS THE GENERAL DELIVERY SPECIFICATION FOR CARBON AND LOW ALLOY PLATE. IT IS ORGANIZED AS FOLLOWS:

1. SCOPE: DESCRIBES THE BASIC MATERIAL SPECIFICATIONS TO WHICH SA-20 APPLIES.
2. APPLICABLE DOCUMENTS: INDICATES REFERENCE DOCUMENTS FOR TESTING SUCH AS SA-370.
3. DESCRIPTION OF TERMS: DEFINES THE VARIOUS TERMS APPLICABLE TO STEEL MANUFACTURING.
4. BASIS OF PURCHASE: INDICATES WHAT SHOULD BE STATED IN THE PURCHASE ORDER.
5. MANUFACTURE: STATES THE FURNACE PROCESS BE USED.
6. HEAT TREATMENT: INDICATES THE REQUIRED HEAT TREATMENT SUCH AS NORMALIZING, ETC.
7. CHEMICAL ANALYSIS: INDICATES HOW THE ANALYSIS IS TO BE TAKEN.
8. METALLURGICAL STRUCTURE: GIVES GRAIN SIZE AND OTHER TESTS REQUIRED TO ESTABLISH GRAIN STRUCTURE.
9. QUALITY: INDICATES THE ACCEPTABLE SURFACE IMPERFECTIONS, EDGE IMPERFECTIONS AND DESCRIBES REPAIR OF MATERIAL BY WELDING.

SA-20 SUMMARY

(CONTINUED)

10. METHODS OF TESTS: INDICATES TEST METHODS TO BE USED.

11. TENSION TESTS: DESCRIBES THE NUMBER AND LOCATION OF TENSION TESTS.

12. NOTCH TOUGHNESS: REFERENCES SA-370 AND INDICATES THE LETTER CODE DESIGNATION THAT IS TO APPEAR ON THE MATERIAL.

13. IDENTIFICATION: DESCRIBES WHERE THE PLATES ARE TO BE IDENTIFIED AND HOW.

14. DIMENSIONS AND MASS: GIVES WEIGHT REQUIREMENTS AND REFERENCES TABLES FOR DIMENSIONAL REQUIREMENTS.

15. INSPECTION AND TESTING: DESCRIBES THE INTERFACE WITH THE INSPECTOR REPRESENTING THE PURCHASER.

16. RETESTS: REFERENCES SA-370 BUT, ALSO GIVES SOME EXCEPTIONS TO THAT SPECIFICATION

17. RETREATMENT: GIVES THE REHEAT TREATMENT PROCEDURES IF RETESTING IS REQUIRED.

18. REJECTION: SELF-EXPLANATORY.

19. MATERIAL TEST REPORTS: DESCRIBES THE CONTENTS OF AN M.T.R.

20. PACKAGING: GENERAL REQUIREMENTS FOR PACKAGING. MARKING AND LOADING.

SA-20
(CONTINUED)

SA-20 ALSO CONTAINS SUPPLEMENTARY REQUIREMENTS LIKE THE BASIC SPECIFICATIONS. THESE REQUIREMENTS WILL BE IMPOSED BY THE CODE OR CUSTOMER. FOR EXAMPLE, WHETHER IMPACT TESTING IS REQUIRED OR NOT.

MARKING REQUIREMENTS SA-20

SA-20 CONTAINS MARKING REQUIREMENTS FOR ALL CARBON AND LOW ALLOY STEEL PLATES. THESE REQUIREMENTS ARE MANDATORY. BRIEFLY, THE MATERIAL MUST CONTAIN:

- MANUFACTURER's NAME OR LOGO
- HEAT AND SLAB NUMBER
- SPECIFICATION, GRADE, CLASS OR TYPE.

THESE MARKINGS MUST BE APPLIED WITH DIE STAMPING UNLESS:

- THE PLATE IS UNDER 1/4 OF AN INCH
- THE PURCHASER SPECIFIES STENCILING

MARKING REQUIREMENTS SA-178/SA-209

THE BASIC SPECIFICATIONS MAY IMPOSE MARKING REQUIREMENTS THAT ADD TO THE GENERAL SPECIFICATIONS. FOR EXAMPLE, SA-178 IS A TUBE SPECIFICATION WHICH, IN ADDITION TO REQUIRING MARKING PER THE DELIVERY SPECIFICATION, SA-450, ALSO REQUIRES 'E.R.W.' TO BE MARKED ON EACH TUBE. THIS MARKING MUST BE PLACED 8 FEET FROM ONE END WHEN THE MARKING IS PLACED ON BY HAND. ANOTHER EXAMPLE IS SA-209 WHICH, IN ADDITION TO REFERENCING SA-450, REQUIRES THE TUBE TO BE MARKED HOT-FINISHED OR COLD-DRAWN.

MARKING REQUIREMENTS SA-450

SA-450 IS THE GENERAL DELIVERY SPECIFICATION FOR TUBING AND CONTAINS MARKING REQUIREMENTS FOR THIS PRODUCT FORM. TUBING MATERIAL MUST CONTAIN:

- MANUFACTURER's NAME OR LOGO
- SPECIFICATION AND GRADE
- X, Y OR Z AFTER THE SPECIFICATION IF THE TUBING IS NOT FULLY A.S.M.E.

THIS IDENTIFICATION MUST BE STAMPED UNLESS THE MATERIAL IS LESS THAN 1 1/4 INCHES IN DIAMETER, THEN, IT MUST BE TAGGED.

UG-94
AUTHORIZED INSPECTOR

THE AUTHORIZED INSPECTOR SHALL INSPECT CODE MATERIAL TO VERIFY THAT IT BEARS THE IDENTIFICATION REQUIRED BY THE APPLICABLE MATERIAL SPECIFICATION.

SA-370 SUMMARY
MECHANICAL TESTING

SA-370 IS THE SPECIFICATION COVERING MECHANICAL TESTING OF STEEL PRODUCTS. IT IS SUMMARIZED AS FOLLOWS:

1. SCOPE: REFERENCES PARTICULAR SPECIFICATIONS FOR TENSION, BEND, HARDNESS AND IMPACT REQUIREMENTS. IT ALSO INDICATES WHICH SUPPLEMENTALS OF SA-20 ARE APPLICABLE FOR THE PARTICULAR PRODUCT FORM. FOR EXAMPLE, FOR TUBULAR PRODUCTS, SUPPLEMENTAL REQUIREMENTS S-5 THROUGH S-9 ARE APPLICABLE.

2. APPLICABLE DOCUMENTS: REFERENCES THE APPLICABLE A.S.T.M. SPECIFICATIONS THAT ARE TO BE USED. FOR EXAMPLE, E-23, NOTCHED BAR IMPACT TESTING OF METALLIC MATERIALS IS REFERENCED.

3. GENERAL PRECAUTIONS: INDICATES SOME OF THE THINGS CAN GO WRONG AND TO BE AWARE OF THESE THINGS.

SA-370 SUMMARY

(CONTINUED)

4. ORIENTATION OF SPECIMEN: INDICATES HOW THE LONGITUDINAL TENSION TEST, TRANSVERSE TENSION TEST, ETC. ARE TO BE MADE.

5. DESCRIPTION: DESCRIBES WHAT A TENSION TEST IS.

6. TEST SPECIMEN PARAMETERS: INDICATES VARIOUS PARAMETERS FOR SPECIFIC PRODUCT FORMS SUCH AS FORGED STEELS CAST STEELS, ETC. IT ALSO INDICATES THE SIZES AND TOLERANCES FOR TENSION TESTS.

7. PLATE TYPE SPECIMEN: DESCRIBES THE TENSION TEST FOR PLATE SPECIMEN.

8. SHEET-TYPE SPECIMEN: DESCRIBES THE TENSION TEST FOR SHEET SPECIMEN.

9. ROUNDED SPECIMEN: DESCRIBES THE TENSION TEST OF ROUNDED MACHINED SPECIMEN.

10. GAGE MARKS: DESCRIBES THE LOCATION OF GAGE MARKS FOR ELONGATION TESTS.

11. TESTING APPARATUS AND OPERATION: DESCRIBES THE LOADING PROCEDURE AND REFERENCES A.S.T.M. E-4. IT ALSO INDICATES THE SPEED OF TESTING OPERATIONS.

SA-370 SUMMARY

(CONTINUED)

12. DEFINITIONS: REFERENCES A.S.T.M. E-6 FOR TENSION TEST DEFINITIONS.

13. DETERMINATION OF TENSILE PROPERTIES: DESCRIBES HOW TO DETERMINE YIELD POINT AND OTHER TENSILE PROPERTIES.

14. DESCRIPTION: DESCRIBES THE BEND TEST.

15. GENERAL: DESCRIBES THE GENERAL REQUIREMENTS FOR HARDNESS TESTING.

16. BRINELL TEST: DESCRIBES THE BRINELL HARDNESS TEST AND PROCEDURAL METHODS.

17. PORTABLE HARDNESS TEST: DESCRIBES PORTABLE TESTERS AND VARIOUS REQUIREMENTS FOR HARDNESS TESTING.

18. ROCKWELL TEST: DESCRIBES THE ROCKWELL HARDNESS TEST AND VARIOUS PROCEDURAL REQUIREMENTS.

19. DESCRIPTION: DESCRIBES CHARPY IMPACT TESTING.

20. TEST SPECIMENS: DESCRIBES THE SIZE OF CHARPY IMPACT TEST SPECIMENS AND THE LOCATION AND ORIENTATION OF THE NOTCH IN THIS SPECIMEN.

SA-370 SUMMARY
(CONTINUED)

21. TESTING APPARATUS AND CONDITIONS: DESCRIBES THE GENERAL CHARACTERISTICS AND CALIBRATION OF THE TEST MACHINE AND TEMPERATURE INDICATING DEVICE.

22. TEST RESULTS: DESCRIBES THE RECORDING AND INTERPRETATION OF TEST RESULTS FOR IMPACT TESTING.

23. ACCEPTANCE CRITERIA: INDICATES THE VARIOUS ACCEPTANCE CRITERIA FOR DETERMINING THE IMPACT STRENGTH REQUIREMENTS OF AN IMPACT TESTED ITEM.

24. SUPPLEMENTAL VARIABLES: GIVES SPECIFIC SUPPLEMENTS APPLICABLE TO VARIOUS PRODUCT FORMS.

SECTION II PART C
WELDING ELECTRODES

SECTION II, PART C COVERS WELDING MATERIALS. SFA-5.1, AS ALL OTHER SPECIFICATIONS, GIVES MARKING REQUIREMENTS. SFA-5.1 STATES THAT PACKAGES SHALL BE MARKED WITH:

- THE A.W.S. SPECIFICATION AND CLASS.
- THE SUPPLIER'S NAME AND DESIGNATION.
- STANDARD SIZE AND NET WEIGHT.
- LOT, CONTROL OR HEAT NUMBER

THE ELECTRODE SHALL BE MARKED WITH THE A.W.S. CLASSIFICATION STAMPED NO MORE THAN 2 1/2" FROM THE GRIP END.

UG-9
WELDING MATERIALS

UG-9 ALLOWS THE USE OF MATERIALS WHETHER IT IS GIVEN IN SECTION VIII, DIVISION 1 OR NOT. IT STATES THAT WELDING MATERIALS DO NOT NEED A MATERIALS TEST REPORT OR CERTIFICATE OF COMPLIANCE PROVIDED:

- THE CONTAINER IS MARKED PER SECTION II REQUIREMENTS, OR
- THE CONTAINER IS MARKED AND TRACEABLE TO THE MATERIALS USED TO QUALIFY THE PROCEDURE.

Table A1
Typical storage and drying conditions for covered arc welding electrodes

AWS Classifications	Storage conditions* Ambient air	Holding ovens	Drying[a]
E6010, E6011	Ambient temperature	Not recommended	Not recommended
E6012, E6013, E6020, E6022, E6027, E7014, E7024	80 ± 20° F (30 ± 10° C) 50 percent max relative humidity	20° F (10° C) to 40° F (20° C) above ambient temperature	275 ± 25° F (135 ± 15° C) 1 hour at temperature
E7015, E7016, E7018, E7028, E7048	80 ± 20° F (30 ± 10° C) 50 percent max relative humidity	50° F (30° C) to 250° F (140° C) above ambient temperature	475 ± 25° F (245 ± 15° C) 2 hours at temperature

a. Because of inherent differences in manufacturer, the suppliers of these electrodes should be consulted for the exact drying conditions.
* After removal from manufacturer's packaging.

MISCELLANEOUS TESTING SECTION VIII, DIVISION 1

IN CERTAIN CASES, SECTION VIII, DIVISION 1 IMPOSES REQUIREMENTS ON MATERIAL TESTING OVER AND ABOVE SECTION II. EXAMPLES ARE:

- UCS-85: IF HEAT TREATING IS NOT PERFORMED BY THE MATERIAL MANUFACTURER, THE FABRICATOR MAY PERFORM IT. IF THE HEAT TREATMENT IS ABOVE THE LOWER TRANSFORMATION, TEST PLATES REPRESENTING THE VESSEL MUST BE TREATED AT LEAST 80% OF THE TIME THAT THE VESSEL WILL BE TREATED. IF THE MATERIAL IS P-1, GRADES 1 OR 2, AND TREATMENT IS BELOW THE LOWER TRANSFORMATION, THIS MAY BE WAIVED.
- UNF-95: IF CATEGORY A OR B JOINTS ARE USED IN A TITANIUM OR ZIRCONIUM VESSEL, BEND TESTS OF EACH SPECIFICATION, GRADE AND THICKNESS MUST BE MADE.
- UHA-52: FOR WELDED VESSELS OF TYPE 405, NON-P.W.H.T.'d, TEST PLATES MUST BE RUN OF EACH MELT USED IN CONSTRUCTION. FOR EACH GRADE.
- UHT-6: CHARPY V-NOTCH TESTS ARE REQUIRED FROM EACH PLATE AS HEAT TREATED.
- UHT-81: HEAT TREATMENT PERFORMED BY THE FABRICATOR MUST BE VERIFIED TO HAVE PRODUCED REQUIRED PROPERTIES. THIS IS DONE BY HEAT TREATING COUPONS SIMULTANEOUSLY WITH THE VESSEL.

UG-84(j)
REJECTION

UG-84(j) STATES "IF THE VESSEL TEST PLATE FAILS TO MEET THE IMPACT REQUIREMENTS, THE WELDS REPRESENTED BY THE PLATE SHALL BE UNACCEPTABLE. REHEAT TREATMENT AND RETESTING ARE PERMITTED.

REPAIRS OF MATERIALS

REPAIRS TO MATERIALS ARE PERMITTED BY VARIOUS PARAGRAPHS IN THE CODE. SOME OF THESE PARAGRAPHS ARE:

- UG-78: STATES THAT THE ACCEPTANCE OF THE A.I. IS REQUIRED.
- UCS-56: GIVES THE P.W.H.T. REQUIREMENTS AND ALTERNATIVES FOR REPAIRS.
- UCI-78: DOES NOT ALLOW WELDED REPAIRS TO CAST IRON MATERIALS.
- UCD-78: DOES NOT ALLOW WELDED REPAIRS TO CAST DUCTILE MATERIALS.

MATERIAL INSPECTIONS
UG-93

UG-93 COVERS WHAT IS NORMALLY REFERRED TO AS "RECEIVING INSPECTION". IT GIVES THE REQUIREMENTS THE MATERIAL MUST MEET PRIOR TO A FABRICATOR USING IT IN A CODE VESSEL. REQUIREMENTS ARE:

- PLATE: AN M.T.R. OR C. of C. AS REQUIRED BY THE SPECIFICATION.
- OTHER PRODUCT FORMS: EACH PIECE MUST BE MARKED WITH THE SPECIFICATION, GRADE, TYPE AND CLASS WHEN THE SPECIFICATION COVERS SUCH MARKING. TUBING MAY BE MARKED BY BUNDLE.

RELATIVE TO THIS PARAGRAPH, THE A.I. MUST:

- EXAMINE THE M.T.R. OR C.of C. AND VERIFY THAT THE MATERIAL MARKING IS COMPATIBLE OR,
- VERIFY THE MATERIAL IS MARKED AS REQUIRED BY THE SPECIFICATION.

THE FABRICATOR MUST ALSO VERIFY THOSE ITEMS DESCRIBED ABOVE, BEFORE THE A.I. BUT, IN ADDITION, HE MUST:

- EXAMINE DIMENSIONS AND,
- FURNISH TEMPLATES TO THE A.I. AS REQUESTED.

MATERIAL IDENTIFICATION
UG-77

UG-77 GIVES REQUIREMENTS FOR MATERIAL CONTROL ONCE THE MATERIAL IS RECEIVED AND ACCEPTED BY THE FABRICATOR. THE FABRICATOR:

- MUST MAINTAIN IDENTIFICATION OF THE MATERIAL UNTIL THE VESSEL IS COMPLETE.
- MAY USE A CODED MARKING IN LIEU OF THE ORIGINAL MARKING. THIS CODED MARKING MUST BE ACCEPTABLE TO THE A i
- TRANSFER ANY MARKING, WHETHER IT IS A CODED MARKING OR THE ORIGINAL WHEN THAT MATERIAL IS DIVIDED OR MACHINED.

MATERIAL TEST REPORT

A MATERIAL TEST REPORT IS A DOCUMENT THAT:

- IS ISSUED BY THE MATERIAL MANUFACTURER.
- REPORTS THE REQUIREMENTS OF THE SPECIFICATION SUCH AS:
  - RESULTS OF TESTS OR EXAMINATIONS
  - ANY REPAIRS TO THE MATERIAL
  - HEAT TREATMENTS PERFORMED
  - SUPPLEMENTARY REQUIREMENTS
  - IDENTIFICATION OF THE MATERIAL

MATERIAL TEST REPORT
UG-93

A MATERIAL TEST REPORT IS REQUIRED PER UG-93 FOR:

- PLATE MATERIAL AS INDICATED IN THE MATERIAL SPECIFICATION,
- SOME MATERIAL SPECIFICATION REQUIREMENTS ARE PERFORMED BY OTHER THAN THE MATERIAL MANUFACTURER,
- TIMES WHEN THE REQUIREMENTS OF SECTION VIII, DIVISION 1 EXCEED OR SUPPLEMENT THE REQUIREMENTS OF THE MATERIAL SPEC-FICATION.

CERTIFICATE OF COMPLIANCE

A CERTIFICATE OF COMPLIANCE IS SIMPLY A WRITTEN STATEMENT ISSUED BY A MATERIAL MANUFACTURER OR SUPPLIER CERTIFYING THAT THE MATERIAL FURNISHED IS IN COMPLIANCE WITH THE MATERIAL SPECIFICATION.

P NUMBERS TO WATCH

IN ADDITION TO ZIRCONIUM, P NUMBER 61 AND TITANIUM, P NUMBERS 51 AND 52, CARE SHOULD BE TAKEN WHEN WELDING NICKEL WHICH HAS A P NUMBER OF 11.

INSPECTION OF WELDS

THE CODE REQUIRES THAT CERTAIN CRITERIA BE MET DURING WELDING OF ITEMS. IN ORDER TO ASSURE THESE CRITERIA ARE MET, INSPECTIONS MUST BE MADE. SOME INSPECTIONS ARE:

- THAT THE MATERIALS ARE ACCEPTABLE TO THE CODE AND MEET THE DESIGN CRITERIA.
- THAT THE FITUP GEOMETRY MEETS THE REQUIREMENTS OF THE W.P.S. AND THAT TACK WELDS ARE ACCEPTABLE.
- THE ROOT PASS SHOULD BE INSPECTED BY WELDING PERSONNEL TO AVOID PROBLEMS LATER IN THE LIFE OF THE JOINT.
- INSPECT BACK-GOUGING TO ASSURE SOUND METAL IS REACHED PRIOR TO WELDING FROM THE SECOND SIDE.
- VISUAL OF THE COMPLETED WELD BOTH INSIDE AND OUT.
- ANY REQUIRED N.D.E.
- THAT ALL APPROPRIATE DOCUMENTATION IS AVAILABLE AND CORRECT.

SECTION VIII
N.D.E.
REQUIREMENTS

UW-51 FULL R.T.

UW-51 GIVES THE REQUIREMENTS FOR FULL R.T.

- PERSONNEL MUST BE QUALIFIED USING SNT-TC-1A AS A GUIDE.
- NO REQUIREMENT FOR A WRITTEN PROCEDURE IS INDICATED.
- ACCEPTANCE CRITERIA.
- RECORD RETENTION NOT REQUIRED.

FULL RADIOGRAPHY ACCEPTANCE CRITERIA

THE ACCEPTANCE CRITERIA FOR FULL R.T. ARE:

- LINEAR INDICATIONS:
  - NO CRACK OR ZONE OF INCOMPLETE FUSION OR PENETRATION.
  - ANY ELONGATED SLAG INCLUSION GREATER THAN:
    - 1/4" FOR t < 3/4"
    - 1/3" FOR t = 3/4" TO 2 1/4" INCLUSIVE
    - 3/4" FOR t > 2 1/4"
  - ANY GROUP OF SLAG INCLUSIONS IN LINE GREATER THAN t IN A 12t LENGTH EXCEPT WHEN THE DISTANCE BETWEEN INCLUSIONS IS GREATER THAN THE 6 TIMES THE LENGTH OF THE LONGEST INCLUSION.
- ACCEPTANCE CRITERIA FOR ROUNDED INDICATIONS ARE FOUND IN APPENDIX 4.

RADIOGRAPHY REQUIREMENTS SECTION VIII, DIVISION 1

WHEN RADIOGRAPHY IS TO BE USED IN BUILDING A CODE VESSEL, INFORMATION MAY BE FOUND IN:

- UW-2: SPECIFIC DESIGNS AND SERVICE RESTRICTIONS.
- UW-9: STAGGERED JOINTS.
- UW-11: DEFINITIONS AND APPLICATIONS.
- UW-12: EFFICIENCY REQUIREMENTS.
- UW-42: REPAIRS AND BUILD-UP.
- UW-51: REQUIREMENTS FOR FULL R.T..
- UW-52: REQUIREMENTS FOR SPOT R.T..

MISCELLANEOUS INFORMATION MAY BE FOUND IN UCS-57, UNF-57, UHA-33, UCL-35 AND 36, UHT-57, ULW-56 AND ULT-57.

TABLE UCS-57

THICKNESS ABOVE WHICH FULL RADIOGRAPHIC EXAMINATION OF BUTT WELDED JOINTS IS MANDATORY

P-No. & Gr. No. Classification of Material	Nominal Thickness Above Which Butt-Welded Joints Shall Be Fully Radiographed, in.
1 Gr. 1, 2, 3	1¼
3 Gr. 1, 2, 3	¾
4 Gr. 1, 2	⅝
5 Gr. 1, 2	0
9A Gr. 1	⅝
9B Gr. 1	⅝
10A Gr. 1	¾
10B Gr. 2	⅝
10C Gr. 1	⅝
10F Gr. 6	¾

UW-52 SPOT R.T.

UW-52 GIVES THE REQUIREMENTS FOR SPOT R.T.

- PERSONNEL MUST BE QUALIFIED USING SNT-TC-1A AS A GUIDE.
- NO REQUIREMENT FOR A WRITTEN PROCEDURE IS INDICATED.
- ACCEPTANCE CRITERIA.
- RECORD RETENTION NOT REQUIRED.

SPOT RADIOGRAPHY ACCEPTANCE CRITERIA

THE ACCEPTANCE CRITERIA FOR SPOT R.T. ARE:

- LINEAR INDICATIONS:
  - NO CRACK OR ZONE OF INCOMPLETE FUSION OR PENETRATION.
  - ANY ELONGATED SLAG INCLUSION GREATER THAN:
    - 2/3t
    - ANY GROUP OF SLAG INCLUSIONS IN LINE GREATER THAN t IN A 6t LENGTH AND THE DISTANCE BETWEEN THE LONGEST INDICATIONS CONSIDERED IS GREATER THAN 3L, WHERE L IS THE LONGEST INCLUSION.
- ROUNDED INDICATIONS:

  ROUNDED INDICATIONS ARE NOT A FACTOR IN SPOT RADIOGRAPHY.

UHA-21 WELDED JOINTS

MATERIAL PARAGRAPHS CAN AFFECT THE N.D.E. OF AN ITEM. FOR EXAMPLE, UHA-21 STATES "WHEN RADIOGRAPHIC EXAMINATION IS REQUIRED FOR BUTT-WELDED JOINTS BY UHA-33, JOINTS OF CATEGORY A AND B (SEE UW-3) SHALL BE OF TYPE NO. (1) OR NO. (2) OF TABLE UW-12".

ULT-57 EXAMINATION

ANOTHER MATERIAL PARAGRAPH THAT AFFECTS THE N.D.E. OF AN ITEM IS ULT-57. IT STATES:

(a) ALL BUTT JOINTS SHALL BE EXAMINED BY 100% RADIOGRAPHY, EXCEPT AS PERMITTED IN UW-11(a)(7).

(b) ALL ATTACHMENT WELDS, AND ALL WELDED JOINTS SUBJECT TO PRESSURE NOT EXAMINED BY RADIOGRAPHY OR ULTRASONIC TESTING, SHALL BE GIVEN A LIQUID PENETRANT EXAMINATION EITHER BEFORE OR AFTER HYDROTEST. RELEVANT INDICATIONS ARE THOSE WHICH RESULT FROM IMPERFECTIONS. ANY RELEVANT LINEAR INDICATION GREATER THAN 1/16 IN. SHALL BE REPAIRED OR REMOVED.

WHEN A PNEUMATIC TEST IS REQUIRED BY ULT-99(b), THESE LIQUID PENETRANT EXAMINATIONS SHALL BE PERFORMED PRIOR TO PNEUMATIC TEST.

P.T. AND M.T.
SECTION VIII, DIVISION 1

WHEN P.T. OR M.T. IS TO BE USED IN BUILDING A CODE VESSEL, INFORMATION MAY BE FOUND IN:

- UW-42: REPAIR OR BUILDUP.
- UW-50: PRIOR TO PNEUMATIC TESTING.
- APP. 6: MAGNETIC PARTICLE.
- APP. 8: LIQUID PENETRANT.

MISCELLANEOUS INFORMATION MAY BE FOUND IN UNF-58, UHA-34, UHT-57 AND 85, ULW-56 AND 57 AND ULT-57.

APPENDIX 8 P.T.

APPENDIX 8 GIVES THE REQUIREMENTS FOR P.T.

- PERSONNEL NEED NOT BE QUALIFIED USING SNT-TC-1A. CERTIFICATION BY THE MANUFACTURER FOR:
  - VISUAL
  - COMPETENCE IN THE P.T. DISCIPLINE
- ACCEPTANCE CRITERIA.
- WRITTEN AND QUALIFIED PROCEDURES ARE REQUIRED PER ARTICLE 6 OF SECTION V.

ULTRASONIC REQUIREMENTS SECTION VIII, DIVISION 1

WHEN ULTRASONIC EXAMINATION IS TO BE USED IN BUILDING A CODE VESSEL, INFORMATION MAY BE FOUND IN:

- UW-11: FINAL CLOSURE SEAMS.
- UW-53: TECHNIQUES.
- APP. 12: TECHNIQUES.

MISCELLANEOUS INFORMATION MAY BE FOUND IN ULW-57 AND ULT-57.

APPENDIX 12 ULTRASONICS

APPENDIX 12 GIVES THE REQUIREMENTS FOR U.T.

- PERSONNEL MUST BE QUALIFIED USING SNT-TC-1A AS A GUIDE.
- A WRITTEN AND QULIFIED PROCEDURE IS REQUIRED.
- ACCEPTANCE CRITERIA.
- RECORD RETENTION REQUIRED FOR 5 YEARS.
- SPECIFIC REQUIREMENTS FOR UNCORRECTED AREAS.

UHA-34 LIQUID PENETRANT EXAMINATION

ANOTHER MATERIAL PARAGRAPH THAT HAS AN INFLUENCE ON N.D.E. OF CODE ITEMS IS UHA-34. IT STATES:

(a) ALL AUSTENITIC CHROMIUM-NICKEL ALLOY STEEL WELDS, BOTH BUTT AND FILLET, IN VESSELS WHOSE SHELL THICKNESS EXCEEDS 3/4 IN., AND ALL 36% NICKEL STEEL WELDS, BOTH BUTT AND FILLET, REGARDLESS OF THICKNESS, SHALL BE EXAMINED FOR THE DETECTION OF CRACKS BY THE LIQUID PENETRANT METHOD. THIS EXAMINATION SHALL BE MADE FOLLOWING HEAT TREATMENT IF HEAT TREATMENT IS PERFORMED. ALL CRACKS SHALL BE ELIMINATED.

APPENDIX 6 M.T.

APPENDIX 6 GIVES THE REQUIREMENTS FOR M.T.

- PERSONNEL NEED NOT BE QUALIFIED USING SNT-TC-1A. CERTIFICATION BY THE MANUFACTURER FOR:
  - VISUAL
  - COMPETENCE IN THE M.T. DISCIPLINE
- ACCEPTANCE CRITERIA.
- WRITTEN AND QUALIFIED PROCEDURES ARE REQUIRED PER ARTICLE 7 OF SECTION V.

REQUIRED N. D. E.

IN SUMMARY, N.D.E. IS REQUIRED BY THE CODE AS FOLLOWS:

- R.T. OF WELDING AS REQUIRED FOR SPECIAL SERVICE OR DESIGN (UW-11, 12, ETC.).
- P.T. OR M.T. PRIOR TO PNEUMATIC TESTING (UW-50).
- P.T. OR M.T. OF REPAIRS OR WELD METAL BUILD-UP (UW- 42).
- VISUAL OF THE PRESSURE TEST (UG-99).

N.D.E. PROCEDURE QUALIFICATIONS

WHEN IT IS REQUIRED TO QUALIFY AN N.D.E. PROCEDURE, THE FOLLOWING PROVIDE THE INFORMATION NEEDED. REMEMBER, AN R.T. PROCEDURE IS NOT REQUIRED FOR SECTION VIII, DIVISION 1. USUALLY, THIS IS A REQUIREMENT OF THE Q. C. MANUAL.

- R.T. PER ARTICLE 2 OF SECTION V.
- M.T. PER APPENDIX 6 OF SECTION VIII.
- P.T. PER APPENDIX 8 OF SECTION VIII.
- U.T. PER APPENDIX 12 OF SECTION VIII.

N.D.E. PERSONNEL QUALIFICATIONS

TO QUALIFY N.D.E. PERSONNEL, REQUIREMENTS MAY BE FOUND IN:

- SNT-TC-1A, AS A GUIDE FOR R.T.
- SNT-TC-1A, AS A GUIDE FOR U.T.
- APPENDIX 6 OF SECTION VIII FOR M.T.
- APPENDIX 8 OF SECTION VIII FOR P.T.

RECERTIFICATION OF N.D.E. PERSONNEL

AN EMPLOYER'S WRITTEN PRACTICE MUST COVER THE RECERTIFICATION OF N.D.E. PERSONNEL. PERSONNEL MUST BE RECERTIFIED:

- EVERY 3 YEARS BY:
  - CONTINUED SATISFACTORY PERFORMANCE
  - RE-EXAMINATION
- WHEN THERE IS REASON TO QUESTION THEIR PERFORMANCE BY EITHER Q.C. PERSONNEL OR THE AUTHORIZED INSPECTOR.
- RE-EMPLOYMENT

NOTE: AN ANNUAL VISION EXAMINATION, INCLUDING A COLOR TEST, IS REQUIRED.

PRESSURE TESTING
STAMPING AND
DATA REPORTS

PRESSURE TESTING

PRESSURE TESTS ARE USED TO DETERMINE STRUCTURAL INTEGRITY. THEIR PURPOSE IS TO DETECT GROSS DEFECTS IN DESIGN AND VESSEL FABRICATION. THERE ARE TWO TYPES OF PRESSURE TESTING GIVEN IN SECTION VIII, DIVISION 1. THEY ARE:

- HYDROSTATIC
- PNEUMATIC

WHAT MUST BE HYDRO TESTED?

ALL SECTION VIII, DIVISION 1 PRESSURE VESSELS MUST BE HYDROSTATICALLY TESTED, EXCEPT THOSE PNEUMATICALLY TESTED. TESTING REQUIREMENTS ARE FOUND IN:

- UG-99 HYDROSTATIC TESTING
- UG-100 PNEUMATIC TESTING
- UG-101 PROOF TESTING

HYDROSTATIC TEST PRESSURE FOR HIGH TEMPERATURE SERVICE

THE STRESS RATIO DISCUSSED EARLIER IS DEPENDANT ON THE TEMPERATURE OF THE MATERIAL DURING OPERATION. FOR EXAMPLE:

- SA-515-70 HAS A STRESS VALUE OF 17.5 K.S.I. FOR TEMPERATURES UP TO 650 F.
- SA-515-70 HAS A STRESS VALUE OF 6.5 K.S.I. AT 900 F.

THEREFORE, IF M.A.W.P. IS TO BE 100 P.S.I. AT 900 F., HYDROSTATIC TEST PRESSURE WOULD BE,

$$1\ 1/2\ (100)\ \frac{17.5}{6.5} = 404\ \text{P.S.I.}$$

HYDROSTATIC TEST PRESSURE SPECIAL CASES

THERE ARE SEVERAL CASES WHERE THE HYDRO-STATIC TEST PRESSURE MAY BE BASED ON:

- HIGHER CALCULATED TEST PRESSURE
- COMBINATION UNITS
- VACUUM SERVICE
- ENAMELED VESSELS
- CAST IRON VESSELS

CALCULATED TEST PRESSURE

FOR THE HIGHER, CALCULATED TEST PRESSURE, THE FORMULA FOR M.A.W.P. WOULD INCLUDE THE THICKNESS OF THE CORROSION ALLOWANCE. HYDROSTATIC PRESSURE WOULD THEN EQUAL:

M.A.W.P.(NEW AND COLD) (1.5) - HYDROSTATIC HEAD

THIS CALCULATED PRESSURE MUST:

- BE CALCULATED USING NEW AND UNCORRODED THICKNESSES.
- NOT BE LESS THAN THE PRESSURE FROM UG- 99 (b).
- NOT OVER-YIELD THE MATERIAL.
- ONLY BE USED WITH THE CONCURRENCE OF USER.

VACUUM SERVICE

FOR VACUUM SERVICE THE TEST MUST BE CONDUCTED USING A PRESSURE DETERMINED AS FOLLOWS:

- 1.5 (14.7 P.S.I.A. - THE VESSEL'S MINIMUM INTERNAL PRESSURE ABSOLUTE).
  - FOR A FULL VACUUM:
    - 1.5 (14.7 P.S.I.A. - 0.0 P.S.I.A.)
  - FOR SOME PARTIAL VACUUM:
    - 1.5 (14.7 P.S.I.A. - 9.7 P.S.I.A.).

COMBINATION UNITS

FOR COMBINATION UNITS, HYDROSTATIC TESTS V ULD BE PERFORMED AS FOLLOWS:

- FOR ADJACENT CHAMBERS THAT WILL OPERATE INDEPENDANTLY:
  - HYDROSTATICALLY TEST EACH UNIT AS A SEPARATE VESSEL.
- FOR ADJACENT CHAMBERS DESIGNED FOR A DIFFERENTIAL PRESSURE, AND THE DIFFERENTIAL PRESSURE IS MORE THAN THE M.A.W.P. FOR EACH UNIT, YOU MUST TEST EACH UNIT USING A PRESSURE CALCULATED AS FOLLOWS:
  - DIFFERENTIAL PRESSURE (1.5) (STRESS RATIO). NOTE: THIS TEST MUST AT LEAST MEET THE PRESSURE OF UG-99(b) OR (c).
- FOR ADJACENT CHAMBERS DESIGNED FOR A DIFFERENTIAL PRESSURE, AND THE DIFFERENTIAL PRESSURE IS LESS THAN THE M.A.W.P. FOR EITHER UNIT, YOU MUST TEST EACH UNIT USING A PRESSURE CALCULATED AS FOLLOWS:
  - DIFFERENTIAL PRESSURE (1.5) (STRESS RATIO). THEN TEST EACH UNIT IN ACCORDANCE WITH UG-99(b) OR (c).

CAST IRON VESSELS

FOR CAST IRON VESSELS, THE TEST MUST BE CONDUCTED USING A PRESSURE DETERMINED AS FOLLOWS:

- FOR M.A.W.P. LESS THAN OR EQUAL TO 30 P.S.I.:
  - 2.5 (M.A.W.P.), IN NO CASE MAY THIS EXCEED 60 P.S.I..
- FOR M.A.W.P. GREATER THAN 30 P.S.I.:
  - 2 (M.A.W.P.)

INSPECTION OF THE HYDROSTATIC TEST

ONCE THE HYDROSTATIC TEST PRESSURE IS REACHED, THE PRESSURE WILL THEN BE REDUCED BY 1/3. AT THAT TIME, AN INSPECTION WILL BE MADE OF ALL WELDS AND CONNECTIONS.

NEVER INSPECT AT FULL TEST PRESSURE.

WITNESSING OF THE HYDROSTATIC TEST

THE HYDROSTATIC TEST MUST BE WITNESSED BY THE AUTHORIZED INSPECTOR. THIS IS REQUIRED IN ALL BUT ONE CASE FOR ANY VESSEL TO BE STAMPED WITH THE "U" SYMBOL STAMP. THE ONE EXCEPTION IS FOR MULTIPLE, DUPLICATE VESSELS BUILT IN ACCORDANCE WITH UG-90(c)(2). THE AUTHORIZED INSPECTOR SHALL WITNESS THE TEST AT 2/3 OF THE TEST PRESSURE. HE SHOULD NOT WITNESS A TEST AT FULL HYDROSTATIC TEST PRESSURE.

PNEUMATIC TEST SECTION VIII, DIVISION 1

A PNEUMATIC TEST MAY BE SUBSTITUTED FOR A REQUIRED HYDROSTATIC TEST IF:

- THE VESSEL WAS NOT DESIGNED TO SUPPORT THE WEIGHT OF A LIQUID OR,
- THE TESTING MEDIUM WILL BE HARMFUL TO THE OPERATING SUBSTANCE AND,
- ALL WELDS AROUND OPENINGS OR CONNECTIONS WITH A THROAT DIMENSION GREATER THAN 1/ 4" WILL BE P.T.'d OR M.T.'t PRIOR TO THE TEST.

MINIMUM PNEUMATIC TEST PRESSURE

THE PNEUMATIC TEST PRESSURE IS DETERMINED BY THE FORMULA:

$$P = (M.A.W.P.)(1.25)(\text{LOWEST STRESS RATIO})$$

WHERE: M.A.W.P. IS THAT STAMPED ON THE VESSEL AND,

$$\text{STRESS RATIO} = \frac{Sa \text{ AT TEST TEMP.}}{Sa \text{ AT DESIGN TEMP.}}$$

PNEUMATIC TEST PROCEDURE

PNEUMATIC TESTING SHALL BE PERFORMED IN ACCORDANCE WITH UG-100(d). IT STATES "THE PRESSURE IN THE VESSEL SHALL BE GRADUALLY INCREASED TO NOT MORE THAN ONE-HALF OF THE TEST PRESSURE. THEREAFTER, THE TEST PRESSURE SHALL BE INCREASED IN STEPS OF APPROXIMATELY ONE-TENTH OF THE TEST PRESSURE UNTIL THE REQUIRED TEST PRESSURE HAS BEEN REACHED.

INSPECTION OF THE PNEUMATIC TEST

ONCE THE PNEUMATIC TEST PRESSURE IS REACHED, THE PRESSURE WILL THEN BE REDUCED BY 1/5. AT THAT TIME, AN INSPECTION WILL BE MADE OF ALL WELDS AND CONNECTIONS.

NEVER INSPECT AT FULL TEST PRESSURE.

WITNESSING OF THE PNEUMATIC TEST

THE PNEUMATIC TEST MUST BE WITNESSED BY THE AUTHORIZED INSPECTOR. THIS IS REQUIRED IN ALL BUT ONE CASE FOR ANY VESSEL TO BE STAMPED WITH THE "U" SYMBOL STAMP. THE ONE EXCEPTION IS FOR MULTIPLE, DUPLICATE VESSELS BUILT IN ACCORDANCE WITH UG-90(c)(2). THE AUTHORIZED INSPECTOR SHALL WITNESS THE TEST AT 4/5 OF THE TEST PRESSURE. HE SHOULD NOT WITNESS A TEST AT THE PNEUMATIC TEST PRESSURE.

TEST GAUGES
UG-102

UG-102 COVERS TEST GAUGES. IT STATES THAT GAUGES MUST BE:

- CONNECTED DIRECTLY TO THE VESSEL.
- VISIBLE TO THE OPERATOR.
- GRADUATED TO A RANGE ABOUT DOUBLE THAT OF THE TEST PRESSURE BUT, IN NO CASE, LESS THAN 1 1/2 NOR MORE THAN 4 TIMES THAT PRESSURE.
- CALIBRATED AGAINST A DEAD-WEIGHT TESTER OR A CALIBRATED MASTER GAUGE.
- CALIBRATED WHENEVER ERROR IS SUSPECTED. THERE IS NO ESTABLISHED FREQUENCY IN THE CODE FOR GAUGE CALIBRATION. THIS IS USUALLY COVERED IN A Q. C. SYSTEM.

STAMPING
DIRECTLY ON THE VESSEL

WHEN CODE STAMPING IS APPLIED DIRECTLY ON THE VESSEL, STAMPING MUST:

- BE DONE USING LETTERS AND FIGURES AT LEAST 5/16" HIGH.
- BE ARRANGED PER FIGURE UG-116 WHERE SPACE PERMITS.

STAMPING ON A NAMEPLATE

WHEN CODE STAMPING IS APPLIED TO A NAMEPLATE, THE STAMPING MUST COMPLY WITH THE FOLLOWING:

- IT IS ARRANGED PER UG-118.
- THE CODE SYMBOL AND MANUFACTURER'S SERIAL NUMBER MUST BE STAMPED.
- LETTERS AND FIGURES MUST BE AT LEAST 5/32" HIGH.
- THE NAMEPLATE MUST BE ATTACHED IN A CONSPICUOUS PLACE.
- THE SYMBOL MAY BE STAMPED PRIOR TO ATTACHMENT TO THE VESSEL HOWEVER, THE PROCEDURE MUST BE ACCEPTED BY THE A.I..
- THE A.I. DOES NOT HAVE TO WITNESS THE STAMPING OF THE CODE SYMBOL HOWEVER, HE MUST VERIFY THAT THE NAMEPLATE IS ATTACHED TO THE PROPER VESSEL.

REQUIRED NAMEPLATES

A NAMEPLATE IS REQUIRED ON:

- FERROUS VESSELS LESS THAN 1/4" THICK.
- NON-FERROUS VESSELS LESS THAN 1/2" THICK.

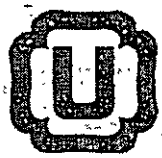
NOTE: A NAMEPLATE MAY BE USED AS AN OPTION ANYTIME, WHETHER REQUIRED OR NOT.

MODE OF INSPECTION

SECTION VIII, DIVISION 1 RECOGNIZES TWO TYPES OF AUTHORIZED INSPECTION. ONE IS BY THE AUTHORIZED INSPECTOR AND THE OTHER IS BY THE OWNER-USER INSPECTOR. THE STAMPING WOULD APPEAR AS FOLLOWS:

USER

USER INSPECTED SYMBOL



AUTHORIZED INSPECTION

TYPE OF CONSTRUCTION

THE TYPE OF CONSTRUCTION, I.E. WELDED, BRAZED, ETC., MUST BE INDICATED ON THE NAMEPLATE UNDER THE "U" SYMBOL. THE TYPES OF CONSTRUCTION AND THEIR SYMBOLS ARE AS FOLLOWS:

- ARC/GAS WELDED W
- BRAZED B
- FORGE WELDED F
- RESISTANCE WELDED RES

W

SPECIAL SERVICE

IF A SPECIAL SERVICE IS REQUIRED, IT MUST BE INDICATED ON THE NAMEPLATE UNDER THE "U" SYMBOL. THE SPECIAL SERVICES AND THEIR SYMBOLS ARE AS FOLLOWS:

- LETHAL — L
- UNFIRED STEAM BOILER — UB
- DIRECT FIRED VESSEL — DF

W

L

DEGREE OF RADIOGRAPHY

THE DEGREE OR AMOUNT OF RADIOGRAPHY MUST BE INDICATED ON THE NAMEPLATE UNDER THE "U" SYMBOL. THE DEGREE OF R.T. AND THE SYMBOLS ARE AS FOLLOWS:

- FULL — RT-1
- UW-11(a)(5)(b) — RT-2
- SPOT — RT-3
- DOES NOT COMPLY WITH RT-1, 2 OR 3 HOWEVER, NONE IS NOT RT-4 — RT-4

W

L

RT-1

POSTWELD HEAT TREATMENT

THE AMOUNT OF POSTWELD HEAT TREATMENT MUST BE INDICATED ON THE NAMEPLATE UNDER THE "U" SYMBOL. THE SYMBOLS ARE AS FOLLOWS:

- ENTIRE VESSEL H.T.
- PART OF VESSEL P.H.T.

W

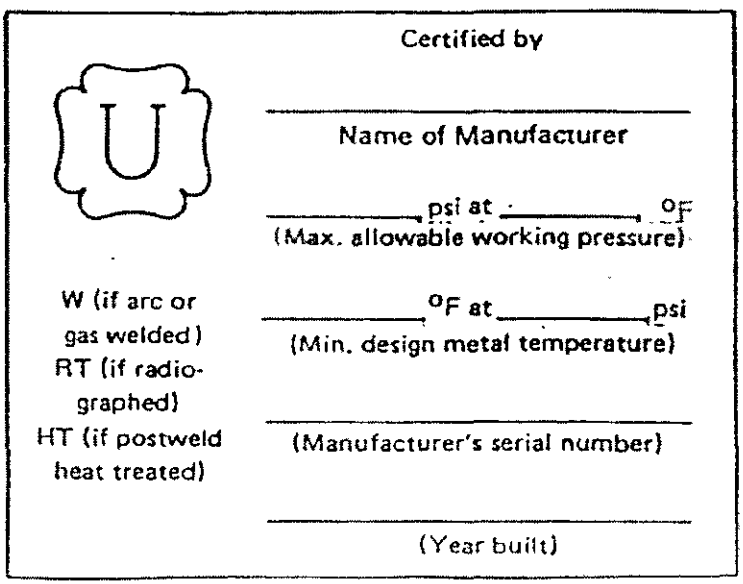
L

RT-1

H.T.

CODE NAMEPLATE
UG-118

THE ARRANGEMENT OF THE INFORMATION ON A CODE NAMEPLATE IS SHOWN IN FIGURE UG-118.



PARTS OF VESSELS

WHEN ONLY PART OF A VESSEL IS SUPPLIED BY MANUFACTURER, THE WORD PART MUST APPEAR UNDER THE "U" SYMBOL STAMP. UG-116(h) GOES ON TO STATE THAT THE MANUFACTURER'S NAME, PRECEDED BY THE WORDS "CERTIFIED BY", AND SERIAL NUMBER MUST APPEAR ON THE NAME-PLATE.

REMOVABLE PARTS

UG-116(I) STATES "REMOVABLE PRESSURE PARTS SHALL BE PERMANENTLY MARKED IN A MANNER TO IDENTIFY THEM WITH THE VESSEL OR CHAMBER OF WHICH THEY FORM A PART. THIS DOES NOT APPLY TO MANHOLE COVER, HANDHOLE COVERS AND THEIR ACCESSORY PARTS PROVIDED THE MARKING REQUIREMENTS OF UG-11 ARE MET".

MINIATURE VESSELS

HE REQUIREMENTS FOR MINIATURE VESSELS ARE FOUND IN U-2(j). IT STATES THAT VESSELS MEETING THE CRITERIA GIVEN MAY BE BUILT WITHOUT INSPECTIONS BY AN A.I.. TO BUILD THESE VESSELS A FABRICATOR MUST HOLD THE "U" OR "S" STAMP. THE CRITERIA ARE:

- FULL R.T. IS NOT REQUIRED.
- QUICK ACTUATING CLOSURES MAY NOT BE USED.
- IT MUST BE 5 CU. FT. AND 250 P.S.I OR LESS OR,
- 1.5 CU. FT. AND 600 P.S.I. OR LESS.

THESE VESSELS MUST COMPLY WITH ALL OF THE RULES OF THE CODE WITH THE EXCEPTION OF INSPECTION BY AN A.I.. SOME JURISDICTIONS WILL NOT ACCEPT THESE TYPES OF VESSELS.

UG-90(c)(2) VESSELS

THE VESSELS COVERED BY THIS PARAGRAPH ARE IDENTICAL, MASS-PRODUCED VESSELS. THE A.I. IS NOT INVOLVED IN ALL INSPECTIONS. THE MANUFACTURER'S PERSONNEL PERFORM SOME OF .HE INSPECTOR'S DUTIES. THE MANUAL MUST BE ACCEPTABLE TO THE AGENCY, THE JURISDICTION AND AN A.S.M.E. DESIGNEE. ANY REVISIONS ARE SUBJECT TO THE APPROVAL OF THESE OR-

RENEWAL OF CODE SYMBOL STAMPS

CODE SYMBOL STAMPS ARE NORMALLY RENEWED EVERY THREE YEARS. THE RENEWAL IS BASED ON A JOINT REVIEW PERFORMED BY THE AGENCY AND AN A.S.M.E. DESIGNEE. AN EXCEPTION TO THE TRIENNIAL REVIEW IS THE UM CERTIFICATE. IT IS RENEWED ANNUALLY BASED ON A JOINT REVIEW THE FIRST ISSUE AND AN AUDIT BY THE AGENCY FOR THE TWO FOLLOWING YEARS. THE CYCLE THEN STARTS AGAIN.

MANUFACTURER'S DATA REPORTS

THE DATA REPORTS USED TO DOCUMENT CODE COMPLIANCE ARE:

- U-1 BASIC DATA REPORT FOR VESSELS.
- U-1A ALTERNATIVE REPORT FOR SINGLE CHAMBERED, SHOP FABRICATED VESSELS ONLY.
- U-2 PARTIAL DATA REPORT FOR PARTS.
- U-2A ALTERNATIVE PARTIAL DATA REPORT.
- U-3 CERTIFICATE OF COMPLIANCE FOR UM VESSELS.
- U-4 SUPPLEMENTARY SHEET