

BI-NT – NONDESTRUCTIVE TESTING (ALL TASKS)

References:

- [Subchapter D](#)
- [Subchapter F](#)
- [Inland Barge Repair Guide \(guidance\)](#)
- [NVIC 7-68 Steel Vessel Repair \(guidance\)](#)

- [ABS Rules for Building and Classing Steel Vessels: Steel Vessel Rules](#)
- Part 1: Conditions of Classification
- Part 2: Materials and Welding
- Part 3: Hull Construction and Equipment
- Part 4: Vessel Systems and Machinery
- Part 5: Specific Vessel Types
- Part 6: Specialized Items and Systems
- Part 7: Survey After Construction

- [ABS Nondestructive Inspection of Hull Welds: ABS NDT Guide](#)
- Section 1: General
- Section 2: Radiographic
- Section 3: Ultrasonic
- Section 4: Liquid Penetrant
- Section 5: Magnetic Particle
- Section 6: Alternating Current Field Measurement Technique
- Section 7: Eddy Current
- Section 8: Acceptance Criteria for Hull Welds

Nearly all NT tasks will begin with Sub “D” and proceed until we get to the [ABS NDT Guide](#). The typical cite paths are listed below:

- 46 CFR 31.10-1 (Subchapter D)
 - Kicks to [ABS Steel Vessel Rules](#)
 - ABS Steel Vessel Rules 2-4-1/5.17 (p. 272)
 - Kicks to [ABS NDT Guide](#)
- 46 CFR 31.30-1 (Subchapter D)
 - Kicks to [Subchapter F: Marine Engineering](#)
- 46 CFR 32.60-1 (Subchapter D)
 - “Built to ABS standards”

See also:

- SSC-177 "Guide for Interpretation of NDT of Welds in Ship Hull Structures" prepared by the Ship Structures Committee (great resource for understanding some weld and NDT basics)

- ASME Boiler and Pressure Vessel Code
 - ASME VII: Rules for Construction of Pressure Vessels
 - ASME IX: Welding, Brazing and Fusing Qualifications

FIND ALL REFERENCES AND GUIDANCE LISTED ABOVE HERE: <https://marineinspector.org/forum/barge/barge-references/>

Definitions:

- NDT LEVEL I
 - NDT LEVEL II
 - NDT LEVEL III
 - NDT TRAINEE
 - VISUAL INSPECTION (VT)
 - RADIOGRAPHY (RT)
 - ULTRASONIC (UT)
 - MAGNETIC PARTICLE (MT)
 - LIQUID PENETRANT (PT)
 - MAWP
 - TEST PRESSURE
 - CLASS I, II, I-L, II-L PIPING
-

BI-NT01: Liquid Dye Penetrant (PT)

- NDT Level: Anyone may administer; results interpreted by Marine Inspector or Surveyor
 - Follow manufacturers instruction
 - 40°-125° temps, colder temps require more dwell time
 - Primarily for surface imperfections
 - Parts / procedure
 - Cleaner
 - Not always included, but surface should be prepped by cleaning
 - Penetrant
 - 5 minute minimum dwell time
 - Double the dwell time between 40°-50°
 - Wipe away, do not use solvents to remove
 - Developer
 - Applied ASAP after penetrant is wiped clean
 - 10 minute minimum, 60 minute max developing time
 - *ABS Steel Vessel Rules 2-4-1/5.17*: Magnetic-particle or dye-penetrant inspection or other approved methods are to be used when investigating the *outer surface* of welds or may be used as a check of *intermediate weld passes* such as root passes and also to check back-gouged *joints* prior to depositing subsequent passes. *Surface inspection* of important tee or corner joints in critical locations, using an approved magnetic particle or dye penetrant method, is to be conducted to the satisfaction of the Surveyor.
-

BI-NT02: Magnetic Particle (MT)

- Personnel Required: NDT **Level II** must be present to supervise test, interpret data, and evaluate indications
 - Electromagnetic and solid magnet variants (10lb / 40lb test)
 - Tests and calibrations are conducted at beginning and end of each *test day*
 - *ABS Steel Vessel Rules 2-4-1/5.17*: Magnetic-particle or dye-penetrant inspection or other approved methods are to be used when investigating the *outer surface* of welds or may be used as a check of *intermediate weld passes* such as root passes and also to check back-gouged *joints* prior to depositing subsequent passes. *Surface inspection* of important tee or corner joints in critical locations, using an approved magnetic particle or dye penetrant method, is to be conducted to the satisfaction of the Surveyor.
-

BI-NT03: Radiography (RT)

- Personnel Required: NDT **Level II** must be present to supervise test, interpret data, and evaluate indications
 - Gamma Ray or X-Ray radiation
 - Film must be marked with hull number or details of vessel and exact locations of NDT areas
 - Repaired weld films must be marked with an “R”
 - Note that there are minimum quality standards as well as Image Quality Indicators (IQI)
 - See ABS NDT Guide 2.9 (p. 13) for report requirements to include vessel, location of NDT, materials, radiation source, settings and evaluation
-

BI-NT04: Ultrasonic (UT)

- Personnel Required: NDT **Level II** must be present to supervise test, interpret data, and evaluate indications
 - Used for welds as well as gaging thickness of material
 - Initial UT demonstrations may require supplemental testing in the form of RT or other NDT to ensure accuracy
 - Surveyors discretion to require supplementary NDT if UT does not suffice
 - UT transducers
 - Must be calibrated to IIW block (International Institute of Welding)
 - Block must be same material / heat treatment as what is being tested
 - Must be recalibrated at change of examiner or at 4 hours of continuous use
 - Qualified every 3 months for linearity by master transducer; benchmark unit not used in field
 - Straight beam
 - Angle beam
 - Couplant is the gel between transducer and material tested
 - PAUT – Phased Array UT
 - Multiple transducers producing an array of phases to detect anomaly
 - TOFD – Time Of Flight Diffraction
 - Two transducers angled to work in tandem measuring reflection from one to the other
-

BI-NT05: Hydrostatic (pressure vessels)

No ABS NDT Guide here, Pressure Vessels are all CFR with the ASME Boiler & Pressure Vessel Code incorporated by reference. Sub "F" contains the majority of what we need.

- All PVs shall be:
 - Visually examined prior to installation
 - Subject to periodic inspection, every 5 years minimum
 - External examination
 - Internal examination if possible
 - Hydrostatically tested at 125% MAWP
 - Twice in 5, but no less than 3 years between
 - Exemptions include satisfactory internal visual inspection
 - Hydrostatically tested for cause at 150% MAWP
 - U1A Certificate details all aspects of build / ratings (see attached)
 - Sufficient time to hydrostatically test all components in system
-

BI-NT06: Hydrostatic (piping systems)

- Hydrostatic testing required prior to placing in service a piping system, except
 - Systems that cannot be safely filled with water
 - Systems that cannot tolerate the testing medium; whenever possible have subsystems or sections hydro'd individually before installation into the overall system
 - 150% MAWP, but no greater than 90% of yield strength during hydrostatic test of piping
 - 200% / 90% for non-standard piping components (manifolds, welded valves, non-standard connections)
 - Do not exceed the max TEST PRESSURE of any component in system (pumps, seals, manifolds, etc)
 - Ten minute examination period minimum
 - Water is the only accepted medium, unless otherwise approved by COMDT
 - Piping classes I-II based on pressure & temp. "L" designation for low temperature
 - Valves must be examined, what about hydro test pressure If MI chooses to require it?
 - 46CFR 56.20-9(c)
 - Valves must be designed for the maximum pressure to which they may be subjected, but in no case shall the design pressure be less than 50 psi
 - Sea Valves / Skin Valves? See ABS 4: Vessel Systems and Machinery
 - ABS 4.6.2 (p. 458)
 - New valves requires hydro at 72.5 psi minimum
-

BI-NT07: Hydrostatic (tanks & bulkheads)

- ABS 3: Hull Construction and Equipment: Ch. 7 Testing, Trials and Surveys During Construction - Hull
 -
-

BI-NT08: Pneumatic (pressure vessels)

- 110% MAWP maximum

- Proposals submitted to OCMI for approval
- Process
 - Gradually increase to 50%
 - Increase in steps of 10%
 - Reduce back to MAWP for inspection
 - Leak test

BI-NT09: Pneumatic (piping systems)

- Non flammable gas as medium
- Temperature of medium must be acceptable for piping
- Components of system may need to be isolated, disconnected or blanked
- 120% minimum; 125% maximum MAWP for test pressure
 - Relief valve setting can define the MAWP
- 10 minutes minimum
- Process
 - Gradually increase to 50%
 - Increase in steps of 10%
 - Reduce back to MAWP for inspection
 - Leak test

BI-NT10: Pneumatic (tanks & bulkheads)

- ABS 3: Hull Construction and Equipment: Ch. 7 Testing, Trials and Surveys During Construction - Hull
 - 2.2psi max (believe it or not, that's quite a lot of pressure on a void)
 - U-tube / manometer used to measure pressure and monitor drop if present
 - Soap up areas of concern / repairs on outside

BI-NT11: Hose Test

- ABS 3: Hull Construction and Equipment: Ch. 7 Testing, Trials and Surveys During Construction - Hull
 - Laminar (smooth) flow, no pressure washers
 - 30psi
 - .5" inner diameter hose
 - 5' distance max

BI-NT12: Vacuum Box

- ABS 3: Hull Construction and Equipment: Ch. 7 Testing, Trials and Surveys During Construction - Hull
 - Venturi effect, compressed air passes by a valve that then pulls a vacuum (negative psi) on the inside of the box
 - 2.9-3.8psi of negative pressure inside
 - Make sure it sticks and develops a full seal
-

Additional References:

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS ④ 639592
(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by Foremost Universal L.P, 6614-50th Ave, Lloydminster AB, T9V 2W8, CANADA
(Name and address of Manufacturer)

2. Manufactured for Foremost Stettler, 5221-46th Str, Stettler AB, T0C 2L0, Canada
(Name and address of Purchaser)

3. Location of installation Built For Stock
(Name and address)

4. Type Vertical 032041-1 K6566.123 EDS-6150 Rev 1 N/A 2014
(Horizontal or vertical, tank) (Manufacturer's serial number) (CRN) (Drawing number) (National Board number) (Year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2010
Year

to July 1st 2011 N/A N/A
[Addenda, if applicable (date)] (Code Case numbers) [Special Service per UG-120(d)]

6. Shell SA-516-70N 31.8 mm 3.2 mm 698 mm 3048 mm S/S
(Material spec. number, grade) (Nominal thickness) (Corr. allow.) (Inner diameter) (Length (overall))

7. Seams Type 1 Full 1.0 607°C 1.25 Type 1 Full 1.0 1
[Long (welded, dbl., singl., lap, butt)] [R.T. (spot or full)] (Eff. %) (H.T. temp.) (Time, hr) [Girth (welded, dbl., singl., lap, butt)] [R.T. (spot or full)] (Eff. %) (No. of Courses)

8. Heads: (a) Material SA-516-70N (b) Material SA-516-70N
(Spec. no., grade) (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	Top	41.3 mm	3.2 mm	-	-	2:1 S.E.	-	-	-	Concave
(b)	Bottom	30.2 mm	3.2 mm	-	-	2:1 S.E.	-	-	-	Concave

If removable, bolts used (describe other fastenings) N/A
(Material spec. number, grade, size, number)

9. MAWP 9928 kPa N/A at max. temp. 54°C N/A
(Internal) (External) (Internal) (External)
 Min. design metal temp. -29°C at 9928 kPa Hydro, pneu., or comb. test pressure 14892 kPag
 Proof Test N/A

10. Nozzles, inspection, and safety valve openings:

Purpose (Inlet, Outlet, Drain etc.)	No.	Diameter or Size	Type	Material		Nozzle Thickness		Reinforcement Material	Attachment Details		Location (Insp. Open)
				Nozzle	Flange	Nom.	Corr.		Nozzle *	Flange **	
Inlet c/w Deflector	1	NPS 6	RFWN CL 600	SA-106-B	SA-105N	21.9	3.2	SA-516-70N	(c)	(6)	
Outlet	1	NPS 6	RFWN CL 600	SA-106-B	SA-105N	21.9	3.2	N/A	(a)	(6)	
Drain	1	NPS 2	RFWN CL 600	SA-106-B	SA-105N	8.7	3.2	N/A	(a)	(6)	
Inspection	2	NPS 3	RFWN CL 600	SA-106-B	SA-105N	11.1	3.2	SA-516-70N	(a-1)	(6)	Shell
PSV / HLSD / LC / Dump	6	NPS 2	TOL	SA-105N	N/A	CL.6000	3.2	N/A	(a)	N/A	
LG / TI	5	NPS 3/4	TOL	SA-105N	N/A	CL.6000	3.2	N/A	(a)	N/A	
PI	1	NPS 1/2	TOL	SA-105N	N/A	CL.6000	3.2	N/A	(a)	N/A	

11. Supports: Skirt Yes Lugs N/A Legs N/A Other N/A Attached Attached Welded To Bottom Welded To Bottom
(Yes or no) (Number) (Number) (Describe) (Where and how)

12. Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report:
(Name of part, item number, Manufacturer's name and identifying stamp)

(1) Impact testing not required for the following: - Shell and Heads as per UCS-66(b)(1)(a); - Flanges as per UCS-66(c); - All other components as per UG-20(f)(1-5). (2) Foremost WO# 032041. (3) Construction DWG: V-032041-D201 Rev 0. (4) PSV supplied and installed by others. (5) Capacity 1.32 m³. (6) * As per Fig UW-16.1 ** As per Fig 2-4. (7) All measurements are in mm unless otherwise noted.

CERTIFICATE OF SHOP/FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. "U" Certificate of Authorization Number 29,239 expires Sep 15, 2016
 Date JUN 03 2014 Co. Name FOREMOST UNIVERSAL LP Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP/FIELD INSPECTION

Vessel constructed by FOREMOST UNIVERSAL LP at 6614-50th Ave, Lloydminster AB, T9V 2W8, Canada
 I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the State or Province of Alberta and employed by ABSA
 have inspected the component described in this Manufacturer's Data Report on JUN 03 2014, and state that,
 to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1. By signing this certificate neither the Inspector nor his/her employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his/her employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.
 Date JUN 03 2014 Signed [Signature] Commissions AB 311 NB 13490 A
(Authorized Inspector) (National Board (incl. endorsements), State, Province and number)

§ 56.04-2 Piping classification according to service.

The designation of classes according to service is found in Table 56.04-2.

TABLE 56.04-2—PRESSURE PIPING CLASSIFICATION

Service	Class ¹	Pressure (p.s.i.g.)		Temp. (°F)
Class B and C poisons ²	I	any	and	0 and above.
	I-L	any	and	below 0.
	II	(³)	(³)	(³)
Gases and vapors ²	II-L	(³)	(³)	(³)
	I	above 150	or	above 650.
	I-L	above 150	and	below 0.
Liquefied flammable gases ²	II	150 and below	and	0 to 650.
	II-L	150 and below	and	below 0.
	I	above 150	and	0 and above. ¹
Molten sulphur	I-L	above 150	and	below 0.
	II	150 and below	and	0 and above.
	II-L	150 and below	and	below 0.
Cargo liquids Grades A through D ²	I	above 225	or	above 330.
	I-L	above 225	and	330 and below.
	II	225 and below	and	above 150.
Cargo liquids Grade E	II-L	225 and below	and	below 0.
	I	above 225	or	above 400.
	I-L	above 225	and	below 0.
Water	II	225 and below	and	0 to 400.
	II-L	225 and below	and	below 0.
	I	above 225	or	above 350.
Fuels (Bunker, diesel, gasoline, etc.)	II	225 and below	and	350 and below.
	I	above 150	or	above 150.
	II	150 and below	and	150 and below.
Lubricating oil	I	above 225	or	above 400.
	II	225 and below	and	400 and below.
	I	above 225	or	above 400.
Asphalt	II	225 and below	and	400 and below.
	I	above 225	or	above 400.
	II	225 and below	and	400 and below.
Heat transfer oil	I	above 225	or	above 400.

Service	Class ¹	Pressure (p.s.i.g.)		Temp. (°F)
Hydraulic fluid	II	225 and below	and	400 and below.
	I	above 225	or	above 400.
	II	225 and below	and	400 and below.

Flammable or combustible dangerous cargoes. Refer to specific requirements of part 40 of this chapter.
Other dangerous cargoes. Refer to specific requirements of part 98 of this chapter.

¹ Where doubt exists as to proper classification, refer to the Commandant for resolution.
² For definitions, see 46 CFR parts 30, 151, and 154. Note that the category "B and C" poisons is not used in the rules applying to self-propelled vessels (46 CFR part 153).
³ Not permitted except inside cargo tanks approved for Class B and C poisons.

3.3.2

The definition of each test type is as follows:

<i>Hydrostatic Test:</i> (Leak and Structural)	A test wherein a space is filled with a liquid to a specified head.
<i>Hydropneumatic Test:</i> (Leak and Structural)	A test combining a hydrostatic test and an air test, wherein a space is partially filled with a liquid and pressurized with air.
<i>Hose Test:</i> (Leak)	A test to verify the tightness of a joint by a jet of water with the joint visible from the opposite side.
<i>Air Test:</i> (Leak)	A test to verify tightness by means of air pressure differential and leak indicating solution. It includes tank air test and joint air tests, such as <i>compressed air fillet weld tests</i> and <i>vacuum box tests</i> .
<i>Compressed Air Fillet Weld Test:</i> (Leak)	An air test of fillet welded tee joints wherein leak indicating solution is applied on fillet welds.
<i>Vacuum Box Test:</i> (Leak)	A box over a joint with leak indicating solution applied on the welds. A vacuum is created inside the box to detect any leaks.
<i>Ultrasonic Test:</i> (Leak)	A test to verify the tightness of the sealing of closing devices such as hatch covers by means of ultrasonic detection techniques.
<i>Penetration Test:</i> (Leak)	A test to verify that no visual dye penetrant indications of potential continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids (i.e., dye penetrant test).