



WILLBROS GOVERNMENT SERVICES (U.S.), LLC

A WILLBROS COMPANY

PRESSURE TEST PROCEDURE NDT-3

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Rev	Description	Reviewed	Approved
0	Approved	IQC	DG
1	General	IQC	DG
2	General	IQC	DG
3	General	IQC	DG
4	General	IQC	DG
5	General	IQC	DG
6	General	IQC	TDA
7	General	IQC	RGG
8	General	IQC	RGG
9	General	IQC	RGG

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HYDROSTATIC TEST PROCEDURE

I. SCOPE:

This procedure is to insure that all the requirements of the applicable sections of the ASME Code are met and to insure the safety of all personnel which are involved in performing the hydrostatic test.

II. RESPONSIBILITIES:

The Site Manager or Field Superintendent is responsible for the safe performance of the hydrostatic test. Only trained personnel, aware of these procedural steps, shall be used to conduct the test.

The Quality Control Manager or his designee is responsible for witnessing and documenting the results of the hydrostatic test and assuring that it is performed safely in accordance with this procedure.

For hydrostatic tests performed to meet ASME Code requirements, the Quality Control Manager or his designee is responsible for notifying the Authorized Inspector in advance of the test so that he may be present.

NOTE: The Authorized Inspector must witness and accept all hydrostatic test performed to meet Code requirements.

III. REQUIREMENTS:

All welds shall be satisfactorily completed and the vessel and or piping released by Quality Control for hydrostatic testing.

NOTE: All fabrication shall have been completed, except for operations which cannot be performed prior to the test such as weld end preparation, seal welding of vent plugs or cosmetic grinding on the base material which does not affect the required thickness. All examinations shall have been performed, except those required after the test.

IV. PROCEDURE:

- 1.0 The hydrostatic test pressure will be 162 PSI. This number is based on the maximum pressure a tank full of water will produce on the piping. The formula $PSI_{max} = 1.5((0.433 \times Sp \text{ Gr})(H))$ was used to determine the final pressure. The height was assumed at 250 ft and the Specific Gravity at 1. $162 = 1.5((0.433 \times 1)(250))$.

- 2.0 Flanges and nozzles which are not utilized during the hydrostatic test shall be blanked and plugged using material approved for the job or standard approved material in the hydrostatic test area.
- 2.1 Material (blinds, threaded plugs, bolting, etc.) shall be compatible for the design pressure of the vessel and or piping and for use with the specified test pressure. Only material in good physical condition shall be used.
- 2.2 Material used for welded closures shall be as specified on the vessel/piping drawing and identified by "P" number or by material specification.
- 2.3 Welded connections made to temporary closures shall have the minimum weld sizes as specified on the vessel/piping drawing.
- 2.4 Any additional NDE specified on the drawing for welded temporary closure shall be performed and any necessary repairs made.
- 2.5 These connections must be visually inspected for verification of proper material, preparation, welding, threading, or bolting as specified on the vessel/piping drawing.
- 2.6 The design and capacity of test plugs will be verified by Supervision and Quality Control. The plugs will be secured by chain or other means to assure containment if they slip.
- 2.7 Visual inspection by Quality Control of all closures is required before pressure application.
- 3.0 Hydro Trees will be engineered and constructed to WGS Engineering specifications or better. All Hydro Trees will be marked with their rated capacity. Temporary drains and vents will use the same or higher schedule pipe as the Hydro Tree.
- 4.0 The testing medium shall be clear city tap water with less than 50 ppm Chloride content unless otherwise specified in the vessel/piping design specifications. This report will include the latest city water quality report. Other liquid mediums may be used if there is a danger of freezing or water would cause adverse effects on the vessel/piping. After testing is completed, the water will be drained into totes for disposal off-site.
- 5.0 A calibrated gauge shall be selected with a dial range of at least 1 1/2 times and not more than 4 times the hydrostatic test pressure. The increments between graduations will be 1 psig or less such that the Quality Control Inspector and the operator controlling the test shall be able to determine when the required test pressure has been applied.

- 5.1 Digital reading pressure gauges having a wider range of pressure may be used provided the readings give the same or greater degree of accuracy as obtained with dial pressure gauges.
- 5.2 The indicating gauge shall be mounted inside the tank and directly to the piping as near as practical on the top most part undergoing the hydrostatic test. Hydrostatic head on the gauge shall be considered depending on the location of the gauge.
- 5.3 The indicating gauge will be readily visible to the operator controlling the pressure applied. For large vessels, consideration shall be given to the use of a recording gauge in addition to indicating gauges.
- 5.4 Using a thermocouple, we will measure temperature to 0.1°F, throughout the test.
- 5.5 A pressure chart recorder will be used to continuously plot pressure over the duration of the entire test.
- 5.6 The official pressure sensing device will be a deadweight tester capable of measuring in at least 1 psi increments.
- 6.0 Connect all fill and vent connections as necessary.
 - 6.1 Open vents must be located at the high point of the vessel/piping during the fill up to purge the air from the system.
 - 6.2 A hose or some other means to control water release should be installed on the high point vent.
- 7.0 Prior to filling the vessel, all personnel not involved with the hydrostatic test shall be kept at a safe distance from the testing area. The item to be hydro tested, the pump and the high pressure hose will be roped off at a safe distance with red barricade tape.
- 8.0 The temperature of the testing medium shall be as specified in the vessel / piping design specifications.
 - 8.1 The testing medium shall be at least ambient temperature but in no case less than 70 degrees F for Section I items. For NBIC repairs, the metal temperature should not be less than 60 degrees F preferably at least 30 degrees above the MDMT but not more than 120 degrees F for section VIII Division 1 items. The temperature for B31.3 Piping is limited by the stress value at test pressure-temperature.
 - 8.2 The test pressure shall not be applied until the vessel and its contents are at about the same temperature.
- 9.0 The vessel shall be filled with the testing medium until all air pockets have been expelled. The vent valve shall be closed when it is determined that venting is completed.

- 9.1 Vents shall be provided at all high points of the vessel/piping in the position in which it is to be tested to purge possible air pockets while the vessel is filling. If the operator or the Quality Control Inspector determines the vent arrangement is inadequate, the test shall be aborted until the problem is resolved.

CAUTION: The venting of air at ALL high points must be checked IMMEDIATELY prior to the pressure test. As the temperature of the testing medium increases, air may be released. It must be vented.

- 9.2 If the pressure does not come up readily when pumping, stop. This could be an indication of air in the system. Depressurize and re-purge to assure the removal of air.
- 10.0 The operator of the hydrostatic pump shall have a clear view of the test pressure gauge, so that he will be aware of the test pressure at all times.
- 10.1 The pump operator will be stationed away from the immediate vicinity of the vessel/piping being tested as deemed necessary to provide for his safety. A means of observing the pressure gauge will be provided.
- 10.2 If the operator or the Quality Control Inspector suspects any gauge to be in error, the test will be aborted until such gauge has been replaced or recalibrated.
- 11.0 At this time and until the conclusion of the hydrostatic test, the pump operator will not leave the pump station for any purpose except when relieved by an individual competent in the performance of this operation.
- 12.0 The hydrostatic pressure shall be applied gradually until the required test pressure of 162 psig is reached. The pressure application will be witnessed by the Quality Control Inspector. A close visual inspection WILL NOT BE conducted at this time.
- 12.1 The test pressure shall never be more than 170 psig.
- 12.2 NO FITTINGS OR CONNECTIONS WILL BE TIGHTENED WHILE THE SYSTEM OR VESSEL IS UNDER PRESSURE.
- 12.3 If a leak is detected during testing, the pressure is to be removed prior to approaching the vessel.
- 12.3.1 Leakage of temporary gaskets or plugs installed for the purpose of conducting the hydrostatic test and which will be replaced later may be permitted unless the leakage exceeds the ability to maintain the vessel/ piping test pressure for the required amount of time or interferes with the evaluation of the test results.
- 13.0 Once the line is pressurized to 162 psig, that pressure will be maintained for 4 hours.

- 13.1 The holding time shall be a minimum of four (4) hours or a greater time if specified on the vessel/piping drawing or requested by the Inspector to complete the visual inspection of joints or components.
- 14.0 A close visual examination will then be conducted of all joints and connections at this time. Since some of the piping is not accessible for visual inspection DV/DP calculations will be performed. There will be two (2) DV/DP values. One DV/DP value will be theoretically calculated using the ambient temperature within the tank. The other DV/DP value will be read from actual field measurements. If the calculated and measured DV/DP values are within the limits specified by the California State Fire Marshal's Office, the tested section of piping will be determined acceptable (PASS).
- 15.0 Upon completion of the hydrostatic test, the pressure will be dropped. The pressure gauge will be checked to verify it has returned to zero.
- 16.0 Drain and vent valves will be opened to allow the vessel to drain. Never open the drains on a large vessel without first opening the vent. Open lines shall be elevated in order to be free of any standing water.

V. Calibrations

The test gauge(s) shall be calibrated within a (1) year current time frame and in accordance with NIST standards. A copy of the gauge(s) calibration will be present during the test.

VI. Records

The Hydrostatic/Pneumatic Pressure Test will be recorded on the appropriate form as determined by the QC Inspector at the completion of the test. The test record will be maintained for the duration as specified by the applicable code.

1.0 Approved Test Forms

- 1.1 Record of Hydrostatic/Pneumatic Test
- 1.2 Pressure Test Certificate

A copy of the test gauge calibration(s) shall be attached to the test report for final records. All test records or reports will be submitted in the project final report or data book.

Test data and results will be forwarded for review to NAVFAC EXWC within 24 hours of test completion. Forwarded test data and results will include a statement of PASS or FAIL and reasoning.

Record of Hydrostatic / Pneumatic Test

Job Number _____ Location _____

Sheet Number _____ Mark Number _____

Date of Test _____ Gage Number _____ Calibration _____

Chart Recorder Number _____

Calibration Date _____

Hydrostatic Test Pressure _____ PSIG

Test Medium _____

Duration of Test _____

Witness and Accepted by:

Inspector: _____ Date: _____

Customer Representative _____ Date: _____

Pressure Test Certificate

PROJECT		LOCATION		JOB NUMBER	
CONTRACTOR		P & ID No.			
SERVICE					
TEST PACK NUMBER.		DRAWING No.			
SYSTEM NUMBER					
MARK No.		ISO No.			
LINE No.					
LINE SPECIFICATION		TEST MEDIUM			
DESIGN PRESSURE (MAWP)		PSI		TEST PRESSURE	
				PSI	
STRESS RELIEVED		YES		NO	
INTERNAL LINING		YES		NO	
ALL PRE- TEST NDE COMPLETE AND ACCEPTED		SIGNATURE		DATE	
MATERIAL RECORDS COMPLETE		SIGNATURE		DATE	
WELDING HISTORY RECORDS COMPLETE		SIGNATURE		DATE	
PRE-TEST INSPECTION		FOREMAN SIGNATURE		DATE	
WELDING OF PRESSURE PARTS COMPLETE		SYSTEM FILLED AND PURGED OF AIR			
PROPER GASKETS, BOLTS AND BLINDS		TEMPERATURE WITHIN SPECIFICATION			
TEMPORARY VENTS AND DRAINS INSPECTED		HYDRO EQUIPMENT AND GAGES INSPECTED			
TEST PLUGS INSPECTED AND SECURED		OPERATORS PROPERLY INSTRUCTED			
INSTUMENTATION BLOCKED OR REMOVED		BARRACADES IN PLACE			
VALVES IN THE RIGHT POSITION (OPEN/CLOSED)		AREA CLEARED OF PERSONEL			
TEST MEDIUM WITHIN SPECIFICATION					
QUALITY CONTROL SIGNATURE				DATE	
PRESSURE TEST		DATE OF TEST		FINISH	
DURATION		TEMP.		START	
COMMENTS (TO INCLUDE GAGE NUMBER AND CALIBRATION DATE)					
Inspected by		Witnessed by			
COMPANY					
SIGNATURE					
PRINT NAME					
DATE					
POST HYDRO RESTORATION					
HYDRO BLOWN DOWN & DRY		CONTROL & CHECK VALVES INSTALLED			
HYDRO BLINDS PULLED		HIGH POINT PLUGS SEAL WELDED & INSPECTED			
PROPER GASKETS INSTALLED		NDE ON PLUG SEAL WELDS COMPLETE			
PROPER BOLTING & TIGHTNESS		DRAIN / VENT VALVES CLOSED & PLUGGED			
Inspected by		Witnessed by			
COMPANY					
SIGNATURE					
PRINT NAME					
DATE					

STRESS CALCULATIONS FOR 3/4" SA106-GR B PIPE
t-12.5% for pipe with no Corrosion Allowance

ASME PG-27.2.1 TUBING PRESSURE CALCS. <=5"OD

Thickness	Diameter	Stress	Exp tubes
0.135	1.05	17100	0
t	D	S	e

$$P = S [2t - 0.01D - 2e / D - (t - 0.005D - e)]$$

Pressure
2218.725

Sch 80

ASME PG-27.2.1 TUBING PRESSURE CALCS. <=5"OD

Thickness	Diameter	Stress	Exp tubes
0.192	1.05	17100	0
t	D	S	e

$$P = S [2t - 0.01D - 2e / D - (t - 0.005D - e)]$$

Pressure
3193.425

Sch 160

ASME PG-27.2.1 TUBING PRESSURE CALCS. <=5"OD

Thickness	Diameter	Stress	Exp tubes
0.269	1.05	17100	0
t	D	S	e

$$P = S [2t - 0.01D - 2e / D - (t - 0.005D - e)]$$

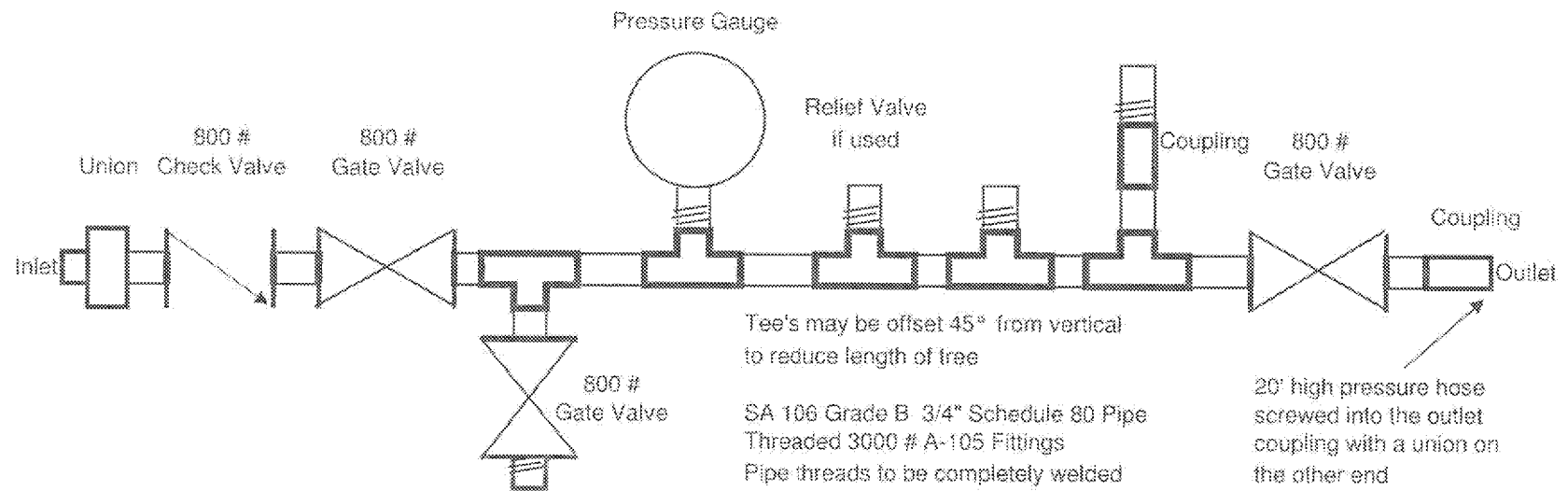
Pressure
4510.125

Sch XXS

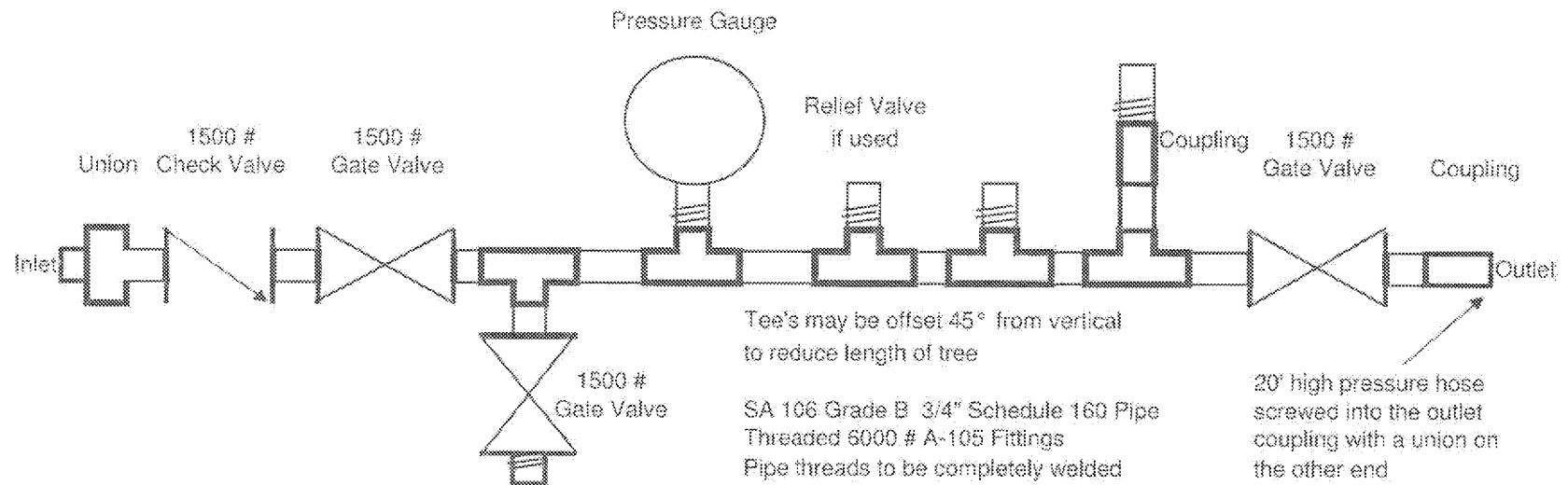
MAWP FOR HYDRO TREE VALVES:

TYPE	PRESSURE
800#	2000#
1500#	3750#
2500#	6250#

Hydro Tree Rated to 1500 PSI



Hydro Tree Rated to 3000 PSI



Hydro Tree Rated to 4500 PSI

