

HYDROSTATIC TESTING OF EQUIPMENT

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| PURPOSE & SCOPE | 1. This Instruction covers the general principles to be followed in the hydrostatic testing of equipment which is subjected in service to internal or external pressure. The purpose of such tests is to establish the strength, tightness or suitability of equipment for service and insure its safety in operation. |
| TEST PRESSURES | 2. General test pressures are outlined in Appendix I. The pressure to be applied, the duration of the test, the testing medium and other specifications which may apply to each test shall be as outlined by other Engineering Instructions, Safety Instruction Sheets, or as directed by the Engineer. |
| FREQUENCY | 3. A hydrostatic test shall be applied to equipment as outlined below:

3.1 Before it is initially placed in service.
3.2 After repairs or alterations which may affect the strength of the equipment.
3.3 At scheduled intervals as specified in Safety Instruction Sheets.
3.4 Whenever considered necessary by the Head Equipment Inspector and approved by the Engineer. |
| TESTING WITH COMPRESSIBLE FLUIDS | 4. An air, gas, or steam pressure test shall not be applied to any installation without first obtaining the approval of the Chief Engineer, except as specified in Item 6, Appendix I. |
| RESPONSIBILITY | 5. The Operating Department will supervise the isolating of equipment, fill the equipment with the testing medium when requested by Engineering or Maintenance personnel, observe the leakage test, and notify the Inspector when offplot lines not hydrostatically tested are first pressured with stock.

6. The Inspector assigned to witness a test shall be responsible for the following:
6.1 Checking the equipment to determine whether it is properly prepared for the test.
6.2 Seeing that the test pressure is applied as required.
6.3 Making the necessary inspections during the test.
6.4 Approving the test before the equipment is released for service.

7. The Maintenance Foreman in charge shall be responsible for the proper direction of all work required for testing. |

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SAFETY PRECAUTIONS

8. The Maintenance Foreman assigned to the job shall see that all necessary precautions shall be taken to assure that the test is made in a safe manner. It should be kept in mind that a considerable amount of energy may be stored in large vessels at high pressure due to the compression of entrained air, compression of the water, and elongation of the steel. Only those persons who are essential to the test should be permitted in the vicinity.

TEST GAGES

9. Gages used for pressure tests may be of standard types with full scale at least 150% of desired test pressure. All such test gages shall have been shop calibrated not more than 30 days prior to use. Connect two pressure gages; one on the test pump discharge and one on the equipment to be tested. Gages should be visible to the pump operator, who shall stand by the pump throughout the duration of the test.

PROTECTION FROM OVER PRESSURE

10. A relief valve must be used on any test pump other than a hand pump except as noted below. Should a satisfactory adjustable relief valve not be available, an additional man shall be used to watch the pressure gage on the equipment and bleed off the fluid so the pressure does not rise over 5% above the specified test pressure. When a relief valve is used, set and check the relief valve at 5% over the hydrostatic test pressure. No relief valve is required on hand test pumps. If yard air pressure test is approved by the Chief Engineer for an air test, the relief valve shall be large enough to discharge the capacity of the supply air line.

STATIC HEAD

11. Safety Instruction Sheets normally specify the test pressure at the top of vessels. When the test pressure gage is not located at the top of the vessel, the test pressure applied shall be adjusted to correct for the hydrostatic head above the gage to give the prescribed test pressure at the top of the vessel. (Add $0.43 \times$ head above gage to the specified test pressure).

TEST TEMPERATURES

12. When testing pressure vessels, the testing fluid and the shell of the vessel to be tested shall be above 60°F. to avoid possible brittle failure of the metal. It may be necessary, in cold weather, to install temporary facilities to heat the test fluid. The temperature of the testing fluid should not exceed 125°F.

PREPARING FOR TEST

13. Disconnect or blind off from the equipment on test all operating pressure gages, meters, relief valves, or other equipment not capable of withstanding the test pressure. Isolate and vent all other connected lines and equipment not to be included in the test. Be sure that the test medium

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cannot leak into a system where it creates a hazard; for example, water leaking into a hot oil system.

TESTING

14. When all preparations have been made and precautions taken, fill the system with the testing medium. Vent all high points so that all air is displaced from the system and when this has been done, close the vents. Then apply the required hydrostatic test pressure to the equipment.
15. If any indication of yielding or incipient failure of the equipment is apparent at any time while building up the pressure, stop the test pump, reduce the pressure, and report the result to the Engineer and Head Equipment Inspector for further instructions.

INSPECTING

16. While the equipment is under test pressure the Inspector shall make a close inspection of the installation for sweats, cracks or other defects, paying special attention to castings (particularly at fillets and at sudden changes in section), forgings, new welds, connections and repairs to existing equipment.

VENT
EQUIPMENT

17. Do not allow equipment filled with a testing medium to stand without venting it to the atmosphere as temperature changes of the testing medium may build up an excessive pressure or vacuum, either of which may injure the equipment.

DRAIN
EQUIPMENT

18. At the completion of a test, drain the equipment promptly and protect against deterioration and corrosion. The Inspector shall check each vessel that cannot stand full vacuum conditions before it is drained to be sure it is vented to the atmosphere and that it is drained slowly so a vacuum will not be formed.

APPROVE FOR
SERVICE

19. The Inspector shall report all defects and shall follow the necessary repairs. The test shall be repeated after each repair. When the equipment has successfully passed the test and the Inspector is satisfied that it is safe for operation, he shall approve the installation to be mechanically sound for operating service.

RECORDING

20. The Inspector shall record the date, test pressure, and any other pertinent details of each hydrostatic test.

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Attachment: Appendix I

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CHEV BB
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APPENDIX I
HYDROSTATIC TEST PRESSURES

1. The normal test pressure for refinery equipment shall be 1-1/2 times the equivalent cold design working pressure.
2. New pressure vessels built in accordance with the API-ASME Code shall be tested in accordance with the Code. Metal added for corrosion allowance shall be considered as a part of the shell thickness, and test pressure shall be based on nominal plate thicknesses (Engineering Specification 430-M).

Normal test pressures for piping systems when valves are blinded off or tested through i.e., open valves, are:

<u>Pressure Class</u> <u>Pound</u>	<u>Maximum Design</u> <u>Working Pressure</u> <u>at 100°F</u>	<u>Test Pressure</u> <u>psig</u>
150	275	425
300	720	1,100
400	960	1,450
600	1,440	2,175
900	2,160	3,250
1,500	3,600	5,400

Note: Maximum cold design pressure for 125# cast iron valves in a system is 175 psi with test pressure of 350 psig.

3. Test pressures when carbon steel gate or globe valves are used to shut off against the hydrostatic test pressure, i.e., test against closed valve, are limited to the following to insure against damaging the seat or disc (Refer to API-600). Remember, the test pressure specified shall be 1-1/2 times the cold design working pressure except as excluded in Paragraph 6.

<u>Pressure Class</u> <u>Pound</u>	<u>Test Pressure</u> <u>psig</u>
150	300
300	750
400	1,000
600	1,500
900	2,200
1,500	3,600

Note: 125# cast iron valves, flanges, or fittings in a system limit tests to 225 psig.

APPENDIX I
HYDROSTATIC TEST PRESSURES

4. The test pressure for piping smaller than two inches diameter shall be the same as the test pressure for larger diameter pipe in the same service. For example, if 150# flanges are acceptable for a particular service, the test pressure for small lines in that service will be 425 psig, even though the small valves in the system are nominally rated at 600 psi.
5. In assembled equipment the Chief Engineer may approve a reduced pressure piping test equal to the test pressure of the lowest rated piece of included equipment if this test pressure is equal to or more than 1-1/2 times the design working pressure of the system.
6. Piping in branch steam, water or air line service, at pressure below 150 psi, which readily may be isolated for repair, shall be tested with their own products at their operating pressures. Low pressure gas systems can be steam tested.
7. Hydrostatic testing of tank field lines is not mandatory except as follows:
 - a. Shop fabricated spools will all be tested whether for off plot or on plot piping systems except as noted in paragraph 6. Shop fabricated spools will be tested by the Shop Foreman.
 - b. LPG systems.
 - c. Systems operating over 250°F. or 250 psig or that frequently cycle between alternately hot and cold operation.
 - d. Underground lines and lines to be insulated.
 - e. Systems with difficult position welds where leakage of product on startup would be troublesome.
 - f. Lines over 16 inches in diameter.
 - g. Lines installed by Contractor personnel unless specifically waived by Chief Engineer.

It should be recognized that tank field lines are primarily tested for tightness and completeness of work rather than strength. The principal problem arises from sloppy or incomplete work such as incompleted welds, valves without packing, plugs left out of bosses, flanges not made up tightly or without gaskets. Therefore, on long lines and complex manifolds where inspection and control are more difficult it is usually economic to hydrotest the system before stock is admitted because of the expense of cleaning up the system in the event repairs are required.

All lines not hydrostatically tested before service shall be tested with product at the maximum pressure possible when first placed in service. The Operating Supervisor shall notify the Inspector when the line is ready for inspection.

8. Strength tests for fired furnace coils shall be at least 1-1/2 times the equivalent cold working pressure of the furnace coil design but not more than 90% of the cold yield stress. Outlet fittings or thin tubes will usually limit.

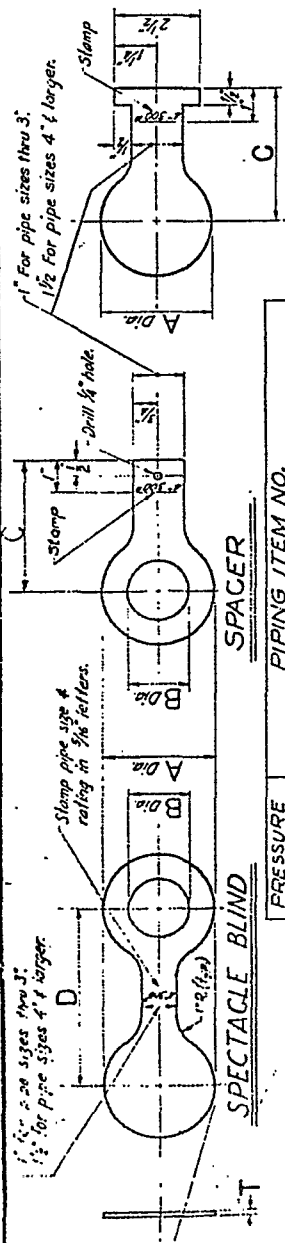
APPENDIX I
HYDROSTATIC TEST PRESSURES

9. Leakage tests on furnaces should be between $1\frac{1}{2}$ x the cold equivalent of outlet design or safety valve setting and $\frac{2}{3}$ of the strength test. Leakage test should not be less than inlet design conditions.
10. Special tests or exceptions, such as air tests to avoid water in the system, reduced pressures, higher pressures, proof tests, etc., shall not be applied to any installation without first notifying the Head Equipment Inspector and obtaining the approval of the Chief Engineer.
11. Questionable welds, not hydrostatic tested, should be radiographed.

Note: Radiography will not prove tightness nor strength of a system. Hence radiography should not be used to eliminate hydrostatic testing where line stresses are apt to be concentrated nor where product leakage on startup would be troublesome.

12. A schedule of thicknesses for blinds corresponding to various test pressures is attached (Std. Dwg. GC-L31452).
13. Form EF-121, "Initial Field Hydrostatic Test Specification," should be used for specifying test pressures on complex systems.

CHEV BB
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PRESSURE CLASS	PIPING ITEM NO.	
	SPACE BLIND	SPACER LBLIND SET
15 PSI (100 PSI)	1,665 *	1,667 *
25 PSI (150 PSI)	1,700 *	1,678 *
45 PSI (300 PSI)	1,666 *	1,668 *
75 PSI (500 PSI)	1,667 *	1,668 *

Standard items
Special items
All dimensions

PIPE SIZE	125°C I & 150° STEEL (SEE DESIGN NOTE 3)										250°C I & 300° STEEL (SEE DESIGN NOTE 3)									
	A B C D T					STUD BOLTS REQ. DIA. 1/2" 5/8" 3/4"					A B C D T					STUD BOLTS REQ. DIA. 1/2" 5/8" 3/4"				
	1/2	1 1/4	5/8	3 1/4	4	3/16	4	1/2	2 1/2	2	2	2 1/2	3 3/8	4 1/4	3/16	4	1/2	2 3/4	2 3/4	1/2
3/4	2 1/8	1 1/8	3 1/2	4 3/8	3/16	4	1/2	2 3/4	2 1/2	2 1/2	2 3/4	4 1/2	5 1/8	3/16	4	3/8	3 1/4	3 1/4	3/4	
1	2 1/2	1	3 5/8	4 3/4	3/16	4	1/2	2 1/2	2 3/4	2 3/4	2 3/4	4 1/2	5 3/8	3/16	4	3/8	3 1/4	3 1/4	1	
1 1/2	3 1/4	1 1/2	4	5 1/2	3/16	4	1/2	2 3/4	3	3 3/8	3 3/8	4 1/2	6 1/4	3/16	4	3/4	3 3/4	3 3/4	1 1/2	
2	4	2 1/4	4 1/2	6 1/2	3/16	4	5/8	3	3 1/2	4 1/4	4 1/4	5 1/4	7	3/16	8	3/8	3 1/4	3 3/4	2	
3	5 1/4	3 1/8	5 1/4	8	3/16	4	5/8	3 1/4	3 3/4	5 1/4	5 1/4	6 1/4	8 3/4	3/16	8	3/4	4 1/4	4 1/4	3	
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5	7 3/4	5 1/8	6 1/2	10 1/2	3/4	8	3/4	4	4 1/4	8 3/8	8 3/8	9 1/4	11 3/4	1/2	8	3/4	5	5 1/4	5	
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24	28 1/2	23 1/2	17 1/2	31	1 1/2	20	1 1/4	8	8	30 3/8	30 3/8	32 1/4	35 1/4	2	24	1 1/2	11	11	24	

PIPE SIZE	400" STEEL										600" STEEL										PIPE SIZE
	A	B	C	D	T	STUD BOLTS		A	B	C	D	T	STUD BOLTS								
						NO REQ.	LENGTH						NO REQ.	LENGTH							
1 1/2	2	1/2	3 3/8	4 1/8	3/16	4	3 1/4	2	1/2	3 3/8	4 1/8	3/16	4	3 1/4	1/2						
3/4	2 1/2	1 1/16	3 1 1/2	5 1/8	3/16	4	3 3/4	2 1/2	1 1/16	3 13/16	5 1/8	3/16	4	3 3/4	3/4						
1	2 3/4	1 5/16	3 5/8	5 3/8	3/16	4	3 1/2	2 3/4	1 5/16	3 1 1/2	5 3/8	3/16	4	3 3/4	1						
1 1/2	3 1/2	1 1/2	4 1/8	6 3/8	3/16	4	4 1/4	3 3/8	1 1/2	4 3/4	6 3/8	1/4	4	4 1/2	1 1/2						
2	4 1/4	2 1/16	4 3/4	7	1/4	8	4 1/2	4 1/4	1 3/8	4 3/4	7	1/4	8	4 1/2	2						
3	5 1/4	3 1/16	5 3/8	8 3/4	3/16	8	5 1/4	5 1/4	2 3/16	5 3/8	8 3/4	3/8	8	5 1/2	3						
4	6 1/8	4	6 1/2	10 1/2	1/16	8	6	7 1/4	3 3/16	6 3/8	11 1/4	1/2	8	6 1/2	4						
5	8 1/4	5 1/16	7	11 1/2	1/2	8	6 3/4	9 3/8	4 13/16	8	13 1/2	3/8	8	7	5						
6	9 3/8	6 1/16	7 3/4	13	3/8	12	6 1/2	10 3/8	5 1/4	8 1/2	14 3/8	3/4	12	7	6						
8	11 7/8	8	9	15 1/2	3/8	12	7 1/2	12 1/2	7 3/8	9 3/4	17	1	12	1 1/4	8						
10	14	9 1/4	10 1/2	18	1	16	1 1/8	15 3/8	9 1/8	11 1/2	19 1/2	1 1/4	16	1 1/2	10						
12	17 1/8	11 3/4	11 3/4	20 3/8	1 1/4	16	1 1/4	17 3/8	11 3/8	12 1/2	21 1/2	1 1/2	20	1 1/4	12						

DESIGN NOTES

1. BLINDS ARE DESIGNED FOR MAXIMUM COLD TEST PRESSURES AS FOLLOWS:
- | | 150" STEEL FLANGES | 300" STEEL FLANGES | 400" STEEL FLANGES | 600" STEEL FLANGES | TEST PRESSURE
FOR CARBON STEEL TYPE 304L | TEST PRESSURE
FOR 316L |
|--------------------|--------------------|--------------------|--------------------|--------------------|---|---------------------------|
| 150" STEEL FLANGES | 425 psi | | | | 425 psi | 425 psi |
| 300" STEEL FLANGES | | 1100 psi | | | 775 psi | 775 psi |
| 400" STEEL FLANGES | | | 1450 psi | | 1025 psi | 1025 psi |
| 600" STEEL FLANGES | | | | 2175 psi | 1550 psi | 1550 psi |
2. BLIND THICKNESSES ARE DETERMINED BY THE FORMULA
- $$T = r \sqrt{\frac{0.88 P}{S_{MAX}}}$$
- T = REQUIRED THICKNESS
 r = INTERNAL RADIUS OF PIPE
 P = TEST PRESSURE
 S_{MAX} = 25,000 psi FOR TYPE 304L & TYPE 316L SST.
 S_{MAX} = 30,000 psi FOR CARBON STEEL & CR-MO ALLOYS.
3. STUD LENGTHS FOR C1 FLANGES BASED ON 1/8" GASKETS.
 STUD LENGTHS FOR C1 FLANGES BASED ON 1/4" GASKETS.

CONSTRUCTION NOTES

1. TOLERANCES SHALL CONFORM TO THOSE ALLOWED BY THE A S A STANDARD B16.5 "STEEL PIPE FLANGES AND FLANGED FITTINGS".
2. GRES-TEC CONTACT SURFACES SHALL BE :
COMMERCIALY SMOOTH WITH A MAXIMUM ROUGHNESS NOT TO EXCEED 500 RMS OR 2 MIL MAXIMUM PEAK TO VALLEY MEASUREMENT.

MATERIAL NOTES

1. CARBON STEEL BLINDS SHALL BE MACHINED FROM FORGINGS OR PLATES CONFORMING TO ASTM A-81 GRADE I OR ASTM A-285 GRADE C.
2. ALLOY BLINDS SHALL BE MADE FROM STOCK SPECIFIED ON PURCHASERS ORDER.

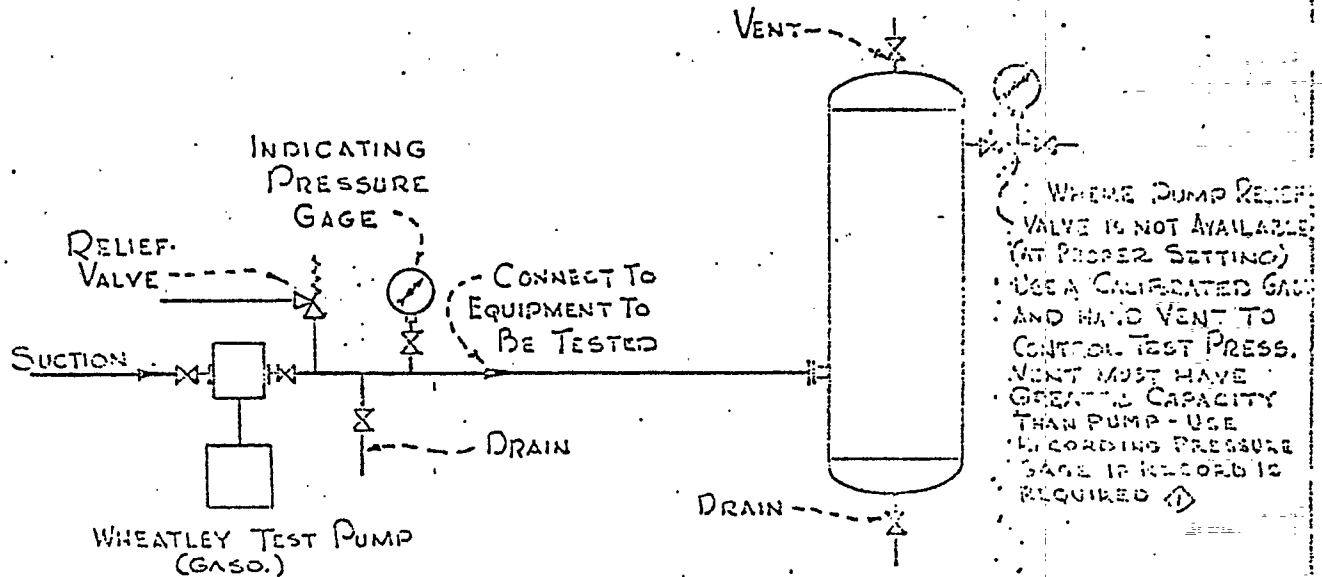
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STANDARD OIL COMPANY OF CALIFORNIA
ENGINEERING DEPARTMENT
SAN FRANCISCO

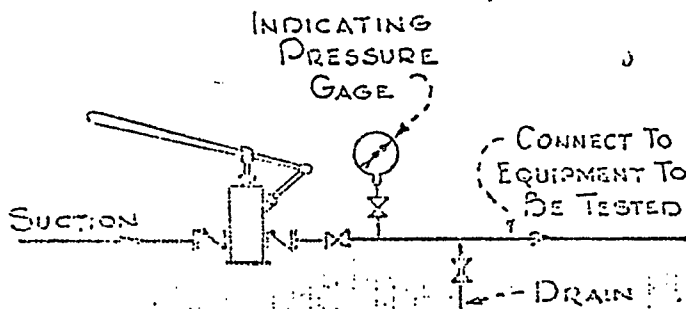
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DR. E.T. CHAN CHART ENGR APPROVED
OPRG. DEPT.
ENGR. DEPT.

STANDARD SPECTACLE BLINDS,
BLINDS AND SPACERS
FOR RFF FLANGES

W.O.	GC-L31452-15
S.O.	



USING RECIPROCATING TEST PUMP



USING HAND TEST PUMP

NOTE: All pressure gage readings shall be recorded as read. Where applicable the elevation of the test gage and the testing media shall be recorded so that the test pressure at any desired point of the equipment under test can be computed.

REVS. 1 51-1 Change Pressure Gage Note - Change Gage Note On Bottom of Sheet 2

STANDARD OIL COMPANY OF TEXAS
ENGINEERING DEPT.

EL PASO REFINERY

SCALE No. 1 DATE 7/1/41

DR. J.M. CH. ENG.

OPRG. DEPT. APPROV.

ENG. DEPT. 1/2

TYPICAL ASSEMBLY OF HYDROSTATIC
TEST EQUIPMENT

PE-51-9141-1