

Water Storage Tank Safety Standards

**PNWS AWWA
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Scope of Presentation

- Manholes for interior access
- Fixed ladders for access to tank roofs
- Fixed stairs (industrial) with railings for steep roof access
- Railings and toeboards
- Roof safety
- Fall restraint, fall arrest, and positioning device systems

Goals for this Presentation

- Describe regulations and standards governing the configuration of tank access and safety features
- To stimulate thought regarding your reservoirs versus current safety regulations and standards
- To motivate you to look critically at your facilities
- Where to look for standards and regulations

Caveats

- Just because a facility doesn't meet current regulations and standards doesn't necessarily mean it's unsafe and requires immediate modification – but it should be consciously evaluated by a “competent person” or a “qualified person”.
- This content is introductory only – see regulations
- Abbreviated information on slides

Organization of this Presentation

- Applicable regulations, standards, and references
- Manholes
- Fixed ladders
- Landings
- Railings
- Roof access hatches
- Roof stairway
- Fall restraint, fall arrest, and positioning device systems

WISHA Regulations

- OSHA is the federal Occupational Safety and Health Administration
- WISHA is Washington State's version of OSHA
- WISHA regulations govern in State of Washington except for federal facilities, floating worksites, tribal lands
- WISHA regulations are found in RCW 49.17.
- WISHA implementing rules are found in WAC Chapter 296
- WAC Chapter 296 is L&I's safety and health requirements for employers.

WAC Chapter 296 Regulations

WAC 296-24, Part J-1, - Working Surfaces,
Guarding Floors and Wall Openings

- WAC 296-24-75011 - Railing, toe boards and cover specifications
- WAC 296-24-765 – Fixed industrial stairs
- WAC 296-24-810 – Fixed ladders

WAC Regulations Continued

- WAC 296-155, Part C-1 – Fall Protection Requirements for Construction - Safety standards for construction work, defined as construction, alteration, related inspection, and or maintenance and repair work, including painting.
- WAC 296-876 – Ladders, Portable and Fixed

Applicable Standards

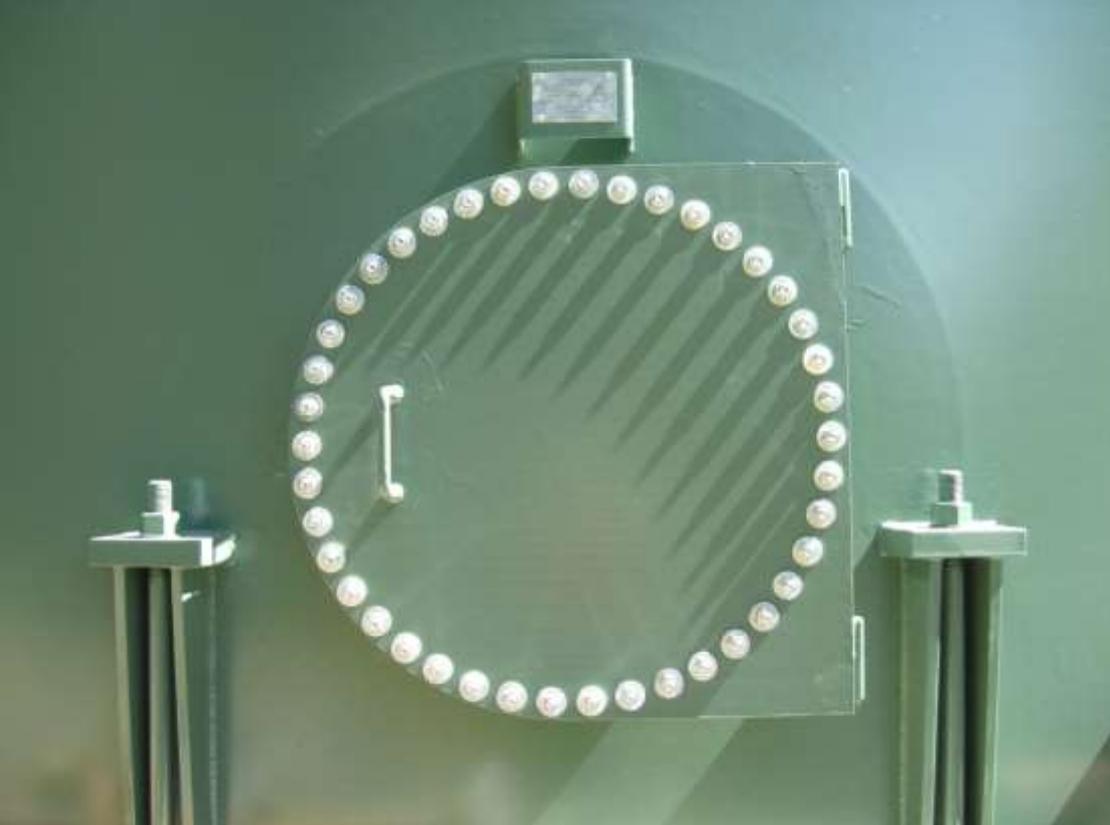
- AWWA D100-11, Welded Carbon Steel Tanks for Water Storage: This standard applies to design of welded steel reservoirs and standpipes.
- AWWA D110-04, Prestressed Concrete Water Tanks
- ANSI A14.3, American National Standard for Ladders-Fixed-Safety Requirements

Additional References

- Fixed Ladders and Climbing Protection Devices, National Safety Council Data Sheet 606 Rev. August 2007
- US Army Corps of Engineers Safety and Health Requirements Manual, Appendix J (EM 385-1-1, Appendix J)

Tank Shell Manholes

- AWWA D100: a minimum of 2 round or elliptical shell manholes within first ring.
- Each a minimum of 24 inches in diameter or 18" x 22" elliptical.
- One shell manhole at least 30 inches in diameter.
- If hatch weighs more than 50 lbs, then a davit or hinges are required



Ladder Definitions

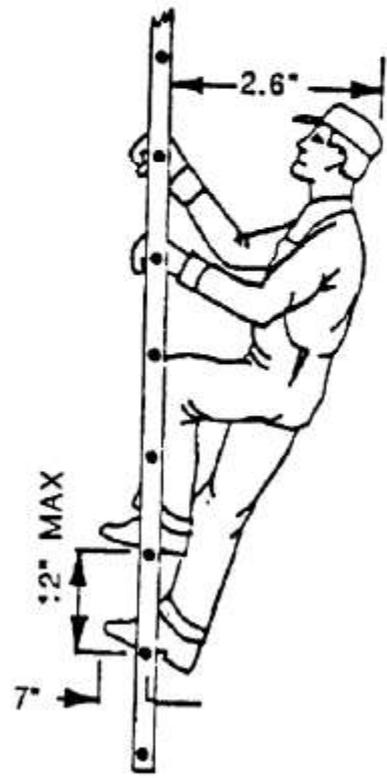
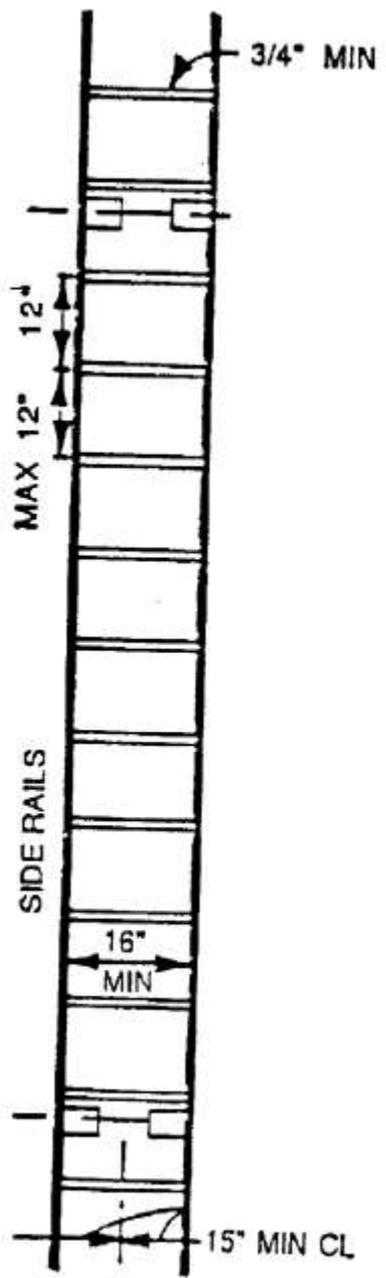
- “Fixed Ladder” – is a ladder permanently attached to a structure.
- “Through ladder” – is a ladder from which a person getting off on top must step through the ladder in order to reach the landing.
- “Side Step Ladder” - a side step ladder is one from which a person getting off at the top must step sideways from the ladder in order to reach the landing.
- “Cage” - is an enclosure that is fastened to the side rails of the fixed ladder part of the structure to encircle the climbing space of the ladder for safety.
- “Well” - is a permanent complete enclosure around a fixed ladder, which is attached to the walls of the well.
- “Ladder safety device” - is any device, other than a cage or well, designed to eliminate or reduce the possibility of accidental falls and which incorporate such features as life belts, friction brakes, and sliding attachments.

Ladder Length Restrictions

- WAC 296-876-60065: fixed ladders over 24 feet in height, on the exterior and interior of the tanks, must be equipped with cages, wells or a ladder safety device.
- WAC 296-876-60065: no length of fixed ladder shall exceed 50 feet, except when a ladder safety device is installed.
- Landing Platforms are required every 30 feet, except where no cage, well, or ladder safety device is provided, landing platforms shall be provided at each 20 feet of height or fraction thereof.
- Each ladder section shall be offset from all adjacent sections.

Requirements for Fixed Ladders

- Ladder side rails must be uniform for the full length and easy to grasp.
- Per AWWA 100-05, flat steel bar side rails must be at least 2.0 inch wide by 3/8" thick.
- At least 16 inches of clear space between ladder side rails, except at the top of the ladder.
- Both side rails must extend 42 inches above platform or edge of tank at top of ladder.
- Ladder rungs at least $\frac{3}{4}$ inch square, or in diameter, and spaced a maximum of 12 inches on center.
- Each rung must support 250 lbs.
- Shape of rungs should not cause slipping.



RAIL LADDER WITH BAR STEEL RAILS AND ROUND STEEL RUNGS

Cages for Fixed Ladders

- Cages extend ≥ 42 inches above top of landing
- Cages extend down to a point ≥ 7 feet or ≤ 8 feet above base of ladder, with bottom flared ≥ 4 inches
- Cages extend 27 inches to 28 inches from centerline of rungs of ladder.
- Cage shall be ≥ 27 inches wide.
- Ladder wells clear width of 15 inches measured each way from centerline.
- Smooth walled wells minimum 27 inches from centerline of rungs to well wall on climbing side.

Landing Platforms

- Landing platforms required for step distance greater than 12 inches from rung to nearest edge of structure
- Landing platforms require standard railings and toeboards.
- Platforms shall not be less ≥ 24 inches wide and ≥ 30 inches long.
- Ladder extensions: side rails of through or sidestep ladder extensions shall extend 3.5 feet above landings.

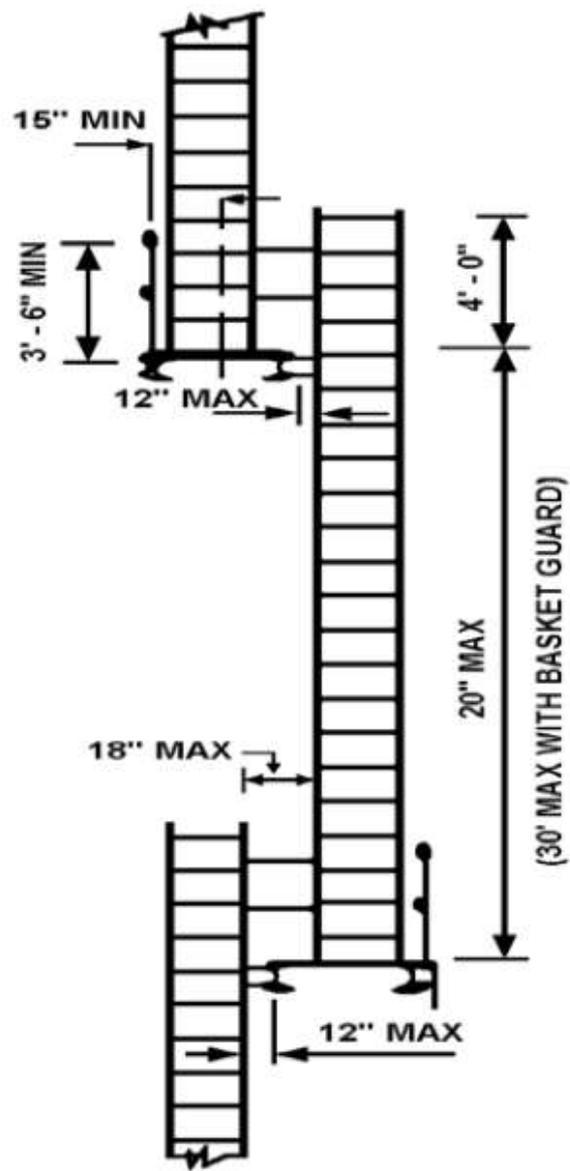


Figure D-10
Offset Fixed Ladder Sections

Top of Fixed Ladders

- Top rung even with roof or platform upon which climber will first step when exiting the ladder.
- 7-12 inches step through distance between top rung and platform or tank edge.
- WAC 296-876-60050: 24-30 inches step-through clearance between ladder side rails, at top of ladder, unless ladder has a ladder safety device, in which case width may be as wide as 36 inches.
- Where climbers pass through a hatch, ladders rails must extend to minimum height of 42 inches or horizontal grab bars must be provided to height of 42 inches.
- At top of ladder, railings required around ladder to prevent exposure to falls while engaging/disengaging ladder safety device.





Clearances

- Ladders without wells or cages must be at least 30 inches from nearest permanent object on climbing side, measured perpendicular to ladder from centerline of rungs.
- Where ladders pass through hatches, hatch cover should be counterbalanced and, if so, must open at least 70 degrees from horizontal.
- Inside clear width of hatch must be a nominal thirty inches.
- Distance from centerline of rungs to edge of hatch opening on climbing side, measured perpendicular to ladders, must be between 24 and 30 inches.
- If clearance on climbing side of ladder is between 24 and 27 inches, a deflector plate must be installed and mounted with an angle of sixty degrees from horizontal.

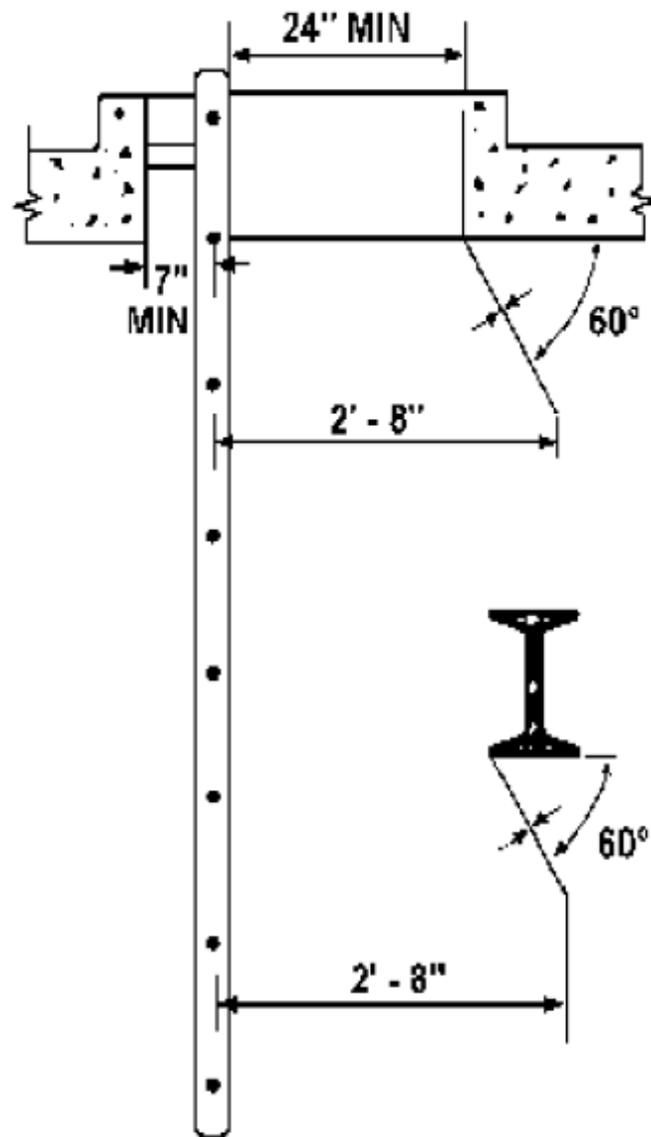
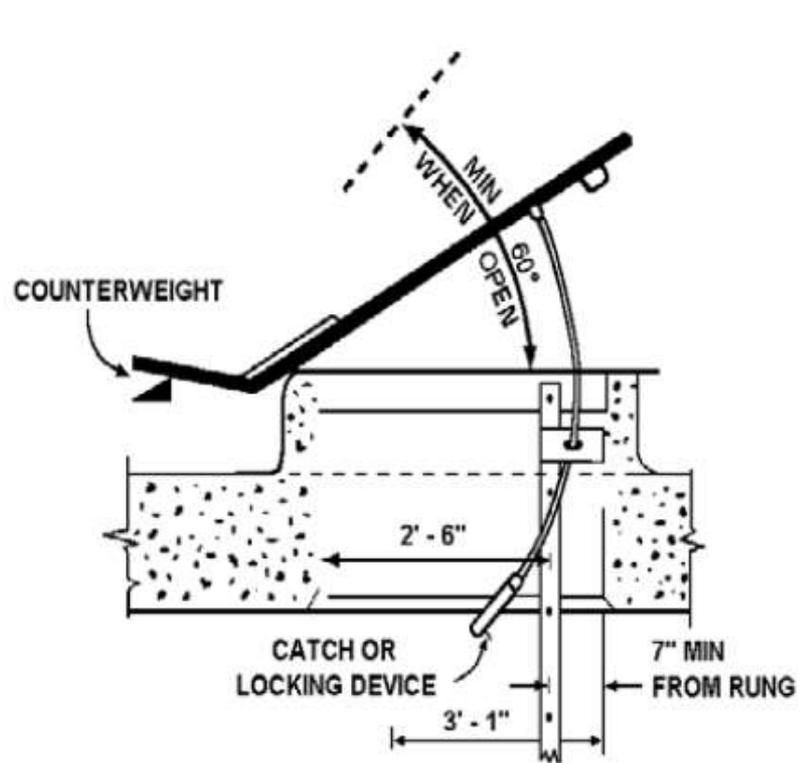


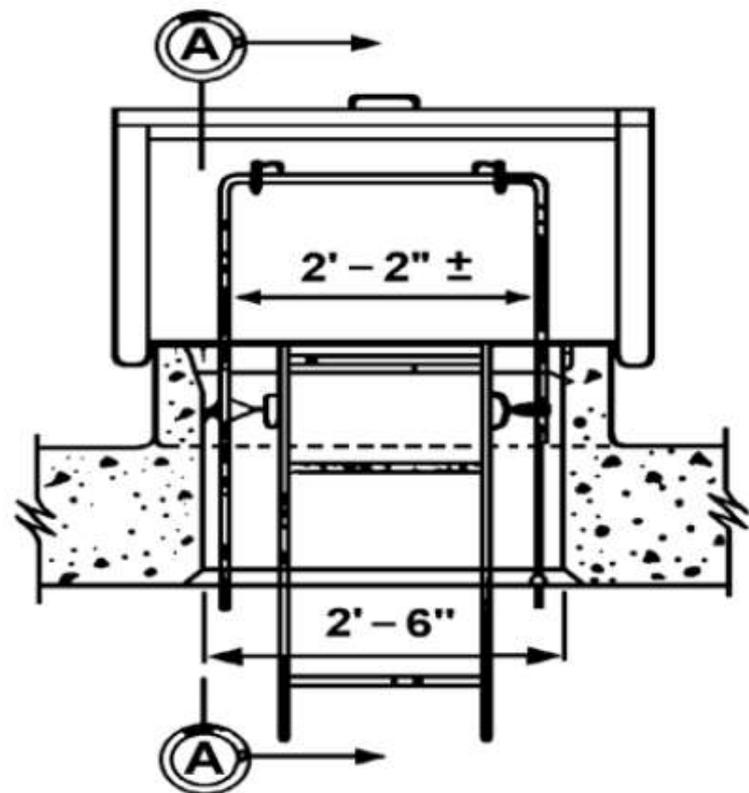
Figure D-5
Deflector plates for Head Hazards

Roof Hatches

- Access hatch on tank roof must either be surrounded by a guard rail or opening must have a 4-inch tall curb around perimeter and a secure access cover.
- Roof access opening ≥ 24 inches wide. Sides of access cover must extend down over curb a minimum of 2 inches.



SECTION A-4



SECTIONAL ELEVATION

Figure D-6

Relationship of Fixed Ladder to a Safe Access Hatch

Fixed Stairs (Industrial) WAC-24-765

- Fixed stairs must carry a load five times normal live load anticipated, but not less than a moving concentrated load of 1,000 pounds.
- Treads slip resistant and nosings of nonslip finish.
- Welded bar grating treads without nosings ok if leading edge is readily identified by personnel descending stairway and tread is serrated or of nonslip design.
- Riser height and tread width uniform on flight of stairs. Fixed stairs ≥ 22 inches wide.
- Fixed stairs must have a rise and run per table D-1 of WAC 296-24-76513.
- Stairs shall have stair railings on both open sides.

Railing & Toeboards WAC 296-24-75011

- Standard railing shall have of top rail, intermediate rail and posts.
- Vertical height of 42 inches \pm 3 inches.
- Intermediate rail approximately half way between top rail and floor.
- Pipe rails should be 1.5 inches nominal with posts not more than 8 feet on center.
- Standard toeboard \geq 4 inches in vertical height from top edge to floor with \leq 1/4-inch clearance from floor.
- Top rail able to withstand 200 pound load applied in any direction.

Fall Protection System

When workers are exposed to falls of 4 feet or more, WAC 296-155-24609 requires a fall protection system consisting of one or more of the following:

- Guardrail system
- Fall restraint system
- Safety net system
- Catch platform
- Warning line

Roof Safety

- For tank roof pitch > 4 in 12, WAC 296-155-24609 requires installation of a permanent perimeter railing or, alternatively, a fall restraint, fall arrest, or positioning device system must be provided to prevent or arrest falls from tank roof.
- For roof pitch ≤ 4 in 12, employment of a safety monitor and warning line system, or a safety watch system, may be used in lieu of railing or fall protection, fall restraint, or positioning device systems.
- Safety watch: Fall protection system in which a competent person monitors one worker who is engaged in a repair work or servicing equipment on a low pitched roof.
- Warning line system: Barrier to warn employees that are approaching an unprotected fall hazard.
- Safety monitor or safety watch is problematic for work near edge of tanks as these systems cannot prevent or arrest falls.

Examples of what personal fall arrest, personal fall restraint and positioning device systems look like:



Fall Arrest



Fall Restraint



Positioning

Fall Restraint Systems

- Fall restraint system: System in which all necessary components function together to restrain/prevent an employee from falling to a lower level, including standard guard systems, personal fall restraint systems, warning systems, or a warning line system and safety monitor.
- Personal fall restraint: Fall restraint system that is worn by employee to arrest employee in a fall from elevation.
- Restraint protection will be rigged to allow movement of employees only as far as sides and edges of walking/working surface.
- To limit movement to not exceed edges of tanks roofs, static lines must be custom sized for each tank and identified and stored so users can readily identify correct static lines.
- Anchorage points used for fall restraint will be capable of supporting 4 times the intended load.

Fall Arrest Systems

- Fall arrest system: Fall protection system that will arrest a fall from elevation and include personal fall arrest systems worn by user , catch platforms, and safety nets.
- Anchorage for a fall arrest system must be capable of supporting 5,000 lbs (static weight).
- Anchorage for a fall arrest system must be capable of supporting 3,000 lbs (static weight) when used in conjunction with either a self-retracting lifeline that limits the maximum free fall distances to two feet or less or a shock absorbing lanyard that restricts the forces on the body to 900 lbs or less.

Positioning Device System

- Positioning device system: Full body harness or positioning harness worn by an employee and rigged to allow an employee to be supported on an elevated vertical or inclined surface, such as a wall, pole or column and work with both hands free from the body support.
- Rigged to prevent fall of greater than 2 feet.
- Anchorage capable of supporting 3,000 lbs (static weight) or twice potential impact load, whichever is greater

Questions?