



## Testing of Elevator In-ground Hydraulic Jacks and Piping

**Date:** 8-23-2022, revision to documents dated 12-9-2013 and 1-30-2015

**Subject of Revision:** Updated codes and requirements.

### In-ground Hydraulic Jack Basic Construction and Operation

An in-ground elevator hydraulic jack consists primarily of a cylinder (large pipe) with a plate or disc welded to the bottom, a plunger (similar to a piston), and a ring-shaped jack head with an oil seal. The cylinder may be made of several sections of pipe welded together.

The assembled cylinder, plunger and head are lowered into a vertical hole drilled or bored in the soil beneath the elevator. The top of the cylinder is supported at the pit floor by steel channels. The top of the plunger is attached to the underside of the elevator car. When oil is forced into the cylinder under pressure by the elevator hydraulic pump the plunger is displaced causing the plunger and the elevator car to rise.

### Advancements in Elevator Hydraulic Jack Safety

For many years hydraulic cylinders were made with one plate or disc welded to the bottom of the vertical cylinder. Investigation of failures of these single-bottom jacks found that failures due to corrosion tended to occur at this weld joint. Failure at the bottom can result in a rapid loss of oil causing the elevator to drop suddenly. Injuries and deaths have been reported in other states as a result of such failures. To address this, the double-bottom (safety-bulkhead) cylinder was developed.

A double-bottom or safety bulkhead cylinder has one bottom or disc welded just inside the bottom of the vertical pipe. Then a cap or second bottom is welded below the first bottom. Since the welded joint attaching the second bottom is exposed, it may be prone to corrosion and failure. The first bottom is provided with a small orifice or hole so a failure of the second bottom will be indicated by the elevator descending in a controlled manner as oil escapes the cylinder through the orifice (the safety bulkhead). New elevator in-ground hydraulic cylinders have been required to be of the double-bottom type in Wisconsin since January 1, 1975.

The safety bulkhead improved reliability but cylinders were still susceptible to corrosion and failure at the joints where sections of pipe were welded together. Effective January 1, 1994 Wisconsin code began requiring the in-ground portion of elevator hydraulic jacks to be completely surrounded by a rigid material to protect the cylinder from corrosion. Polyvinyl chloride (PVC) pipe, including bottom cap, has been commonly used for in-ground elevator jack protection.

### Elevators Requiring Testing

The March 2004 Wisconsin Administrative Code ch. SPS 318 required existing in-ground jacks with installation contract dates prior to *January 1, 1975* (therefore of the single bottom type) to be tested annually to verify their condition.

The December 2008 SPS 318 code began requiring in-ground jacks with installation contract dates prior to *January 1, 1994* to be tested annually to verify the condition of existing double-bottom - safety bulkhead type cylinders not installed in PVC protection.

The August 2014 SPS 318 code adopted the 2013 edition of ASME A17.1 (2013 edition), requiring in-ground hydraulic piping with installation contract dates prior to January 1, 1994 and not in PVC or similar protection to also be including in annual testing.

The May 2020 SPS 318 code eliminated the cut-off date for testing, requiring any elevator with in-ground jack or piping, installed under any edition of the code, to be subject to annual testing. [Link to SPS 318](#)

## Persons Performing Tests

Pressure tests in accordance with ASME A17.1 (2016), requirements 8.6.5.14.1 and 8.6.5.14.2 are to be conducted by licensed elevator personnel. Licensing requirements for elevator personnel can be found in Wisconsin Administrative Code ch. SPS 305, Subchapter X. [Link to SPS 305](#)

## Testing Oil Hydraulic Elevators (Nearly All Hydraulic Elevators)

Requirement 8.6.5.14.1 requires pressurizing the elevator system to the system relief pressure. This is the pressure at which the relief valve operates and is not to exceed 150% of the normal system working pressure.

For elevators with unknown working pressure or where there is a disparity between a previously recorded working pressure and the actual working pressure, licensed elevator personnel must load the elevator with test weights equal to the full capacity of the elevator (rated load). The elevator must lift the rated load at normal rated speed to determine the system working pressure. If necessary, the relief pressure must be adjusted and sealed. The working pressure and relief pressure must be recorded in the maintenance record and should also be recorded permanently on the tank cover or similar location. Form SBD-3E Category 1 Periodic Hydraulic Elevator Test, Section 1 must be completed. As long as the seal remains in place subsequent annual tests may be done without re-establishing the working pressure using test weights.

For an older elevator that has a relief valve but no means to seal the relief valve pressure setting, the system must be pressurized to relief pressure as described above. The working pressure and relief pressure must be recorded in the maintenance record and should be recorded permanently on the tank cover or similar location. Form SBD-3E Section 1 must be completed. As long as the relief pressure is not changed, subsequent annual tests may be done without rechecking the working pressure.

After the test in req. 8.6.5.14.1, req. 8.6.5.14.2 requires the elevator to be parked for a period of 15 minutes (no load is required). The starting and ending positions of the car, oil levels and other information are recorded on form SBD-3E, Section 2. If the elevator changes position (downward) and the change cannot be explained by visible oil leakage, leakage through the control valve or temperature change, a leak is occurring in the portion of the cylinder or piping below ground.

For an older elevator that does not have a pressure relief valve, the elevator must be operated with rated load at rated speed along its full travel. Form SBD-3E Section 1 must be completed as applicable. This must be followed by the test in Req. 8.6.5.14.2 except the elevator must remain fully loaded.

## Testing Water Hydraulic Elevators (Old, Very Uncommon)

Water hydraulic elevators use water under pressure from a municipal or on-site water system or from a pressure tank pressurized by a pump. These elevators must also be tested to provide a reasonable assurance that they will not fail while in use. Testing water hydraulic elevators presents unique challenges due to lack of design safety factors, seals made of leather and surface rust on pistons that could cause damage if tested similarly to oil-hydraulic elevators. This department has determined that water hydraulic elevators with in-ground jacks or pressure piping not exposed for inspection must be tested as follows:

The elevator must be loaded at some point above the bottom landing (such as the next landing above) to 110% of rated load. A valve isolating the unexposed piping and jack must be closed. After 15 minutes at rest, no unexplained loss of water may occur. For water hydraulic elevators using a pump, the pressure setting at which the pump shuts off must be sealed or the point of adjustment must be in a sealed box or under a sealed cover.

## Test Failure

Failure of either test will require the elevator to be removed from service by the elevator personnel performing the test or by an elevator inspector as required by SPS 318.17086(9)(d). Also see SPS 318.1011(8)(c) 2.

Replacement or qualified repair of the leaking in-ground cylinder or piping will be required before the elevator may be returned to service. Approval must be applied for by a licensed elevator contractor prior to replacement or repair of a cylinder.

## Deadline for completing the testing

Failure to show satisfactory completion of these tests within the calendar year prior to the expiration of the PTO (permit to operate) will result in withholding of the PTO.

## **Alternatives to testing**

There are no longer any alternatives to testing of in-ground jacks or piping that are not visible for inspection.

## **Record of oil usage**

The owner of a new or existing elevator with an in-ground hydraulic jack or piping is required to keep a record of oil usage per req. 8.6.5.7 and SPS 318.17086(11)(a). If unexplained loss of oil (or water for water-hydraulic elevators) occurs at any time between scheduled testing, the tests in 8.6.5.14.1 and 8.6.5.14.2 must be performed immediately.