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FIRE HYDRANT SUMMARIES

The following information regarding AWWA C502 fire hydrants is provided in three separate documents to reflect aspects of installation, operation, and maintenance.

The Installation section focuses on the aspects of the construction process, being the contract specification, installation and initial testing. This targets the interest of the project engineer, installer and construction inspector.

The Operation section addresses the three most common operational factors that can result in damage to the hydrant or water system. This information should be considered by anyone who operates fire hydrants.

The Maintenance information is supplemental to published maintenance manuals and provides a general review of the five key mechanical components.

The short summaries provided represent only partial information. Detailed information is available within the AWWA C502 standard, or available from the manufacturer upon request.

FIRE HYDRANT INSTALLATION

GENERAL

Proper hydrant installation is an essential component to long service life with minimal maintenance. The following are some key fire hydrant installation, operation and trouble shooting procedures to consider when inspecting new construction. See the manufacturers installation and maintenance manuals and the AWWA C502 Standard for "Dry-Barrel Fire Hydrants" for more detailed information.

The operational requirement of the application needs to be fully specified to assure the installation complies with local standards. Operational requirements include:

1) Reference to AWWA C502 and/or other appropriate standard.
2) Main valve size (5 ¼" typical)
3) Type & size of pipe connection (6" typical)
4) Depth of trench
5) Hydrant color
6) Nozzle configuration, sizes, and threading
7) Operating nut size and configuration
8) Direction of opening

INSTALLATION DETAILS

Be sure the hydrant selected corresponds to the depth of trench plus proposed adjustments to the finish grade. Finish grade is recommended at 3" (+/-3") below break flanges, which is the designed optimum installation point for break system function. This also assures clearance for full circle operation of 15" hydrant cap wrenches.

The auxiliary valve & hydrant must be adequately restrained to the piping system. A mechanical joint connection is considered an unrestrained joint and requires thrust blocking or mechanical restraint.

The hydrant needs to stand perpendicular. Directional facing of hydrant should provide access for fire fighting needs. All current production AWWA C502 hydrant models provide for 360-degree barrel positioning options.

A gravel sump area must be provided at the hydrant shoe area to accept barrel drainage. This stone filled area should be capable of containing a volume of water twice that held by the hydrant barrel.

Provide a stable and compacted backfill for installation rigidity. This will enhance functionality to the breakaway system.

FUNCTIONAL DETAILS

Check breakaway flanges or lugs for damage inflicted during handling & installation. Verification of break system integrity is an important functional inspection and also relates to operational safety.

Operating nut sizes and nozzle threading must be checked for compatibility with fire department standards. Direction to open must be as indicated by the arrow on the weathershield or bonnet and in compliance with local standards.

OPERATIONAL TESTING

Verify proper hydrant operation. Operate from behind - and not over the hydrant - making appropriate provisions to discharge flow. * Note that higher operating torques at initial opening will be present due to resistance of line pressure. Once flow begins, pressure equalizes and operating resistance is minimized.

The drain valve system will discharge water from drain ports at line pressure during opening - in the one to five turn open range. Prolonged hydrant operation must be only in the full open position to avoid undermining of the gravel sump area and backfill.

Close hydrant very slowly to avoid a water hammer. If air is being discharged, stand clear of the hydrant and allow for discharge of all air before closing. Closure should be smooth and without significant resistance. Be sure the stem lock nut that retains the operating nut is secure and does not back out during closing.

Line pressure aids in closing an AWWA C-502 center stem compression hydrants. There is no need to exert closing torque to retain closure. After full closure, relieve stem & seat assembly stress by turning the op nut approximately 1/4 turn in the open direction.

Debris lodged in the seating area of the main valve - preventing full closure - is the most predominant seating problem with new installations. Water may flow out the nozzles or, in the case of a very minimal leak, be discharged thru the drain valve system.

It is somewhat common that hydrants are overtorqued in the closed position in attempt to overcome a seating obstruction. Difficulty in initial opening of the hydrant can be indicative of high torque seating achieved over debris (*also see above). Failure to achieve re-closure and hold closure with water pressure may indicate the main valve has been damaged. Additionally, overtorquing can damage the operating nut threading, seat ring, or the breakaway assembly.

A "rare” possibility for full closure leakage would be a lower seat O-ring failure. In most cases, this O-ring proves to not be the problem upon further investigation.

Check the hydrant barrel for proper drainage. After closing there should be a slight suction at the hose nozzle, which is detectable with the palm of the hand. Failure to drain is usually caused by blockage of the drain ports due to improper installation. Other less common possibilities include a high water table or the deletion of the drain feature as specified for some applications.

SHELL TESTING

A shell test will verify proper drain valve facing operation and integrity of barrel component seals. When performing this test, special operational safety issues must be considered. First, verify that all nozzles are positively retained to the barrel and caps are fully threaded on to the nozzles. Next, remove a nozzle cap and fill hydrant to the nozzle level then close and replace cap. This step will minimize air in the hydrant barrel as it is pressurized for shell testing. Always operate from behind and not over the hydrant.

As the hydrant is re-opened, the drain system will be flushing in the 1 to 5 +/- turns open range. At full open the drain valve facings will seal the drain ports as per AWWA C-502 sec 5.1.2. "Hydrostatic test” (AWWA C-502 allows for leakage at the drain valve at a rate "not to exceed 5 fl oz/min”). During a shell test, drain valve sealing can usually be confirmed by the absence of sound associated with a flow operation. Damage to drain facings is not as common as in the past due to the use of pressure activated rubber facings vs the leather drain valve facings of the past.

All nozzles, caps & barrel component seals should be drip tight. Barrel component leakage is usually a result of loose shoe to lower barrel bolting. AWWA C502 and the manufactures recommendations instruct the installer to check for bolts that may have worked loose in shipping and handling.

FIRE HYDRANT OPERATION

GENERAL

Maintenance requirements for AWWA C502 center stem compression fire hydrants are often a result of improper operation. The most predominant issues are as follows:

- **A)** Water hammer - resulting from closing the hydrant too quickly.
- **B)** Over torquing in the closed position.
- **C)** Hydrant operation at less than full open.

The following information is intended to be general in nature and may apply to all AWWA C502 hydrants. It is suggested to confirm operational procedures specific to each model. See maintenance information for additional details.

A) CLOSING SPEED & WATER HAMMER

The primary issue of concern is closing the hydrant too quickly - since this has the potential to extend damage beyond just the fire hydrant. It is critically important to close fire hydrants slowly - and also operate from behind and not over the hydrant.

Water weighs about 8 lbs per gallon and may be moving at up to 4 feet per second and can't be stopped abruptly. When a hydrant is closed too quickly - a water hammer will result. Water hammer has a tremendous potential to damage water systems - as it slams against the closed hydrant and bounces back through the water system.

Adding some <u>air</u> into this picture we create a multiplier effect of water hammer. When a system is installed or repaired it is essential to properly bleed off any air within the pipeline. Keep in mind that unlike water, air will compress and can create an extraordinary operational hazard. If you encounter air during operation, stay clear of the hydrant until the airflow ceases - and do not close while blowing off air!

In some cases airflow can be very obvious during hydrant operation and in other cases, despite its presence, is not highly detectable. If hydrants chatter during operation - this should serve as a warning of the possible existence of air in the flow.

If hydrant chattering is common to specific areas of the water system, provisions should be considered to purge air. This is most likely to exist with hydrants at the high points of the system in conjunction with higher pressures and/or velocities. A hydrant with one or multiple extensions may contribute to this condition due to an accumulation of stem assembly tolerances.

When using hose nozzle valves, use only multi turn gate valves. Do not use lever operated quarter turn valves, which are likely to instigate a water hammer.

A water hammer situation can also occur if the stem lock nut - which retains the operating nut - backs out of the bonnet while closing the hydrant. The stem lock nut is designed to tighten when absorbing the higher thrust when opening. In closing, it is conceivable, the stem lock nut can be carried out if inadequately restrained. This is not obvious, but it is detectable if the operating nut is rising during closing. Several methods are used to add retention forces - being lock pins, lock tite, dinging the threads, and over time - a little corrosion serves well at this location.

Do not flow a partially disassembled hydrant - where the bonnet and/or operating nut assembly is removed and the main valve assembly remains in the barrel. This has been known to occur during repair procedures to flush debris from the line - with the auxiliary valve being used for control. When a hydrant is partially disassembled the main valve will generally fall to the open position. Since a center stem compression fire hydrant is a normally closed valve, flushing without the restraint of the operating nut assembly will allow flow to drive the main valve closed.

All of the potential pitfalls of improper hydrant operation are intensified at high pressures. Production testing which meets - or exceeds - AWWA C502, Section 5.1, does not duplicate possible field conditions of high velocity, compressed air, or water hammer induced by closing too quickly.

B) OVER TORQUING

For AWWA C-502 center stem compression fire hydrants, the most common maintenance issue is damage to the main valve. Rocks or other debris becoming lodged in the seating area at installation generally causes main valve damage.

When an obstruction to seating of the main valve occurs, it is important to avoid the use of excessive force in attempts to achieve closure. Excessive closure torques can accelerate damage to the main valve or induce damage to other related parts. The suggested procedure is to reopen the hydrant and flush the obstructions clear and attempt to re-close.

A common cause of main valve damage is routine over torquing in the closed position. Putting an extra snug on the hydrant to assure closure is not required. A center stem compression hydrant is a <u>normally closed</u> valve and closes with the aid of water pressure. High closing torque will likely result in damage to the main valve and cause seating to become less efficient. As seating becomes progressively more unreliable, we get into the slippery slope of needing more torque to close until the main valve eventually needs to be replaced.

Excessive closing torque also retains an undue stress on the stem components. It is recommended after closing to back off the operating nut approximately 1/4 turn from full closure. The water system pressure will maintain closure.

This is in contrast is the opposite operation of the older scissors type hydrant (offset stem vs a center stem), which closes against pressure. This type of hydrant does require more shutoff torque and is generally more maintenance intensive.

C) FULL OPEN OPERATION & DRAIN VALVE SYSTEM

The drain valve system provides for the removal of excess water after closure to prevents freezing within the hydrant barrel. A pressure activated rubber drain facing is designed to seal off at approximately 4 to 7 turns after opening of the hydrant. However, it is recommended that hydrants be operated to <u>flow only in full open position</u>. This assures there is not a continuous high-pressure drain port discharge during use.

If a hydrant is throttled to deliver only a garden hose full of water (such as at a construction site), constant drainage is taking place and undermining of the thrust blocking that supports the installation. Use of a hose nozzle gate valve is the proper method of throttling hydrant flows.

The drain system is designed in this manner to allow a burst of water to flush any debris clear the drain system during initial opening. This helps to facilitate barrel drainage after closing.

Please reference the appropriate manufacturer operation and maintenance information for additional detail.

FIRE HYDRANT MAINTENANCE
GENERAL

Virtually all fire hydrants currently being installed in the Northwest are in compliance with the American Water Works Association (AWWA) C502 standard for dry barrel hydrants. Current center stem compression hydrants are designed to both minimize maintenance needs as well as facilitate maintenance operations when necessary.

The following general information covers key mechanical components that may apply to all AWWA C502 hydrants. It is suggested to reference the manufacturers maintenance manual that is specific to each hydrant model for further servicing information.

When replacement parts are required, it is essential to provide detailed information specific to the subject hydrant. The following Information for identification will be on the barrel section: 1) name of manufacturer, 2) model number, 3) year of manufacture, and 4) main valve size. Direction to open and depth of trench may also be applicable.

MAIN VALVE

The most common maintenance need relates to obstructions in the seating area and resulting damage to the main valve. This is detectable by continued flow with the hydrant in the closed position.

When obstructions to seating of the main valve occur, it is important to avoid the use of excessive force in attempts to achieve closure. Excessive closure torques can accelerate damage to the main valve or induce damage to other related parts. The suggested procedure is to reopen the hydrant and flush the obstructions clear and attempt to reclose. If this is unsuccessful, the main valve assembly will need to be removed for further analysis.

Since we are going to remove the main valve, we must first <u>turn off the auxiliary valve</u>. Some maintenance functions can be performed under water pressure, however, when using a seat removal wrench we must confirm that the hydrant is not under pressure.

<u>DISASSEMBLY</u> - To access the main valve, the hydrant is disassembled starting from the bonnet. In the case of a grease-lubricated hydrant, we remove the bonnet bolts and thread off the bonnet unit off the stem. Next we remove the seal plate if applicable. In the case of an oil-lubricated hydrant, the manufacturer recommends removal of the operating nut assembly and procedures for retaining the oil in the bonnet.

Next, use the appropriate seat wrench (again with the water off) to remove the seat assembly. For recent production hydrants, this wrench engages on the cast iron break coupling below the break point or to an upper stem drive pin.

Most newer model hydrants have bronze to bronze seating (seat ring to subseat). Also, the current use of O-ring seals provides servicing advantages vs old gasket seals. This allows for torque applied through the stem to be sufficient drive out the seat ring.

For older models with a seat ring threaded into cast iron shoe, a longer seat wrench that drives directly on seat ring drive lugs is required to deliver disassembly torque. When encountering excessive resistance to seat removal, safety considerations increase in importance - especially when excessive manual force is employed. The wrench can be secured to the seat ring drive lugs by a retention device threaded to the upper stem. This can prevent the wrench from releasing while manual force is employed. Use of gear or power driven wrenches are preferable to the use of manual forces.

Main valve replacement is accomplished after removal of the bottom plate. Match the corresponding tapered seating surfaces of the main valve and the seat ring. At this point, also check the bronze-seating surface for damage. Minimal roughness can generally be buffed out with an emery cloth.

DRAIN VALVE SYSTEM

Function of the drain valve system needs to be checked for proper operation. There are two primary issues that can cause a need for related maintenance.

1) Hydrant barrel fails to drain after use - which subjects it to freeze damage.
2) During full open hydrant operation, continuous discharge of water is taking place - which can undermine support for the installation.

To accommodate barrel drainage, a gravel sump is installed around the base of the hydrant to accept water from the drain ports. To check for proper drainage, view the water level drop and/or feel for the suction created at the nozzle outlet. If the <u>hydrant barrel fails to drain</u> there are several possibilities to review:

A) Improper installation of a concrete thrust block over the drain ports is somewhat common with new installations. It is also possible that the polywrap used to encase the piping system does not allow for drainage. In either case the need for re-excavation makes the remedy somewhat difficult.

B) There also have been cases where a high water table is the culprit.

C) It is possible the weep holes have become plugged with sand etc over time or during construction. There are two ways to check or remedy this situation.

1) The first option is to attempt to force flush the drain system clear with water pressure. To attempt this, remove a hose cap and open the hydrant slightly and fill hydrant barrel as much as possible. (This step is intended to minimize hazards associated with compressed air inside the hydrant.) Turn off hydrant and tightly secure all hose caps. Open the hydrant approximately 3 turns - standing behind and not over when operating. This allows line pressure to enter the hydrant while the drain system is open creating an opportunity for line pressure to blow the drain system clear.

2) If problems persist, CLOSE the auxiliary valve and remove the main valve assembly using the appropriate tools. Pump the remaining water from the hydrant barrel. Using a long narrow pole with a nail thru the end, locate the drain ports that exit the shoe and attempt to mechanically clear the drain ports.

If all the least difficult remedies are not successful, it is sometimes chosen to designate a hydrant to be pumped out after each use - rather than excavating to address the external drain area. A so designated hydrant should be regularly inspected - since very minor seat leakage may be retained in the barrel section and is subject to freezing.

If <u>during hydrant operation, continuous discharge of water</u> is taking place, note the following possibilities:

A) Hydrant needs to be operated in the full open position only. This assures that the drain valve facing is fully blocking the drain valve port.

B) The drain valve facing is damaged or missing. This is most common with older style hydrants using leather drain valve facings, which are subject to wear, swelling, shrinking & cracking.

The newer pressure activated rubber drain valve facings have been a great improvement to hydrant operations & maintenance. These allow for operational tolerances, which have virtually eliminated wear and resulting, service needs.

C) Inspect the drain valve assembly. This can be subjected to damage from disassembly torques being transmitted thru - and twisting of - the drain ears.

<u>REASSEMBLY</u> - To reinstall the main valve assembly, inspect the O-ring seals and replace if necessary. For hydrants with older style gasket type seals, seal replacement with each servicing is recommended. Clean the threads and apply food grade grease to the O-rings or gaskets and seat ring threads.

Lower the stem and main valve assembly into the barrel - using caution to avoid scrapping or dislodging the O-rings or gaskets. To assure proper starting of the threads, use the wrench to rotate assembly backwards one or two turns to align seat ring threads before threading into place. On models with O-ring seals, only a moderate amount of torque is required to seal the O-rings.

Before applying pressure to the main valve assembly, the bonnet assembly must first be re-installed. This permits valve closure to be regulated by the operating nut. Do not flush a partially disassembled hydrant without the restraint of the operating nut assembly – since this would allow flow to drive the main valve closed and create a water hammer situation.

BREAKAWAY SYSTEM

The breakaway system is the weak point designed to fracture upon impact. This minimizes potential damage to the hydrant, the vehicle, and its occupants. Alternately, the break system must have enough structural integrity to facilitate high flow fire fighting operation. Due to potential for minor impact or bump damage, It is very important to perform a visual check of break flanges or break lugs as part of routine maintenance.

Location of the break system at 3” (+/- 3”) relative to finish grade is essential for proper performance. If the break system is below the recommended range, an extension should be added. This also permits the fire department to efficiently use cap wrenches and attach hoses.

After a collision - repair can be accomplished as follows:

1) Removing broken coupling and standpipe break rings or break lugs.
2) Unscrew the upper stem from the operating nut
3) Install the new break coupling and replace upper stem.
4) Remove the cap/bonnet assembly.
5) Reassemble upper barrel of hydrant to lower barrel - checking to assure proper O-ring / gasket installation.
6) Install breaker rings or break lugs - tighten evenly to manufacturers recommended torques.
7) Replace the cap / bonnet assembly by fully threading onto the upper stem and tighten bolts/nuts.
8) Add lubrication as recommended by the manufacturer.

LUBRICATION & OPERATING NUT

The stuffing box area - located between the stem lock nut and the machined bonnet - contains the thrust collar of the operating stem nut. Line pressure provides resistance to initial opening of the main valve - which is transmitted as upward thrust to the op nut thrust collar - forcing it up against the stem lock nut.

Teflon thrust washers have been used over the past 30 years to reduce operating friction. Hydrants with full travel stiff operation are usually older hydrants lacking a thrust washer and/or weathershield protection of the op nut. Retrofitting a thrust washer is a relatively easy and inexpensive way to greatly improve operation of older hydrants.

Access to the operating nut is achieved after removing the stem lock nut. The stem lock nut is designed with backwards threading (for open left hydrants) - which tends to tighten while absorbing the thrust of opening of the hydrant against water pressure.

Before installing the retrofit washer, clean the stuffing box area. If contacting surfaces have become excessively scored, the bronze parts may need to replaced or refaced. After installation of the washer, be sure enough tolerance exists for operation without binding. Slight machining of the stem lock nut can provide additional tolerance for installation, if required.

After reinstalling the operating nut and stem lock nut, be sure the stem lock nut is fully threaded into the bonnet and retention hardware is engaged. This will prevent the lock nut from backing out while closing the hydrant.

Other possible causes of stiff operating would relate to the remaining operational contact points. These should be limited to:

A) Damaged op nut threads
B) Stem interference through the bonnet or seal plate.
C) Drain valve components that travel within the seat ring.

Hydrant manufactures recommend lubrication of the operating nut either by grease or oil. Regardless of the type of lubricant, use of a NSF food grade lubricant is essential. This is driven by concerns relating to possible contamination of the water system from the use of a petroleum product. Access is provided by either an alemite fitting or fill plug.

NOZZLES

There exist many types mechanical retention systems to secure the nozzles. Current production models use stainless steel set screws, pins or wedges - in conjunction with 1/4 turn or threaded nozzles. Removal of nozzles can become challenging for older hydrants with dysfunctional retention systems. If all else fails, carefully cutting the bronze nozzle only with a sawsall and collapsing with a hammer will work. Follow the manufacturers recommendations for nozzle replacement and retention.

O-ring seals are generally used for sealing to the nozzle section. Gaskets are used to provide a seal to the caps. For lubrication of nozzle threads, a dry graphite lube is recommended. This will avoid the retention dirt or sand vs the application of grease.