Eccentric Engineer

Nathan 1918A “Non-Lifting” Injector

In 1.6” Scale

Installation, Maintenance, and Operation Manual

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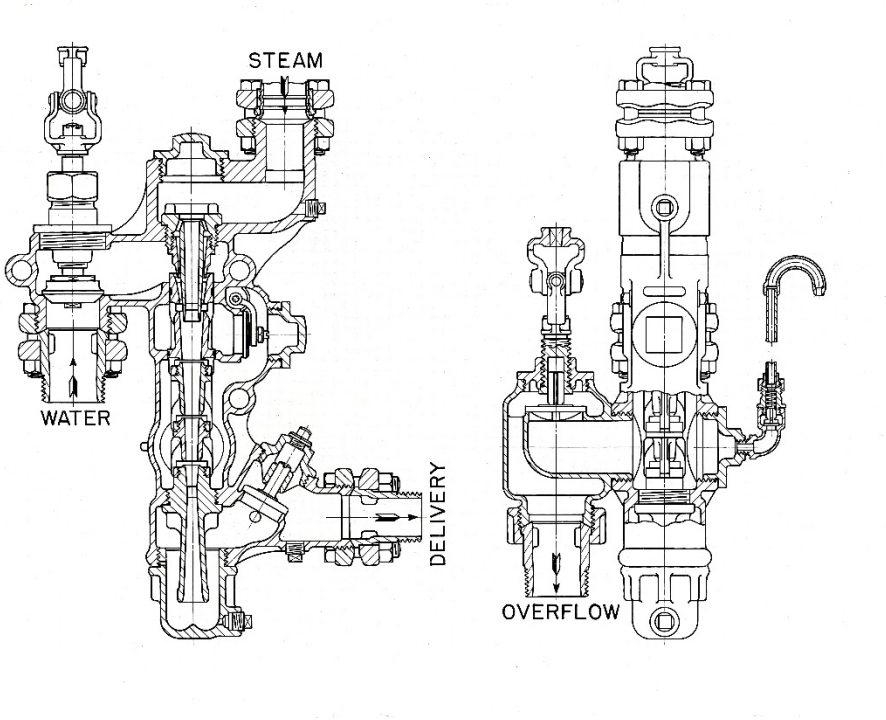
Introduction



The prototype 1918A Injector, cross sectional view.

From original Nathan internal reference drawings

Congratulations on your new 1.6" scale Nathan 1918A injector! Eccentric Engineer has recreated these injectors in miniature as accurately as possible from original Nathan blueprints.

Nathan Manufacturing Co. was founded in 1862 just 3 years after the earliest attempts to manufacture injectors. Focusing initially on items like lubricators and water gauges, they did not introduce their first injector until 1880. Their injectors quickly gained popularity, and by the time the 1918 models were introduced, Nathan was one of the dominant names in injector manufacturing. Many of Nathan's non-lifting size "A" injectors (4018, 4131, 4498) used the same body with slight variations, making this a close match for a wide variety of locomotives.

With any injector, the quality of the installation is the greatest factor to its successful operation. In this manual, we will discuss the best practices for installation, operation, maintenance, and how to troubleshoot if the injector is not working correctly.

Installation

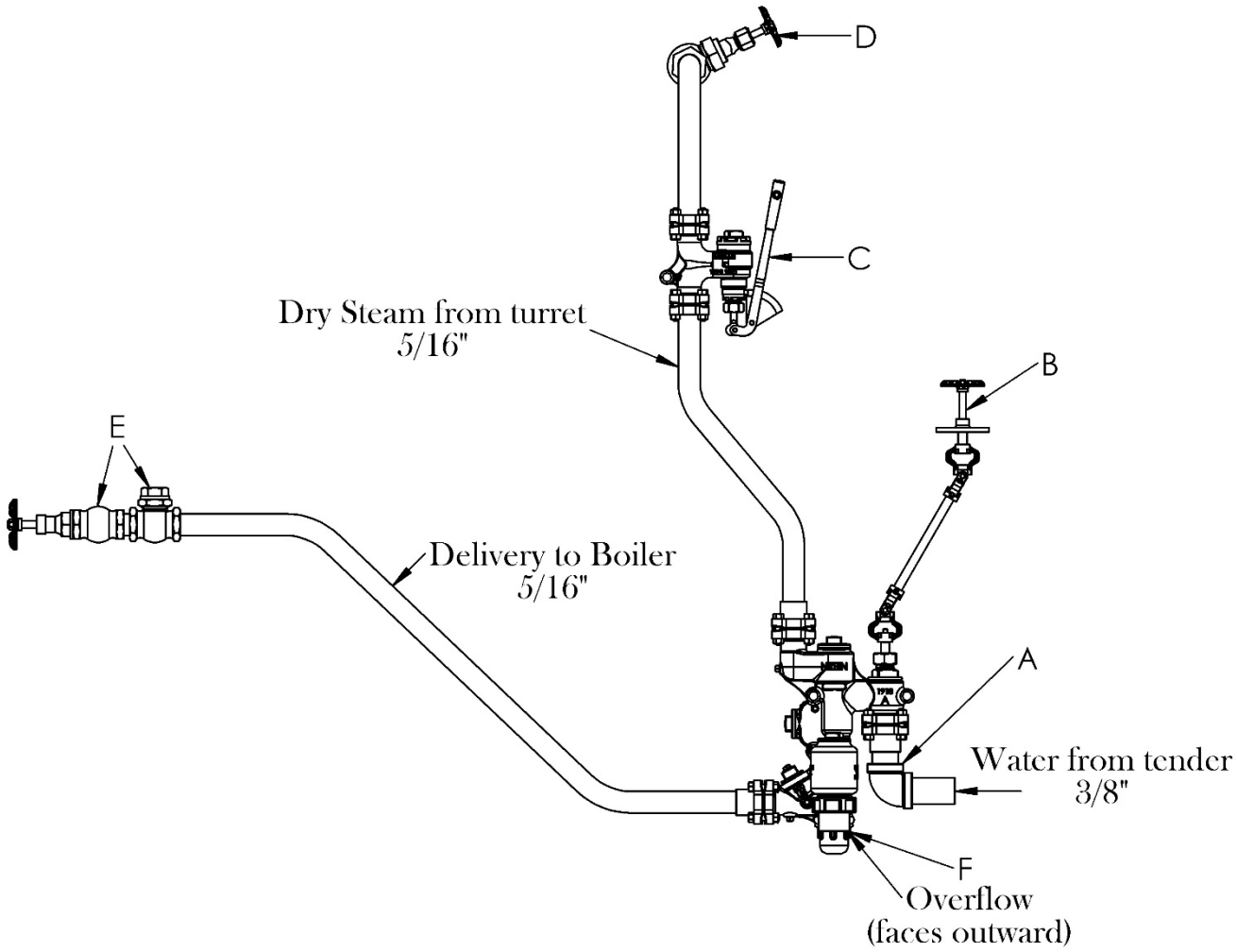


Fig A, Water Suction Line

The water line between the injector and tender must be completely airtight. Use sealant on any threaded fittings and avoid compression fittings if possible. A ball valve on the tender is recommended to use as a shutoff valve and can also be used as a regulating valve.

Fig. B, Water Regulating Valve

The 1918A has a functioning built-in water valve. Universal joints are available if you wish to run an extension rod to the cab of your locomotive. These allow a valve handle to be installed somewhere more easily accessible. If you do not wish to use this valve in operation, EE recommends leaving it adjusted for your maximum operating pressure and use your tender water valve as an on/off valve. The tender valve can then be used to regulate water at lower pressures.

Fig. C, Starter Valve

EE offers a model of Nathan's 1921 injector starter valve, which was designed to work in tandem with the 1918A injector, however it is completely optional.

Fig. D, Steam Shutoff Valve

If you are using a starter valve like the Nathan 1921, a shutoff valve is still strongly recommended. Otherwise, your shutoff valve will serve as your starter valve. Any appropriately sized globe valve or ball valve will work as a steam valve. For flexibility of operation and ease of troubleshooting, "quick start" valves are not recommended.

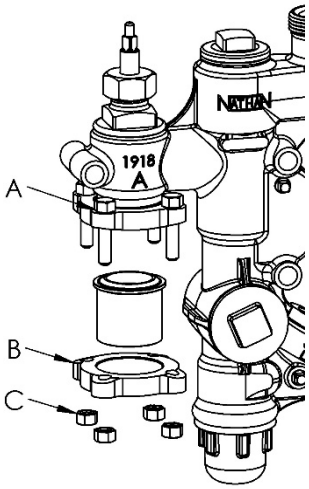
Fig. E, Boiler shutoff & Check Valve

As a bare minimum, a 5/16" MTP (1/16" NPT) check valve should be used. Check valves from PM Research and SuperScale have proven reliable for this injector's capacity. If your check valve does not have a built-in shutoff, it is strongly recommended to have a shutoff valve between the boiler and check valve. This allows the check valve to be safely maintained while the boiler is under pressure.

Fig. F, Overflow

Since the 1918A is to be installed below the cab, the overflow is already ideally positioned near the ground, so an extension should not be necessary. However, overflow diffusers from Keim Steam Pump or SuperScale will suit these injectors very nicely!

Working With Flanges



Having flanges like the prototype really make this injector stand out, but there are some things to keep in mind when working with them.

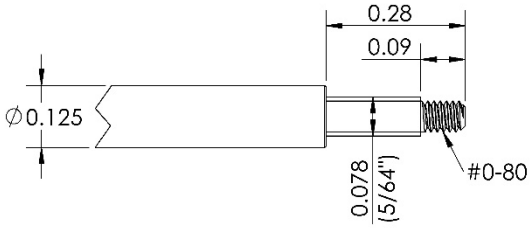
EE recommends keeping the #2-56 bolts mated to the side of the flange that is nearest the injector body, i.e. with the threaded flange. Generally, it doesn't matter if the flange is threaded onto the body with the bolts installed, however on the water suction flange (A), it's critical that the flange be threaded on first to the desired position, then the bolts installed. Otherwise the bolt heads will interfere with the injector body. When disassembling the flange for maintenance, loosen only the nuts, leaving the threaded side of the flange with the bolts installed. Have a cup handy to catch the nuts!

The compressing flange (B) must be placed over your tubing before soldering on the connection!!! Note that there are reliefs on one side the flanges (Fig. B). These must face inward toward each other. The nuts and bolts should not be clamping down on these chamfered edges.

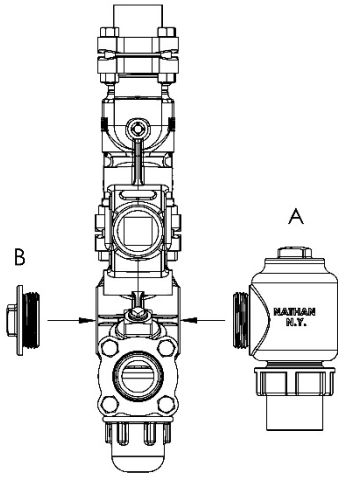
When tightening the nuts (C), first get them finger tight, ensuring that the compressing flange is sitting square with the rest of the assembly. Then, in a crisscross pattern, incrementally tighten down each nut so even pressure is applied all the way around the flange. Tightening in a circular pattern will result in a crooked flange and a leaky joint.

Universal Joints and Extension Rods

EE offers universals pre-assembled and machined to suit the 1918A injector's water valve. If you wish to make extensions using these universals, here is a drawing with features to mate with the universals, identical to the 1918A water valve stem.



Switching Sides



The 1918A's have a left/right arrangement depending on which side the overflow is installed. Standard practice is to have the overflow (A) facing outward so the overflow can be more easily seen from the cab. This can be changed by unscrewing the overflow and body plug (B) and switching them. The threads are clocked so the overflow will always be oriented upright when secured.

Operation

Even though the Nathan 1918A is modeled after a non-lifting injector, this 1.6" scale version has the same internal design as the EE Standard Injector which is an automatic/lifting design. EE does not recommend installing the 1918A in a lifting position, however keeping the internal lifting design lends a lot of flexibility to the injector's operation.

A typical procedure to start your injector would be as follows:

1) Open tender water valve fully
2) Wait for water to flow through the injector via gravity
3) Open the steam valve fully
4) Cut back water valve until overflow runs "dry"
5) Shut off steam valve when water level is satisfactory
6) Close water valve

This procedure will always work provided the installation is sound. However, the automatic design means that the injector will forcefully draw in water on its own without the aid of gravity. If the water valve is open, you are free to open your steam valve.

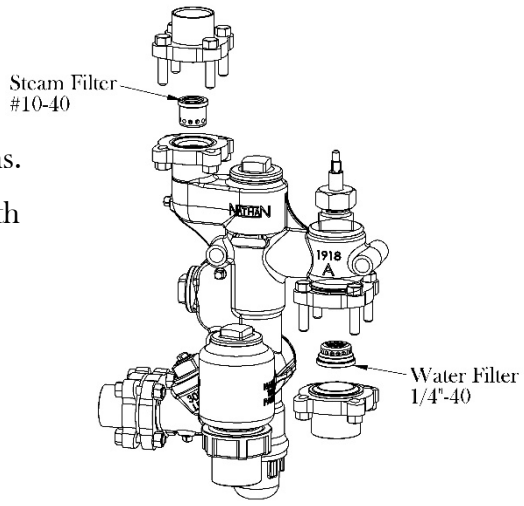
The built-in water valve adds some possibilities to your injector's operation. Having a valve integrated into the injector body offers some major advantages. The greatest vacuum forms between the water valve and the injector, so it is the chief area of concern regarding vacuum leaks. With the valve integrated, the potential problems due to vacuum leaks are greatly minimized.

Even with an extension using universals, the valve handle may still be cumbersome to reach depending on your locomotive, so it may still be most practical to use the tender shutoff as a regulating valve. If you do use the tender shutoff as your water valve, the built-in water valve should be adjusted to suit the highest operating pressure of your boiler. This will help retain the advantages of the integrated valve. To do this, follow the operating procedure above using the built-in valve while leaving your tender shutoff wide open. Once the injector picks up with a dry overflow, continue to close the water valve slowly until the injector starts to drip, then carefully crack the valve back to where it runs dry. This will be the finest delivery setting of the injector at your highest pressure. With the valve set, you can use your tender valve as an on/off valve, and the tender valve can still be used to regulate at lower pressures.

Maintenance

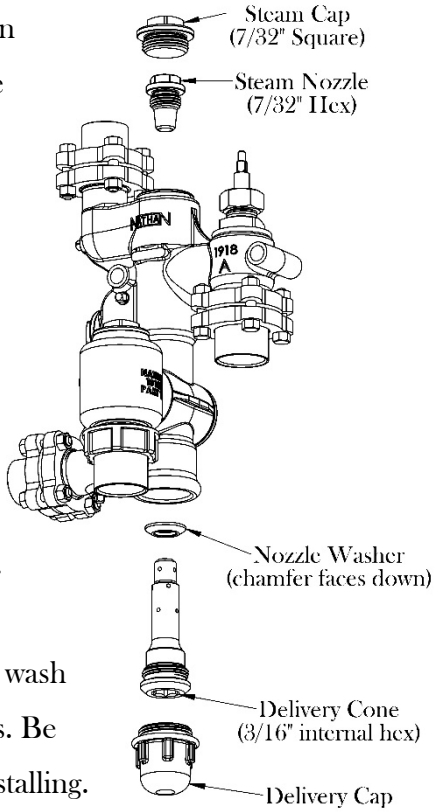
The 1918A has been designed with maintenance in mind from start to finish. As far as EE is aware, this is the first model injector to come with integrated serviceable steam and water filters, which will make the 1918A the most reliable miniature injector ever produced.

Steam and Water Filters



The steam and water filters are recessed into the injector body and held captive by the solder connections. If they are clogged with debris, they can be removed with a #10-40 and 1/4”-40 thread which are provided on the service tool included with your injector. Blow the filters out with air to remove debris.

Nozzles



With the integrated filters, there should rarely be an occasion to remove the nozzles. However, if they become coated in scale or if the washer needs to be serviced, removal is very simple.

The steam nozzle can be removed by first unscrewing the steam cap which features a 7/32” square. The steam cone can then be unscrewed with a 7/32” hex nut driver.

The delivery cone can be removed by first unscrewing the bottom cap. This can be done with a 15/32” socket. An adjustable wrench or ½” spanner wrench will work as well. The delivery cone can then be removed with a 3/16” Allen key.

The washer will come out along with the delivery cone. Be careful not to lose it! If there is problematic scale buildup, a wash in 50/50 CLR and water in an ultrasonic cleaner works wonders. Be sure all mating surfaces are clean and free of debris before reinstalling.

Do not remove the combining cone unless you are replacing it ! Removal will damage it.

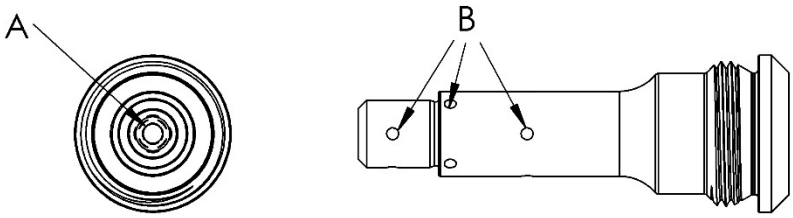
Reinstalling Nozzles

When reinstalling, the steam and delivery nozzle do not need to be tightened excessively. The mating surfaces are machined very precisely, so force is not required to create a good seal. As the injector is used, these nozzles will cement themselves in place due to scale and deposits, so overtightening will make it nearly impossible to remove them in the future. Screw them in until you feel them stop, then give the tool a little extra pinch from there. A bit of copper anti-seize or graphite lubricant is recommended. DO NOT use thread locker.

Obstructed Nozzles

The integrated filters are designed to block any particles large enough to obstruct the delivery nozzle (the narrowest point), but just to be safe let's take a moment to discuss how to safely clear the delivery nozzle.

If your injector was working fine and suddenly stops, a clogged nozzle is the most likely culprit. To check, remove the delivery cone as outlined on the previous page. This has the smallest inner diameter and is the most likely to be clogged. Be sure to look straight through the nozzle (A), and through all 12 cross-drilled holes (B) to make sure there are no obstructions. You should be able to see light clearly through these holes. If the hole pictured in Fig. A is obstructed, use 17 gauge wire to push out the obstruction. ONLY push from the threaded end of the nozzle back toward the cross-drilled end of the nozzle. Failure to do so will lodge the obstruction deeper.
Use 21 gauge wire for the holes shown in Fig. B. The nozzles are machined from 316 stainless. You ***will not*** damage the nozzles by using copper wire or steel gauge pin with caution.



Troubleshooting

The 1918A injector should draw in water and begin injecting or overflowing promptly after opening the steam valve. With the water valve correctly adjusted, the overflow should run completely dry. If there is any variance from this described performance, then something is wrong with the injector or the installation.

Symptoms:

1. Dry steam out of the overflow – See B, J, L, M
2. Water flows freely but injector won't pick up – See A, C, E, H, I, L
3. Injects, but overflow will not run dry – See A, B, D, I, K, L
4. Overflow sputters water and steam during operation – See A, B, H, I, J, L
5. Consistently drips water during operation – A, B, D, I, K, L
6. Steam coming from overflow while injector is not in operation – See F, N

Potential problems:

A. Leak in water suction pipe
B. Obstruction in suction pipe or clogged water filter
C. Clogged delivery nozzle
D. Restricted delivery line
E. Check valve shutoff closed
F. Check valve leaking / stuck open
G. Restricted overflow
H. Wet steam into injector
I. Feed water too warm
J. Water tank empty
K. Worn out nozzles
L. Water valve improperly adjusted
M. Missing steam nozzle
N. Leaky steam valve

Solutions

A. Leak in Water Suction Pipe

Tighten every joint or fitting between the injector and water adjustment valve, including the union in the injector body. Start the injector. If the problem persists, start the injector and run a water hose over every joint between the injector spanner nut and the water tank shutoff valve including solder joints. If water runs over a leak, it will effectively seal the leak and the injector will begin to inject or run dry. If the leak cannot be located this way, it is possible there is more than one leak.

B. Obstruction in Suction Pipe or Clogged Water Filter

If the suction pipe is clogged, either in the line or in the filter, this can act the same as having the water valve closed too far or shut entirely. If possible, first clean out the water filter to rule out that potential issue. Blow out the water lines with steam or air and be sure water is flowing freely out of the tender with the lines disconnected.

C. Clogged Delivery Nozzle

To check if the delivery nozzle is clogged, remove the bottom cap so the injector can discharge into atmosphere. If the installation includes a deck hose or auxiliary line that operates off the injector's delivery, open that valve to check delivery pressure. If the injector is working properly, there should be a very forceful jet of water. If the discharge is unimpressive, then the delivery nozzle is most likely clogged. If the delivery is unimpressive and there are visible air bubbles in the water, then refer to section A.

D. Restricted delivery line

If water flows from the overflow no matter how the injector water valve is adjusted, then it is possible that the delivery line is too restrictive. This could be due to restrictive fittings, pipe with too small of an I.D., a check valve that is too small, or a shut off valve with excessively small passageways. Be sure that all fittings and pipes in the delivery system have a minimum I.D. of 1/4" to ensure optimal performance.

E. Check Valve Shutoff Closed

Make sure the shutoff to the boiler check valve is open.

F. Check Valve Leaking or Stuck Open

If possible, close the check valve shutoff and maintain the check valve. The injector should be able to operate normally if the leak is not severe, however if it is so severe that the injector will not operate, or boiler water loss is significant and there is no secondary injector, follow this procedure:

Close the shutoff to the check valve. Start the injector as normal and set the water valve to its normal operating position. Its delivery will discharge out the overflow with the check valve shut. Slowly open the check shutoff until the injectors overflow runs dry. If the injector breaks while opening the shutoff valve, close the valve and restart the process with the water valve open slightly more than before. When the water level is satisfactory, close the check valve and shut off the injector. If the leak was due to debris, this may fix the leak. If there is a more serious problem with the check valve, this procedure will keep your boiler full until you can safely shut down your locomotive.

G. Restricted Overflow

The overflow line should be at least 3/8" and have as few fittings as possible. Any small or sharp fittings can result in a backflow of steam into the injector, preventing priming.

H. Wet Steam into Injector

If the steam line taken from the boiler is not from a dry pipe, water can be sucked into the steam line. Move the line to a point where it can only receive dry steam. If the boiler water is too high, or contaminants are causing foaming, this can cause priming as well.

I. Feed Water Too Warm

For optimal performance, the feedwater temperature should be 60-80 degrees Fahrenheit. The injector will work with hotter feedwater temperatures, but efficiency and performance will decline. If the feedwater tank is too warm, top off the tank to bring the temperature down. If

the tank is full and still too warm, partially drain the tank before adding cool water. Adding ice to the tender will get you by, too!

J. Water Tank Empty

Be sure to check water tank level frequently to avoid a low water emergency.

K. Worn Out Nozzles

If overall performance has declined, it may be time to replace the nozzles. However, with the frequency the typical hobbyist runs, it should be many decades before the stainless nozzles wear out. Eccentric Engineer keeps extra sets in stock should you wish to replace them!

L. Water Valve Improperly Adjusted

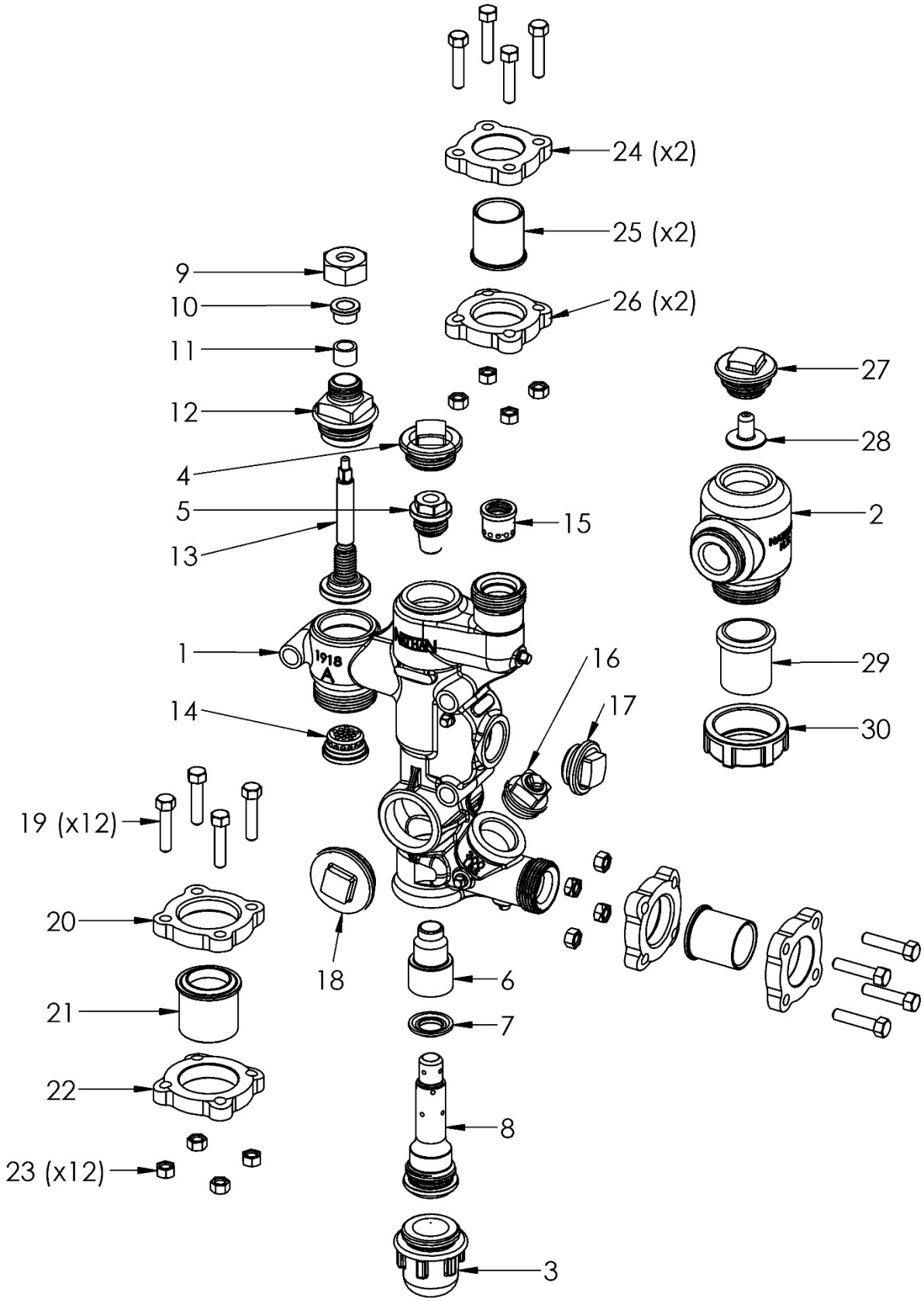
If water is pouring from the overflow during operation, the first thing to try is slowly close the water valve. If the overflow does not dry up, and instead goes from pouring water to sputtering steam, then there is another issue that needs to be addressed. See A, C, H, I, or K.

M. Missing Steam Nozzle

A rare occurrence, but occasionally steam nozzles get lost during maintenance without notice. If it is missing, the injector will not be able to create a vacuum nor will it inject. You will notice an immediate switch from gravity fed water to dry steam, and steam bubbling back into the tender. Remove the top steam cap to make sure the steam nozzle is in place.

N. Leaky Steam Valve

A leaky steam valve can wreak havoc on an injector. If steam is constantly wisping through your injector, the best solution is to fix or replace the leaky valve. The injector will work fine if it is hot, but the steam will also heat up the feedwater line to the point where it can not combine with steam. Luckily with a non-lifting injector, you can simply leave your tender valve open to let the warm water pass through. Once cooler water has reached the injector, it will operate normally.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3

Nathan 1918A Parts List

1 – Main Body

2 – Overflow Body

3 – Bottom Cap

4 – Steam Cap

5 – Steam Nozzle*

6 – Combining Nozzle*

7 – Nozzle Washer*

8 – Delivery Nozzle*

9 – Water Valve Packing Nut

10 – Water Valve Packing Follower

11 – Water Valve Teflon Packing

12 – Water Valve Bonnet

13 – Water Valve Stem

15 – Water Filter*

16 – Delivery Check Cap

17 – Combining Chamber Cap

18 – Body Overflow Plug

19 - #2-56 Bolt (x12)*

20 – Water Threaded Flange

21 – Water Solder Connection*

22 – Water Compression Flange

23 - #2-56 Nut (x12)*

24 – Steam/Delivery Compression Flange

25 – Steam/Delivery Solder Connection*

26 – Steam/Delivery Threaded Flange

27 – Overflow Cap

28 – Overflow Check Plunger

29 – Overflow solder connection*

30 – Overflow Spanner Nut

*Replacement parts can be ordered from www.EccentricEngineer.com/spare-parts

If you need a replacement part that is not on the website, let us know how we can help!

Eccentric Engineer

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