HP Designjet H-Series
HP Scitex FB950 Printer

Troubleshooting vacuum issues

Part number TN2807 Revision A

1 Vacuum system overview

The HP Designjet H-series (former ColorSpan 5400UV series) and HP Scitex FB950 use an air vacuum and pressure system applied to the printheads. This document explains the system from the perspective of the observable symptoms when there is a problem. The goal is to assist users of these printers to troubleshoot small problems, prevent larger issues, and communicate accurately to HP Customer Care when things do go wrong and more help is needed.

1.1 How vacuum is used

Each printhead found in the carriage is an assembly composed of two parts: the actual piezo inkjet printing component, and a small reservoir to hold ink for immediate jetting.

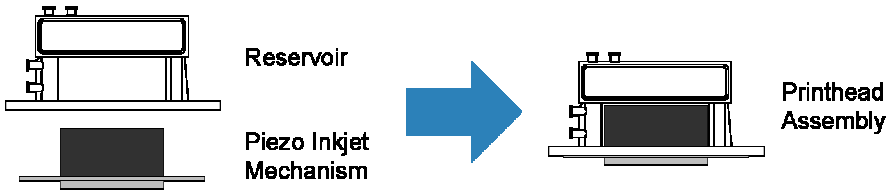

Figure 1 Printhead assembly

Vacuum is delivered to the printhead-reservoir assembly (hereafter simply “printhead”) by a pair of clear tubes that attach to the tops of the printheads. On the HP Scitex FB950, the Designjet H45100, and the Designjet H45500, there are two printheads per color. On the Designjet H35100 and Designjet H35500, there is one printhead per color. In configurations with one head per color, the two primary air tubes connect directly to the single reservoir. In the configurations with two heads per color, one primary air tube connects to each reservoir.

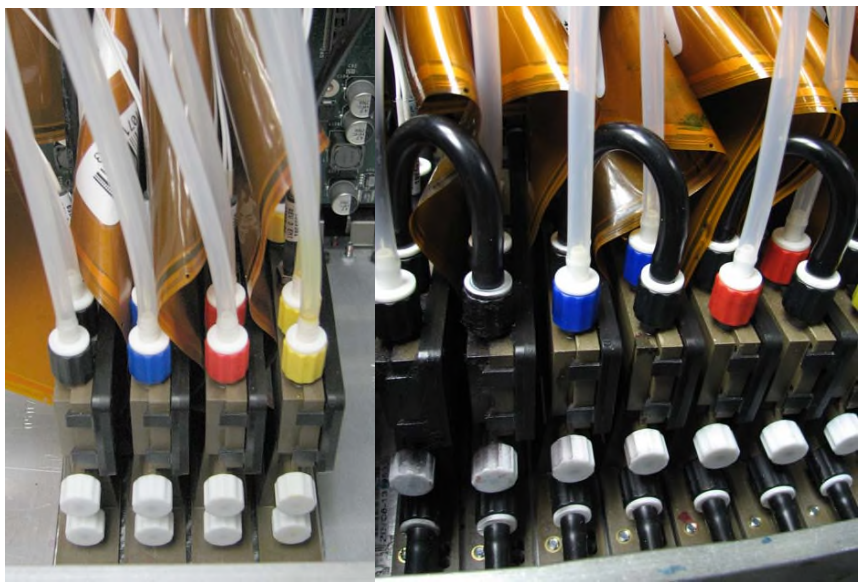

Figure 2 Printhead air tube configurations. Left: H35100; H35500 similar; Right: FB950, H45100 and H45500 configuration (only some printheads shown)

On the two-heads-per-color configurations, a secondary, opaque U-tube at the top of the reservoir connects the two printheads as well. A second U-tube at the front of the reservoir allows ink to flow between the two printheads. The two primary air tubes shown in Figure 2 join at an “F” fitting (“C” in Figure 4) that installs into the air manifold, discussed in section 1.2.1 of this document.

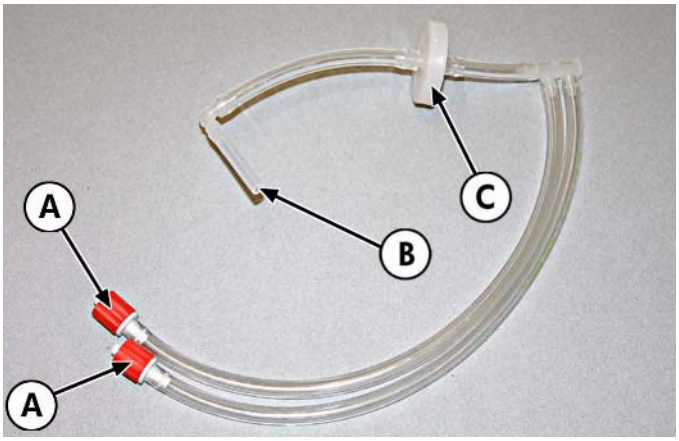

Figure 3 Current versions of the dual air tube assembly with ink-blocking filter (C). The tubing is flexible Tygon type.

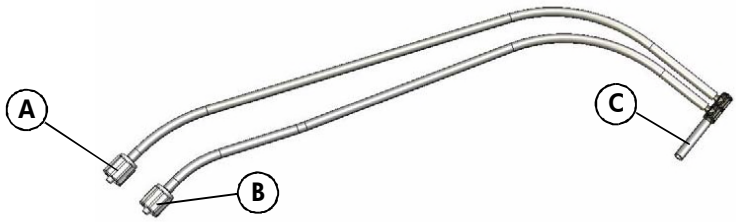

Figure 4 Older revision of dual air tube without filter. In addition to lacking the ink-blocking filter, the tubing is semi-rigid LLDPE (Linear Low-Density Polyethylene).

Each reservoir holds about 20 ml of ink. Without vacuum, any ink in the reservoir will find its way to the jetting orifices found on the bottom of the printhead and eventually drip out. To prevent this, a small vacuum (negative air pressure) is exerted against the ink through these clear air tubes. This is the same effect as when you put your finger over the end of a straw in a glass of water and lift the straw out of the glass. The vacuum at the top of the straw keeps the water in place.

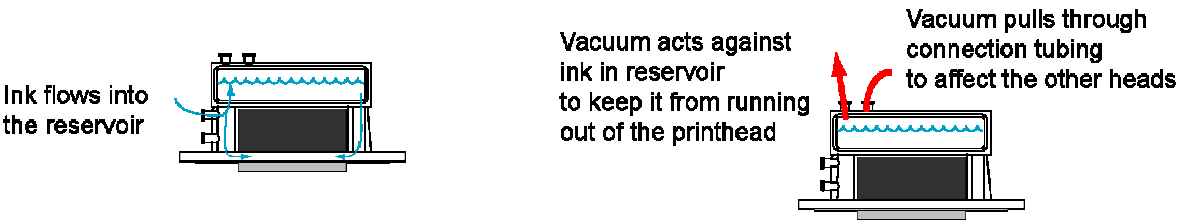

Figure 5 Ink flow and air flow

1.2 Vacuum system components

The preceding section has already identified the following vacuum system components:

- Printhead reservoirs
- Carriage air tubes
- U-tubes

The following additional components are used to deliver the vacuum to the carriage air tubes:

- Valve & manifold assembly
- Long tube in the track
- Vacuum assembly, also known as the IDS (Ink Delivery System) vacuum and sometimes as the Vacuum/Pressure or “VP” assembly.

1.2.1 Valve & manifold assembly

The valve & manifold assembly is located near the top of the back side of the carriage.

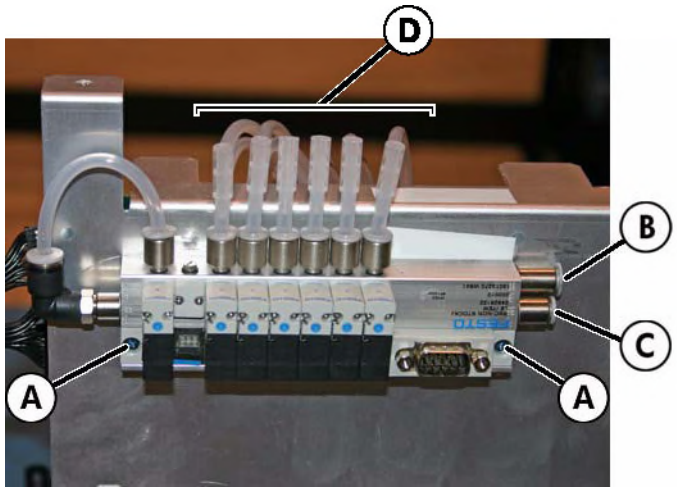

Figure 6 Valve & Manifold assembly

The manifold accepts a long tube carrying vacuum at location “B” and a long tube carrying pressure at location “C”. (See elsewhere in this document for a discussion of the function of positive pressure.) The fittings at location “D” are the F-fittings shown in Figure 4; on newer printers these are instead the elbow fittings visible in Figure 3, item “B”.

1.2.2 Long air tubes in the track

The track is the black plastic chain that carries all cables and tubes that come from the carriage down to other printer components. The air vacuum tube is a semi-rigid LLDPE tube type that is 3/16″ (5 mm) in outer diameter. The air pressure tube is also semi-rigid but is 1/8″ (3 mm) in outer diameter. (Again, see elsewhere in this document for a discussion of the function of positive pressure.)

1.2.3 Vacuum assembly

The vacuum assembly comprises a number of different components that generate and moderate the vacuum.

1.2.3.1 Location of the vacuum assembly

On both FB950 and H-Series models, the vacuum assembly is concealed inside the printer and not normally visible without removing printer enclosures. Figures 7 and 8 show the approximate locations of the vacuum assembly on the respective models.

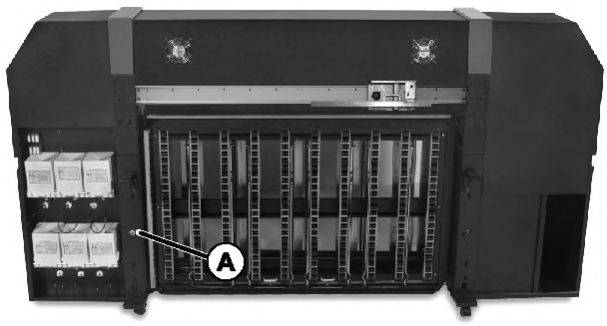

Figure 7 Location of vacuum assembly (inside printer enclosures) on Designjet H-Series

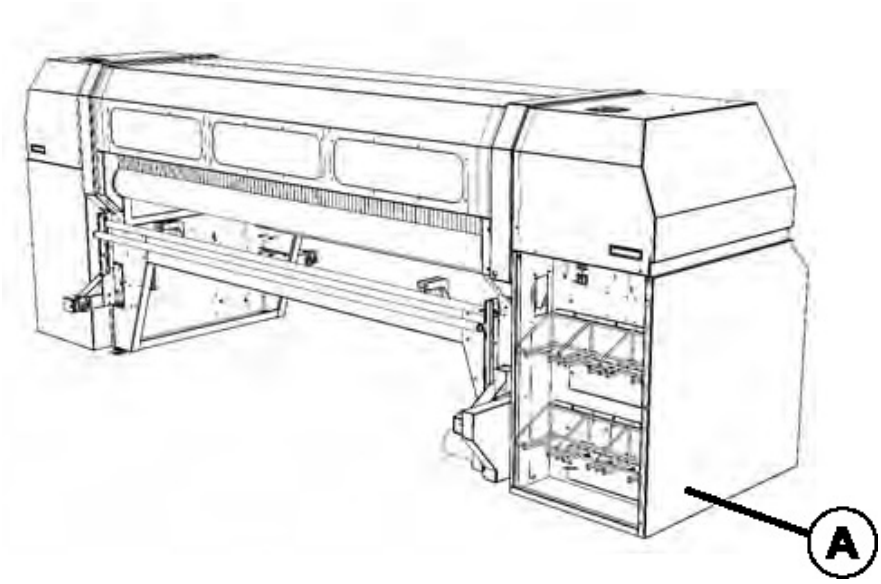

Figure 8 Location of vacuum assembly (inside printer enclosures) on HP Scitex FB950

The vacuum assembly itself is a small, silver-colored aluminum box. On newer H-series printers and all FB950 printers, attached to the box is a white cylinder that somewhat resembles a bottle. Older H-series printers do not have this feature. The white cylinder is a filter for the air intake of the vacuum system.

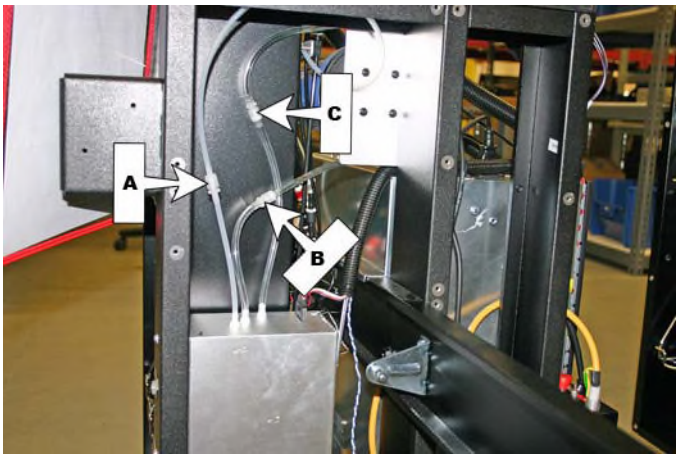

Figure 9 H-Series original-style vacuum assembly without external filter is visible at the lower left. The newer-style is in the same location but has the filter shown in Figure 10.

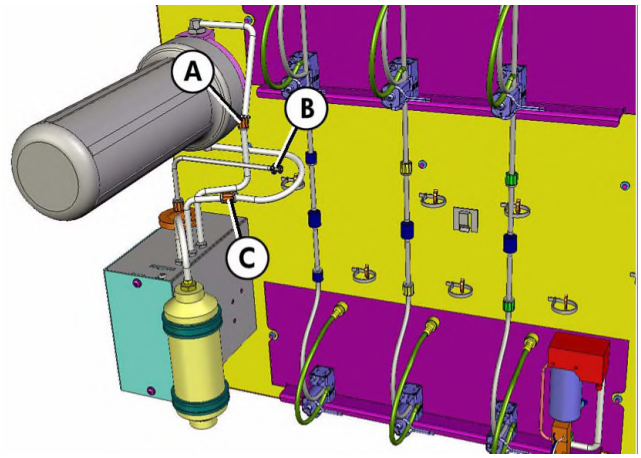

Figure 10 Drawing of FB950 vacuum assembly with external filter

1.2.3.2 Sub-components of the vacuum assembly

The vacuum assembly contains a number of individual components as well as tubing that are used to create, regulate, and sense the vacuum. The primary components include all of the following:

- Pump
- Regulator
- Restrictor fitting
- Circuit board

Figure 11 shows these component locations in the FB950 and newer H-series assembly.

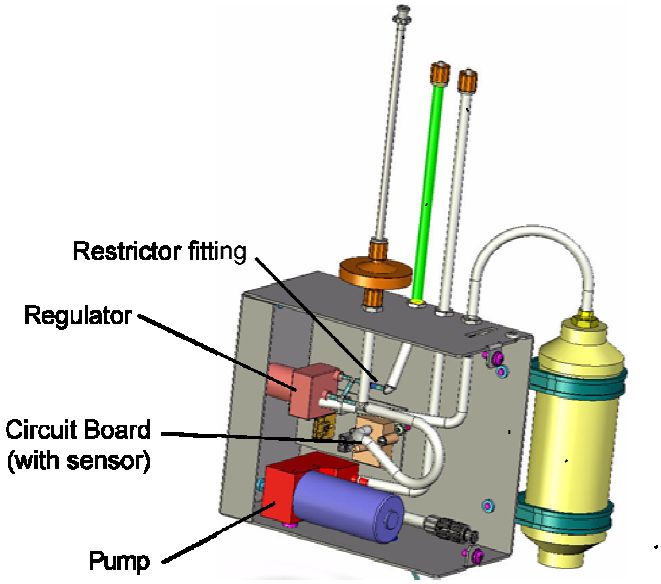

Figure 11 Primary components of the vacuum assembly

In the older H-series assembly only, the vacuum sensor is an individual component mounted separately within the vacuum assembly enclosure. A separate switch is also found in the older assembly; in the newer assembly, the switch function is integrated onto the circuit board.

1.3 Luer cap retention clamp

This component is not precisely part of the vacuum system as it is external to all the vacuum-related parts and is, strictly speaking, completely optional. It is a spring-loaded clamp that slips over the ink

U-tubes and applies pressure on the Luer caps on the front of the printhead reservoirs. These caps sometimes loosen and create a vacuum leak; see section 2.2.2.4 for details.

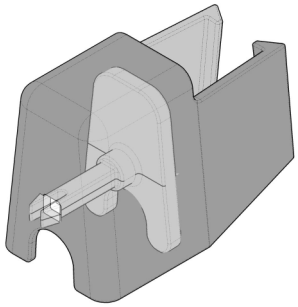

Figure 12 See-through drawing of a Luer retention clamp (spring not shown)

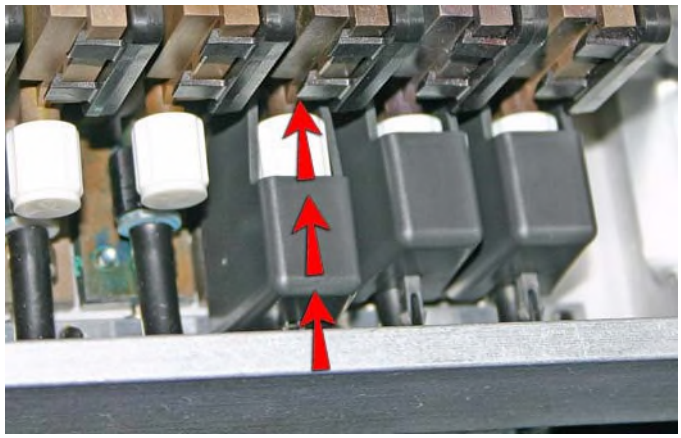

Figure 13 Luer clamps installed

The retention clamp was added to all FB950s, both new and already installed, in mid-2009. The clamp is compatible with the H-series as well, but new manufacturing of H-series printers had concluded by the time the clamp was introduced. Customers who find they have recurring issues with the Luer caps on the printhead reservoirs may wish to invest in a set of these clamps. Note, however, that the clamp requires a “taller” Luer cap than is standard on H-series, see Figure 14.

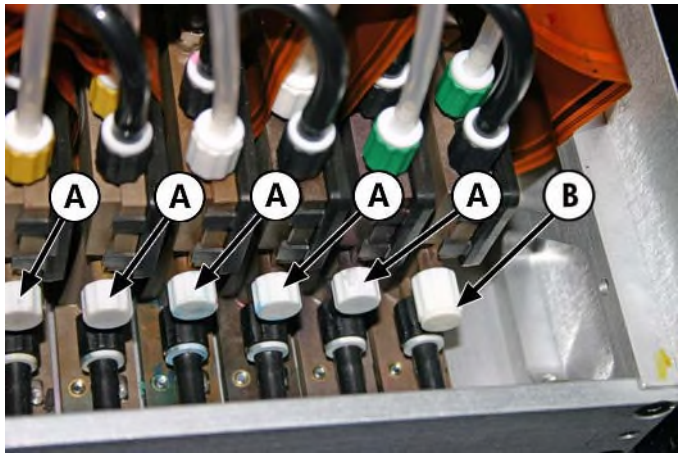

Figure 14 Original size Luer cap (A) and larger cap (B) required with Luer clamp use

Consult Table 1 in Section 6 for applicable part numbers related to both the clamp and the taller Luer cap.

2 Common vacuum-related problems and their solutions

In this section we describe the most common problems that customers have reported involving the vacuum system, and offer techniques to help the printer operator determine the source of the problem and how to resolve the issue.

2.1 Definitions of “normal”

Before embarking on a catalog of problems and solutions, it is important to establish what is normal and expected of the vacuum system. The following is quick summary of what one would expect to observe in a working vacuum system.

2.1.1 Status indications

In a normal and working system, the control panel will show a vacuum pressure status of around 5.25 ″H2O (9.35 mmHg). A variation of plus-or-minus 0.25 ″H2O is acceptable. See Figures 15 and 16 in the following section.

2.1.2 Audible indications

In a normal and working system, the vacuum pump will make a noise every 2-10 seconds, usually for a duration of 1-2 seconds, sometimes less. There is a wide range of acceptable frequencies and durations; the essential understanding is that the pump should not run continuously nor should it never run. As long as the vacuum status is at the nominal range and there are no visual indications of a problem, e.g., ink dripping from the printheads, then whatever periodic sounds the vacuum pump is making are likely acceptable.

2.2 Issues and solutions

2.2.1 Vacuum pressure too low

The observable symptom here is that the vacuums status indicator on the control panel is less than 4.75 ″H2O. On the FB950, there is a green and yellow indicator on the left side of the control panel (“A” in Figure 15). Any value in the green zone is acceptable; any value outside the green zone should prompt further inspection of the system.

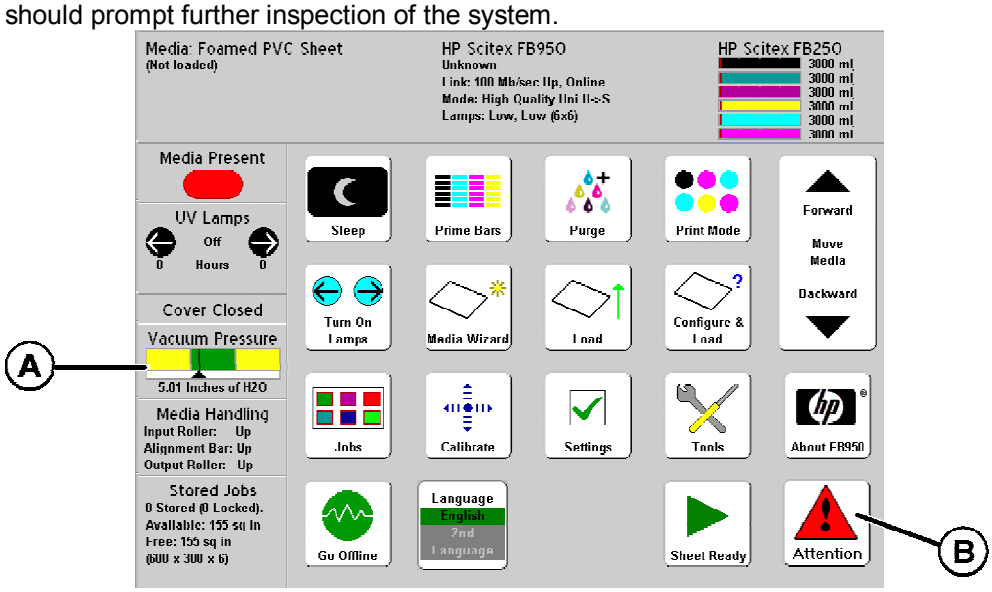

Figure 15 Control panel for FB950

The H-series control panel does not have this visual indicator, but the current vacuum level may be viewed by selecting the following:

1. Touch the top-center Printer Status area of the control panel.
2. Press the “System Info” button.
3. View the vacuum status on page 1 of 4.

See Figure 16.

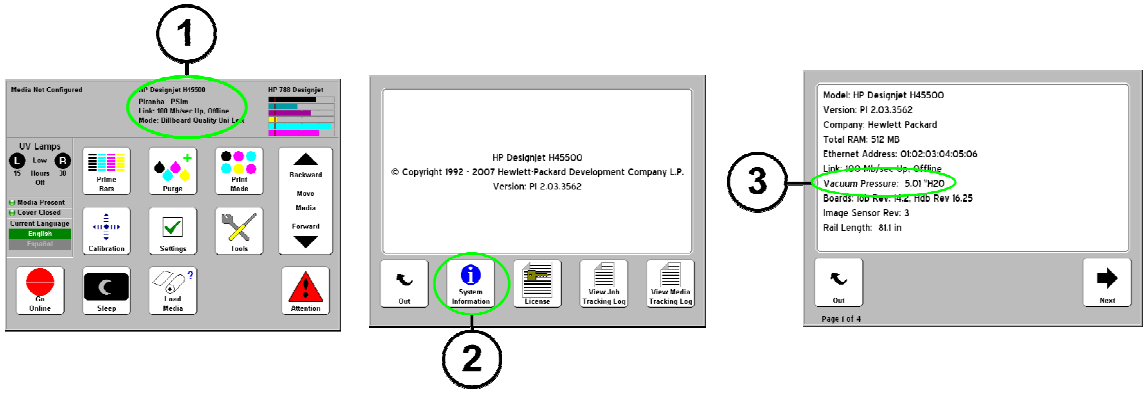

Figure 16 Keystrokes to show H-series vacuum status

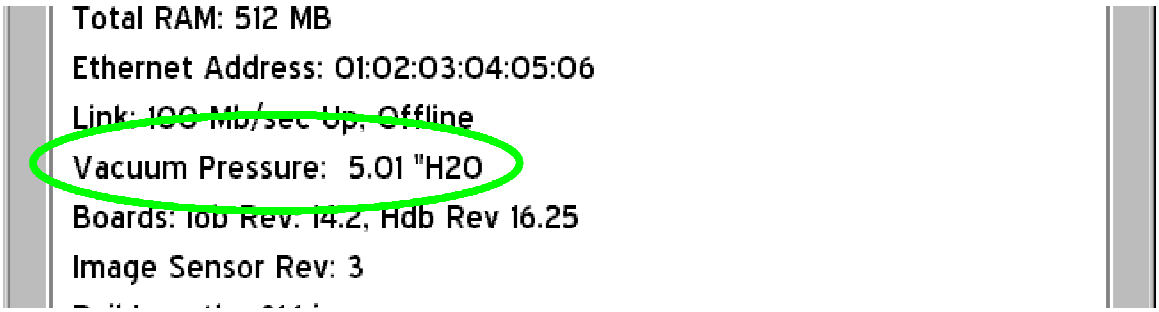

Figure 17 Detail of H-series vacuum status display

In addition to the vacuum status, if vacuum is too low there will be a Warning in the Attention Queue (“B” in Figure 15) that states the vacuum is too low. See Figure 18.

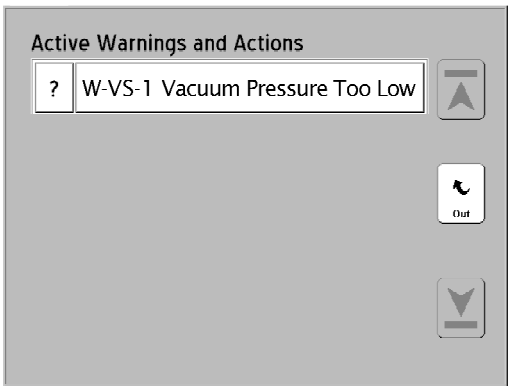

Figure 18 Vacuum Too Low warning (H-Series shown; FB950 similar).

IMPORTANT: Vacuum is sensed in the vacuum assembly, not at the carriage or printheads. For example, a circumstance that blocks the dual air tube for one color will cause those printheads to lose vacuum and drip, but the blockage may also seal off the tube. From the perspective of the vacuum sensor, the system will be closed and operating normally. The vacuum status will show a normal reading and will not cause the W-VS-1 warning to be displayed.

2.2.1.1 Causes and solutions

2.2.1.1.1 The vacuum pump is not running

- There is no power to the vacuum pump from either the main printer power or from the external auxiliary 24V power supply. To test, remove the external 24V power supply, if present. The pump should operate from main printer power. If not, reconnect the 24V power supply. If the pump is now audible, then the mini 24-VDC power supply in the printer has failed and requires replacement.
- The circuit board that manages the power inputs has failed. If the vacuum pump does not operate from either main printer power nor from the external power supply, then the circuit board in the vacuum assembly may have failed. However, this symptom can also be confused with failure of the vacuum pump.
- The vacuum pump has failed. If the pump does not operate from either main printer power or from the auxiliary power supply, the pump may have failed. If verification is desired, the pressure pump located near the ink pumps is identical to the pressure pump. By exchanging the locations of these pumps, you may be able to determine if a pump has failed or if the vacuum assembly circuit board has failed.
- On older H-series models only, the vacuum switch may be stuck. See Section 2.4.6 for more details.

See following section 2.4 for more information regarding a vacuum pump that is not running.

2.2.1.1.2 The regulator is incorrectly set

The regulator is adjusted via an external control point. If the regulator has been set too low, the vacuum generated by the system will be lower than the acceptable threshold and the printer will show the Vacuum Pressure Too Low message.

The procedure to set the regulator depends on whether the vacuum assembly is an original-style H-series model or the newer H-series version with the large external filter. All FB950 printers have the newer style. To determine which version is installed on an H-series printer without removing any enclosures, locate the auxiliary power input location (“A” in Figure 19). If a green LED is visible at the power port (slightly recessed in the printer), then the vacuum assembly is the newer style. If no LED is visible, the vacuum assembly is the older style.

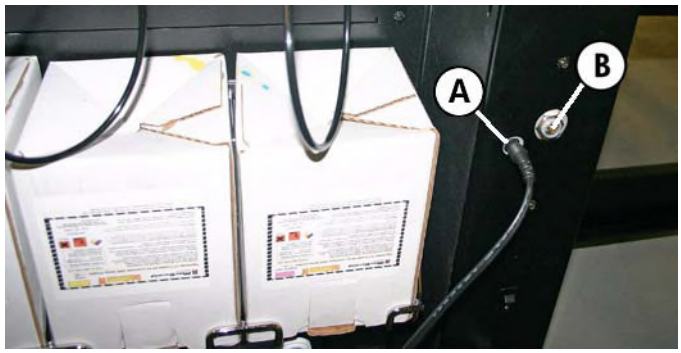

Figure 19 H-series auxiliary power input (A) and regulator adjustment location (B)

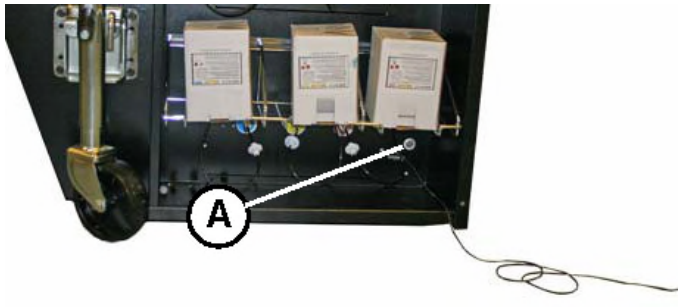

Figure 20 FB950 regulator adjustment location (A)

2.2.1.1.2.1 Adjusting older-style assembly (H-series only):

1. Use the keystrokes shown in Figure 16 to display the vacuum status.
2. If the vacuum level is less than 5.0 at its highest level during a pump cycle, turn the adjustment screw 1/8th turn clockwise and wait for the system to complete a vacuum pump cycle.
3. Watch the display showing the vacuum level. The vacuum level will rise as the pump runs. Record the highest level the vacuum reaches during a pump cycle. The goal is for the vacuum level to reach 5-inch of vacuum at its highest level during a pump cycle.

NOTE: The correct time to take a vacuum-level reading is immediately after the vacuum pump turns off. The vacuum level normally declines continuously while the pump is idle. Do not take vacuum-level readings after the pump has been idle or while the pump is running. Take the reading as soon as the pump stops, which is the end of the pump cycle.

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4. If the vacuum level is still low, and the vacuum pump is not running, turn the vacuum regulator screw ("B" in Figure 19.) clockwise until the pump turns begins to run.

   The vacuum assembly should respond to changes made with the regulator screw within five to ten seconds of turning the screw.
5. Allow the vacuum level to settle to its new setting.

   Allowing the vacuum level to settle should take no more than 60 seconds.

IMPORTANT: Keep track of how far you move the regulator. If the vacuum status does not start to change after the equivalent of ½ of a full turn, it is unlikely that turning it more will have any effect. It is most likely that there is a leak somewhere in the air system. Return the regulator back to its original position before attempting additional troubleshooting steps.

2.2.1.1.2.2 Adjusting newer style assemblies (newer H-series and all FB950)

1. Check the printer's vacuum level from the control panel as indicated in Figure 15 or 16.

NOTE: The correct time to take a vacuum-level reading is immediately after the vacuum pump turns off. The vacuum level normally declines continuously while the pump is idle. Do not take vacuum-level readings after the pump has been idle or while the pump is running. Take the reading as soon as the pump stops, which is the end of the pump cycle.

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2. If the vacuum level is below 5.3 at the end of a pump cycle, turn the adjusting screw 1/8th turn clockwise.
3. Repeat step 6 until the vacuum level is between 5.3 and 5.5 at its highest level during a pump cycle.

IMPORTANT: Keep track of how far you move the regulator. If the vacuum status does not start to change after the equivalent of ½ of a full turn, it is unlikely that turning it more will have any effect. It is most likely that there is a leak somewhere in the air system. Return the regulator back to its original position before attempting additional troubleshooting steps.

2.2.1.1.3 There is a leak in the system

A leak in the system is effectively a relatively large opening somewhere that allows outside air to enter the vacuum tubing. The vacuum system is unable to overcome this unexpected influx of air and so cannot create the desired level of vacuum. The vacuum pump may run continuously as it attempts to overcome the opening.

A leak will generally cause other symptoms to appear, most commonly the dripping or drooling of ink from the printheads. Determining if only one color or if multiple/all colors are dripping will point you in the right direction to find the leak quickly. Continue to the following subsections on ink dripping.

2.2.2 Ink dripping from one color channel/printhead

If only one color (be it one printhead or two) is dripping, then the air leak is most likely either in the printhead reservoir(s) or the on-carriage air tubes. In less common circumstances, the air valve for the specific color may be the problem.

2.2.2.1 Checking the on-carriage air tubes

A crack or other opening in the on-carriage air tubes will allow air to infiltrate the system and prevent the desired vacuum from being achieved. It is simple enough to swap the air tubes between one color and another and see if the problem transfers with tube, or if the problem stays with the original head or heads.

To swap the air tubes, loosen the fittings shown in Figure 2 on the dripping printhead(s) and on an adjacent color that is not dripping. Cross the tubes and reconnect them. Wipe the bottom of the printheads with a lint-free cloth and HP printhead flush solution to clear away old ink, then observe for new drips.

- If the original printhead(s) continue to drip, the problem is not the tube or the valve. Proceed to the following section regarding reservoirs.
- If the original printhead(s) stop dripping and the adjacent color with which the tube was swapped begins to drip, the problem may be in the tubes or in the valve. Proceed to the following section on checking the valve.

2.2.2.2 Checking the valve

Swap the air tubes at the printheads as described in section 2.2.2.1 and evaluate which heads stop/start dripping. Then, swap the fitting (“C” in Figure 4 or “B” in Figure 3) at the manifold.

To remove a fitting from the manifold, depress the compression ring as shown in Figure 21 and pull the tube out of the manifold.

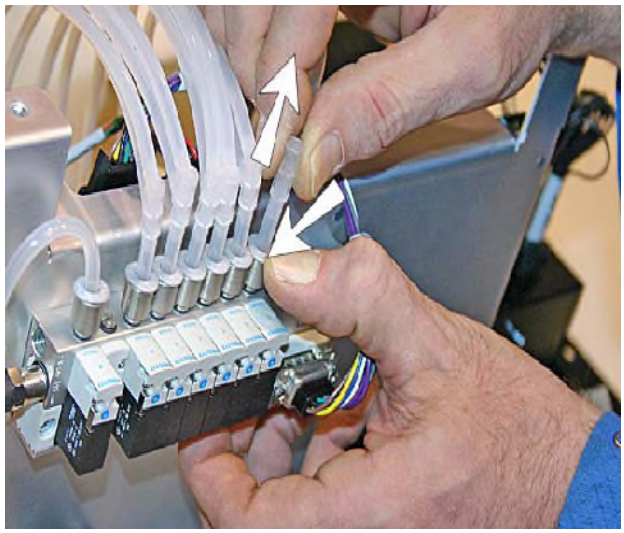


Figure 21 Removing a fitting from the manifold

To insert the fitting, press down on the compression ring while inserting the fitting. Release the compression ring to secure the fitting.

Wipe the bottom of the printheads with a lint-free cloth and HP printhead flush solution to clear away old ink, then observe for new drips.

- If the original printhead(s) resume to dripping, the problem is the valve.
- If the adjacent printhead(s) continue dripping, the problem is the tube.
- If the problem has never changed from the original printhead(s), the problem is the reservoir(s). Proceed to the following section regarding checking the reservoirs.

See also section 4.1 for a test of the valve operation.

2.2.2.3 Checking the reservoirs

Each reservoir is actually a two-piece construction: the main reservoir body (“A” in Figure 22) and the cover (“B” in Figure 22).

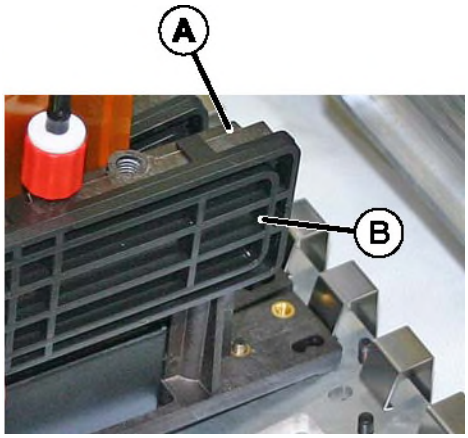


Figure 22 Reservoir body and cover assembled

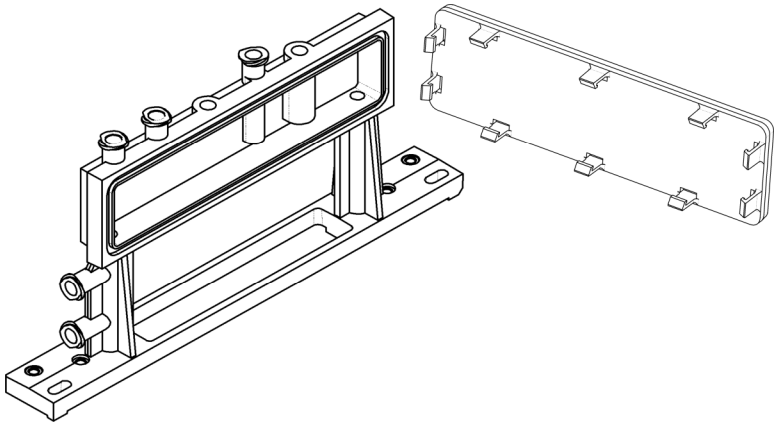


Figure 23 Drawing of an unassembled reservoir and cover

These pieces are assembled and sealed at the factory and are not intended to be separated at any time. However, mechanical stress or other events may cause the seal to fail. In some instances and depending on the location of the failure, leaking ink around the seal may reveal a failed reservoir. This ink leaking from a reservoir must be differentiated from ink that drips out of the bottom of the printhead. In other cases, however, the leak size and location are not enough for ink to leak out, but are enough for air to get in and disrupt the normal operation of the vacuum system.

When the reservoir seal is compromised, several observable symptoms may occur either simultaneously or in succession:

- The vacuum status may drop below normal and a “Vacuum Pressure Too Low” warning may be displayed.
- Ink may start to drip out of the bottom of the affected printhead(s), or from all printheads if the vacuum drop is low enough.
- On the affected printhead(s) only, liquid ink may be observed rising up into the air tubes. This will be a solid column of liquid ink, not merely discoloration in the tube indicating that ink once was there (although that discoloration can indicate that there has been a reservoir leak in the past). The ink column typically will rise only a few inches or less, possibly not even reaching as high as the ink-blocking filter embedded in the air tube.

It is very easy to check if the reservoir(s) is the source of the air leak and the cause of the ink dripping and possible “Vacuum Pressure Too Low” message.

1. Disconnect both air tubes from the suspected reservoir(s) (see Figure 24).

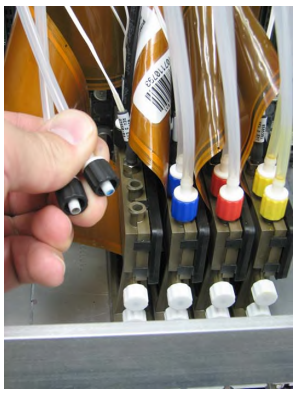


Figure 24 Both air tubes removed from a printhead in an H35100.

2. If available, use Luer plugs to cap off both air tubes (see Figure 25); otherwise, use some other airtight method to seal off these tubes.

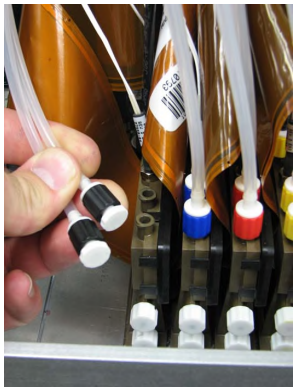


Figure 25 Both tubes capped with Luer plugs

CAUTION: Do not remove a single tube, cap it, and then remove the second tube. Capping one tube may create a siphon effect and begin to draw ink up the second air tube before it can be removed from the reservoir. Always remove both air tubes together and then cap each tube.

3. If the reservoir(s) is the sole cause of the air leak, the vacuum status should quickly go back up to the normal range and the vacuum system should stabilize.

   On printers with two printheads per color, such as the H45100 and H45500 and the FB950, you may choose either to replace both reservoirs or to conduct additional troubleshooting to attempt to isolate one reservoir or the other as the single source of the problem. In many cases a visual inspection of the reservoirs will lead to an indication such as an ink leak or a visible deformity in the reservoir cover, etc.

   If there are no visual indications and it is desirable to determine if only one reservoir requires replacement, then each reservoir must be isolated by removing the U-tubes shown in Figure 2 and capping the open ink port on the front of the reservoir. Attach both air tubes to the two air ports on the top of the single reservoir and observe the vacuum status.

   - If the vacuum status remains stable in this configuration, then that reservoir is sealed and does not require replacement.
   - If the vacuum status drops again, then that reservoir is compromised and must be replaced. You should still proceed to test the other reservoir to verify that only one reservoir is the source of the problem.

2.2.2.4 Loose Luer cap

Figure 2 shows the white Luer caps that are used to seal unused openings on the printhead reservoirs. These fittings occasionally loosen over time, which can allow air to infiltrate and disrupt the vacuum system.

In some extreme cases, a Luer cap may come off completely. This can usually be spotted immediately upon visual inspection of the printheads and carriage. Simply locate the cap and reinstall it onto the open location. Once reinstalled, the vacuum status should quickly return to normal. If the cap cannot be found, see Table 1 in Section 6 for a replacement part number.

2.2.2.5 Poor seal between printhead jetpack and reservoir

Figure 1 shows the piezo jetting component (known as the jetpack) and the reservoir united to become the printhead assembly. The jetpack has two barbs that mate with openings in the base of the reservoir, permitting ink to flow from the reservoir into the jets. A problem at this mating point allows air to infiltrate the reservoir.

2.2.2.5.1 Loose fasteners

The two fasteners securing the jetpack to the reservoir are located right next to the fasteners that secure the whole printhead assembly to the carriage (see Figure 26). It is easy to accidentally

loosen the jetpack-reservoir fastener when intending to loosen the printhead-carriage fastener. Use an Allen key to ensure that the fasteners are snug.

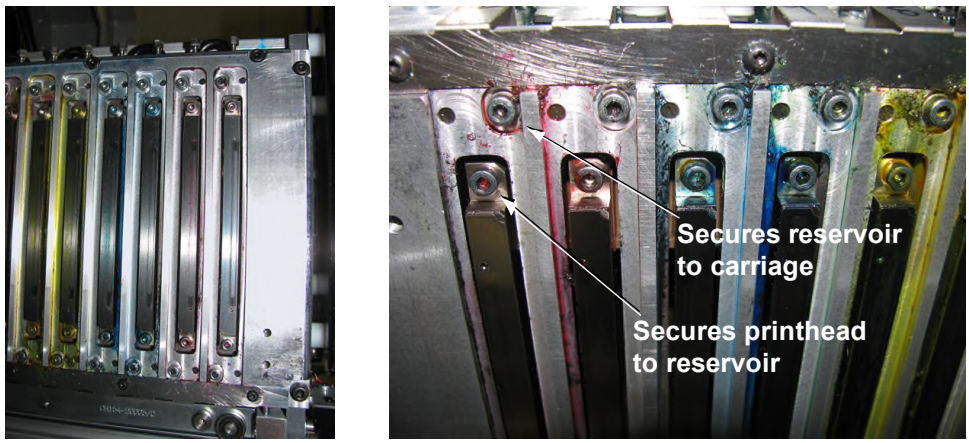


Figure 26 Printhead and reservoir fasteners. Left: general view of the bottom of the carriage; Right: detail of one printhead-reservoir fastener and one reservoir-carriage fastener.

2.2.2.5.2 Missing O-ring

This is not a spontaneous failure, but can occur accidently during a reservoir replacement, which requires disassembly of the jetpack from the old reservoir. The two barbs mentioned above must each have an O-ring to make the seal.

2.2.2.5.3 Too many O-rings

This problem again is likely only following a reservoir replacement. If two O-rings are placed on the same jetpack barb, the seal will be imperfect and air can infiltrate.

2.3 Ink dripping from all colors/all printheads

Ink dripping from all colors/all printheads simultaneously typically indicates that the overall vacuum is too low, and therefore unable to suspend the ink in the reservoirs as described in section 1.1. This may occur due to any of the following:

2.3.1 On-carriage reservoir/tubing issues

Any one of the problems described in section 2.2 may create such a large opening that the vacuum cannot be created. The most efficient method to determine if only a single printhead or printhead pair is the underlying cause is to perform the checks described in section 2.2.2.3, beginning with one color and systematically isolating each color.

- If the vacuum stabilizes and ink stops dripping at any point, then the reservoirs of the current color that has been capped are the source of the issue.
- If the ink dripping and vacuum status never change regardless of what color has been capped, then the problem is elsewhere, or, less likely, the reservoirs of multiple colors have failed at the same time. A systematic capping of each possible combination of pairs of reservoirs (K and C, K and M, K and Y, etc.) would be necessary to detect this condition.

2.3.2 Long vacuum tube and related connections

The long tube was described in section 1.2.2. A failure related to this tube would prevent any vacuum from being applied to all the printheads simultaneously.

2.3.2.1 Tube disconnected at the manifold

The long tube carrying vacuum through the track could have come disconnected from the valve/manifold. See “B” in Figure 6. To reinsert the tube, press gray the compression ring while inserting the tube. Release the compression ring to secure the tube.

2.3.2.2 Tube disconnected at vacuum assembly

The long tube carrying vacuum through the track could have come disconnected from the vacuum assembly. This tube connects to the vacuum assembly by a twist-type connector. See item “A” in Figure 9 for H-series and item “B” in Figure 10 for FB950. Note that there are three tubes in total at the vacuum assembly. Two of the tubes are a softer, flexible tubing; these tubes go to the vacuum accumulator/reservoir located elsewhere. The remaining semi-rigid tube is the long tube that goes through the track.

This connection is an important one for other troubleshooting procedures. By disconnecting the long tube and capping the remaining outlet tube on the vacuum assembly, the vacuum-generating components are isolated from the rest of the printer components. This technique will be used elsewhere in this document.

2.3.2.3 Tube cracked or failed throughout

If the long tube carrying vacuum through the track has in any other way cracked or been compromised with a hole or other opening, vacuum will not be delivered to the printheads.

2.3.2.3.1 Cracked tube ends

The end of the tube that connects into the reservoir should especially be examined for cracks. If a crack is found, use a sharp razor knife to cut off the affected portion and create a new, fresh end for the tube; then reinsert this tube as described in section 2.3.2.1. The other end of the tube with the twist-connector, described in section 2.3.2.2, should also be inspected. If necessary, cut the tube above the fitting; extract the fitting from the old tube fragment; then carefully push the fitting into the new tube end.

2.3.2.3.2 Hole worn in tube

If the tube in the track has been subjected to abnormal friction, a hole may have worn through. Visually inspect the tube throughout the length of the track. If a hole is found, replace the tube.

2.3.3 Vacuum pump not running

Total absence of the vacuum pump would affect all colors simultaneously. See the following section.

2.4 Vacuum pump does not run at all

As long as the printer is connected to main facility power and/or the auxiliary vacuum power supply is connected directly to the vacuum assembly, the vacuum pump should be heard to run periodically as described in section 2.1.2.

2.4.1 Primary internal power supply failed

Regardless of whether the printer power switch is set to “On” or “Off”, while the printer is connected to main facility power a small 24-volt power supply in the printer’s electronics supplies power to the vacuum pump. This is the primary power supply and as long as the vacuum assembly circuit board detects voltage coming from this source, this power supply is used to run the vacuum pump. See Figure 27.

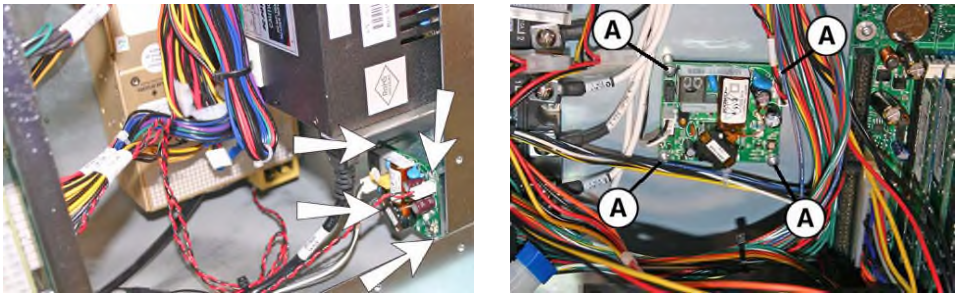


Figure 27 Mini 24VDC power supply in the electronics assembly. Left: DesignJet H-Series; Right: FB950

If the pump cannot be detected as running and the auxiliary external power supply is not connected, connect the auxiliary power supply. If the pump begins to run, then the primary power supply may have failed.

2.4.2 Auxiliary external power supply failed

When the printer is removed from main power altogether (i.e., unplugged) the vacuum pump can be kept running by attaching an external 24VDC power supply (see Figure 28).

Figure 28 Auxiliary 24VDC power supply

If the printer has been disconnected (unplugged) from main power and the 24VDC external adapter is both connected to the printer and plugged in to a working 110-220VAC receptacle, then the adapter may have failed.

See also the Vacuum Pressure User Diagnostic described in section 3.1.1.

2.4.3 Vacuum assembly circuit board failed

The vacuum assembly contains a small circuit board that detects the power source (internal or auxiliary) and switches between them to keep power supplied to the pump. If the pump does not run regardless of which power source is used, this circuit board may have failed, but there may instead be a pump motor problem or an internal cable problem. This circuit board cannot be replaced individually; in the event of a failure, the vacuum assembly must be replaced.

2.4.4 Loose cable connection

The vacuum assembly is electrically connected to the printer by a single connection visible on the outside of the assembly (see Figure 29).

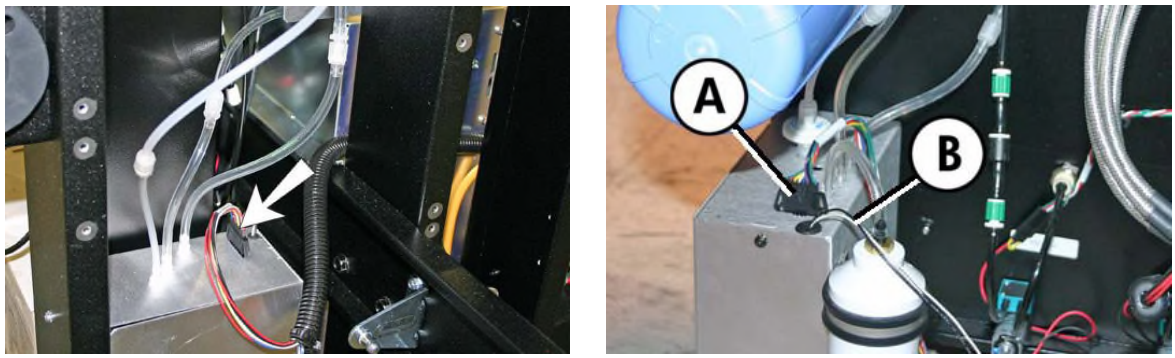


Figure 29 Cable connection to vacuum assembly. Left: H-series; Right: FB950.

Inside the vacuum assembly there are one or more cable connections depending on vintage. The older assembly has connections to the vacuum sensor, vacuum switch, and vacuum pump. The newer assembly has the sensor and switch functions integrated, so there is only one remaining connection to the pressure pump. In both vintages there is a two-wire connection that goes to the pressure pump outside the vacuum assembly; this cable is visible as item “B” in Figure 29.

2.4.5 Pump motor failed

A pump motor failure may be difficult to distinguish from a power supply failure without using a voltage meter to check for power going to the pump. Set the meter to correct range to test for 24 volts. If voltage is detected but the pump is not running, the pump motor has failed.

The pressure pump located elsewhere on the printer is identical to the vacuum pump. If a confirmation of the vacuum pump motor failure is desired, these two pumps can be swapped from their locations and the pressure pump installed in the vacuum assembly. If this pump now runs, it is safe to conclude that the original vacuum pump motor failed.

2.4.6 Vacuum switch stuck (older H-series only)

In the original vacuum assembly found on older H-series printers, a mechanical switch is used to activate the vacuum pump (see illustration found in Table 1 at the end of this document). This switch sometimes succumbs to a phenomenon called “micro welding”, whereby the switch components become stuck and do not allow the pump to turn on.

To test if this is the cause of a pump-not-running condition, apply a moderate blow with your hand to the general location of the vacuum assembly (see Figure 7) or remove the printer enclosure and tap directly on the vacuum assembly. The impact and vibration causes the switch to come unstuck. If the pump starts to run after this, it is possible that the switch is failing in this way. You may replace only the switch or opt to replace the entire vacuum assembly for the newer style that does not have this mechanical switch.

2.5 Vacuum pump runs continuously

In most cases this indicates that there is an opening in the system somewhere that prevents the desired vacuum level from being reached, so the pump runs continuously trying to achieve it.

2.5.1 Opening outside the vacuum assembly

Use the technique described in section 2.3.2.2 to disconnect the outgoing long vacuum tube and cap off the remaining short tube on the vacuum assembly (item “A” in Figure 9 for H-series and item “B” in Figure 10 for FB950).

- If the pump stops running with the vacuum assembly isolated in this manner, then the problem is an opening in the rest of system. Use the techniques described in the preceding sections of this document to isolate the location of the opening. You will have to reconnect the vacuum assembly to the long tube to perform most of the troubleshooting procedures.
- If the pump continues to run even while the vacuum assembly is isolated, the problem is in the vacuum assembly or related remaining components. Continue with the next section.

2.5.2 Opening within the related vacuum components

A primary candidate for an unexpected opening is the seal at the blue vacuum reservoir. This component is located away from the vacuum assembly. The two flexible tubes (“B” and “C” in Figure 9 or “A” and “C” in Figure 10) lead from the vacuum assembly to the vacuum reservoir. The reservoir resembles a filter housing, but there no filter material contained inside it. See Figure 30 for the reservoir as it is found in the H-series; the location of the reservoir in the FB950 is visible at the upper left in Figure 10.

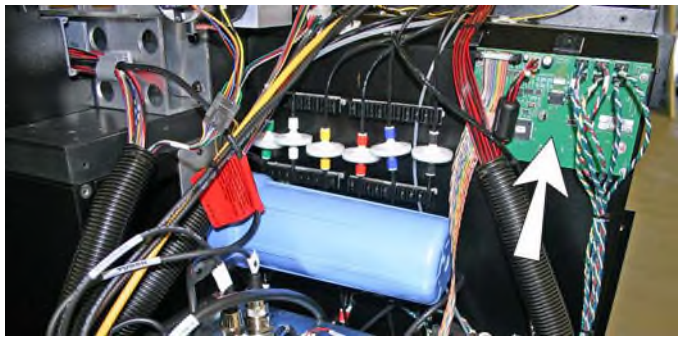


Figure 30 Vacuum reservoir or accumulator in H-series, visible at center. The board at the right is unrelated to the vacuum system.

The blue canister should be securely twisted onto the black base and a rubber O-ring between the two pieces to create the seal. Generally the blue canister is very firmly screwed in place and may be difficult to remove. The seal does not have a history of spontaneous failure. The only real reason to suspect a problem in this area is if it is known that the blue canister was interfered with recently, which may include having removed the canister, thus potentially having lost the O-ring; or if the canister were reinstalled and over-tightened, causing the canister to crack.

2.5.3 Failure of the vacuum pump pumping mechanism, but not the pump motor

This failure is very rare. If the pump is running continuously and no leaks or openings can be found, but vacuum is not reaching the desired level despite the pump motor running, then it could be that the pump motor is operational but the diaphragm or other internal parts of the pump that must operate to create the vacuum have failed. If this failure is suspected, the pressure pump may be substituted in as described in section 2.4.5. If the system works normally with the pressure pump now serving as the vacuum pump, then the original vacuum pump has failed internally.

2.3 Warning “Vacuum not recovering”

The vacuum system is maintained at a nominal value for most of the time that the printer is operating. When certain events occur, such as the automatic printhead servicing (“purge”) or when the ink pumps run to refill the printheads, the overall volume of the vacuum system is affected. The period of time immediately after one of these events is referred to as the recovery. The printer software is programmed to expect the recovery time after one if these events to last only so long. If the vacuum has not been restored to the nominal value within the recovery time, the Attention Queue will display the message “W-VS-3 Vacuum Pressure Not Recovering”.

The speed of the recovery is primarily dependent on a small subcomponent in the vacuum assembly known as the restrictor (see Figure 31 for location). The restrictor is a brass fitting that joins two small-diameter tubes within the vacuum assembly. The restrictor has an internal diameter of 0.007″ (0.01778 mm) and can become clogged over time. As this tiny aperture diminishes, the speed of the vacuum recovery is decreased.

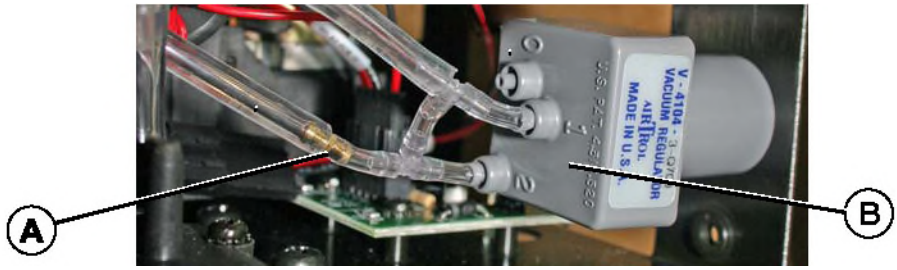


Figure 31 Restrictor (A) and Regulator (B)

It is possible to clean the restrictor with a very thin wire, such as American Wire Gauge 34, which has a diameter of 0.00630″ (0.160 mm). Remove the restrictor from its location in the vacuum assembly and pass the AWG 34 wire through several times. If AWG 34 or equivalent is not available, compressed air may be successful in removing some of the blockage. Alternatively, the restrictor may simply be replaced.

CAUTION: Do not force a larger-diameter object into the restrictor. The 0.007″ aperture is created by a precision-drilled industrial gemstone, and a larger object may dislodge the gem, ruining the restrictor.

2.4 One or more colors drop out during printing and then come back

See section 2.3 regarding the restrictor. In this situation, the ink pumps run and disrupt the vacuum during printing. The vacuum does not recover quickly enough to prevent some ink from seeping out of the printheads and covering the bottom with a thin layer of ink. This thin coating of ink impedes the ability of the printhead to jet new drops, and so the color appears to fade away. As the vacuum slowly recovers, the ink seepage stops and the jets are eventually able print again.

Figure 32 Output from H-series showing all colors fading away and then coming back

Figure 32 shows an example of all colors being temporarily disrupted by a slow-recovering vacuum.

Figure 33 Detail of color coming back in following the drop out

Figure 33 shows in detail how the color gradually comes back. It is important to observe the distinction between an abrupt, total failure of all colors and this gradual failure. An abrupt failure, where the drop out is a clean break all at once, is not indicative of a vacuum failure, but of a problem with the power cable to the headboard. The gradual fade-out and return shown in Figures 32 and 33 indicates either a vacuum issue or an ink supply issue.

2.5 Vacuum Pressure Too High

If the Attention Queue displays the Warning “W-VS-2 Vacuum Pressure Too High”, it indicates that the vacuum level was sensed too far above the nominal range for too long of a time period. If this condition has occurred, this message will persist in the Attention Queue even if the current vacuum is at the nominal level.

2.5.1 Regulator adjustment is incorrect

If the vacuum status is consistently reading too high, the regulator may simply require adjustment downward. See section 2.2.1.1.2 for detailed information on setting the regulator.

2.5.3 Dirty restrictor

The function of the restrictor and the “Vacuum Not Recovering” message are discussed in section 2.3. As the printer attempts to restore vacuum, the vacuum may surge higher than desired nominal value. If this surge lingers long enough, the “Vacuum Too High” message will appear. This message will remain in the Attention Queue even after the current vacuum status has returned to nominal.

2.6 Regulator will not adjust

Section 2.2.1.1.2 describes the procedure for setting the vacuum regulator. In some instances it will appear that turning the regulator, even extreme amounts such as a full turn or more, has no impact on the displayed vacuum status. In these cases, the first assumption should be that there is a leak or opening in the system. Isolate the vacuum assembly as described in section 2.5.1. With the vacuum system isolated, and assuming that the vacuum pump operation is normal, attempt to adjust the regulator. If there is still no impact and no other leaks can be found, the regulator may have failed.

△ **CAUTION:** Do not turn the regulator an extreme amount. Turning the regulator until it stops turning is likely to damage the regulator.

2.7 Vacuum status is “Unknown”

The vacuum sensor has a limited range. If the vacuum is too high, such as may occur from a badly adjusted regulator, or if the regulator was adjusted upwards while there was a leak and then the leak is detected and repaired, the actual vacuum may exceed the range of the sensor. When this occurs, the vacuum status will show as “Unknown”.

Isolate the vacuum assembly as described in section 2.5.1 and adjust the regulator counter-clockwise in small increments, checking the vacuum status each time. Eventually the vacuum will decrease to a level that can be detected by the sensor, and the “Unknown” will be replaced by a number. Continue to adjust the regulator until the desired nominal value is obtained.

TIP: The vacuum troubleshooter found in the User Diagnostics menu (see following Section 3) may display the vacuum status as “0.0” while the System Information display (Figures 12 and 13) instead shows “unknown”. In such an instance, disregard the “0.0” shown by the troubleshooter and assume that the “Unknown” is due to an over-adjusted regulator.

2.8 Ink is observed in the air tubes

This condition is usually detected when one or more printheads begin to drip. The carriage cover is removed and the air tubes are found to be partially filled with ink. This is a secondary symptom of the issues described in sections 2.2 and 2.3.

2.8.1 Causes

When an air leak occurs in a printhead, air is able to infiltrate and create bubbles in the ink. These bubbles percolate upward in the reservoir and eventually find their way into the air tubes. Over time, enough ink gathers there to become a column of ink rising in the air tube.

2.8.2 Resolutions

If the ink is only a little way up the tube and has not reached the ink-blocking filter, the ink can be drained from the tubes. Remove the fitting from the manifold as described in section 2.2.2.2 and hold the tube upright to allow the ink to drain into the reservoir. If this is taking too long, remove the other ends of the tubes from the reservoir and allow the ink to flow out into a paper towel or other suitable receptacle.

If the ink has reached all the way up to the ink-blocking filter, the filter must be replaced after the ink has been drained.

If ink has passed all the way through the ink-blocking filter, then the problem may not be related to the vacuum system. Contact HP Customer Care for guidance.

CAUTION: Do not allow any liquid to contact the ink-blocking filter, including printhead flush. Liquid contact will render the filter impermeable to air, blocking the vacuum to the printheads.

3 Using the Vacuum Troubleshooter on the control panel

The printer has a User Diagnostics menu that includes several guided troubleshooting routines to assist you. One of these routines is for the vacuum system. To access the diagnostic, select “Tools | User Diagnostics | Vacuum Pressure”.

3.1 Test elements

The Vacuum Pressure diagnostic includes the following tests:

- Auxiliary power supply functionality
- Adjust the vacuum pressure setting
- Looking for leaks

At the conclusion of the tests, the printer prompts you to perform a purge and wipe to clean any ink that may have accumulated on the printhead orifices during the testing. If you are planning to repeat any of the Vacuum Pressure diagnostics, you may opt to skip the purge and wipe. If you do not plan to repeat any tests, the purge and wipe are recommended.

3.1.1 Auxiliary power supply functionality

This section of the test instructs you to perform the following steps:

1. Confirm that the auxiliary power supply is connected to an energized 110-220VAC wall outlet, power strip, or uninterruptible power supply (UPS).
2. Turn off the printer at the power switch.
3. Once the printer has fully shutdown, disconnect the main printer power cable from the printer or from the facility receptacle.
4. Listen for the vacuum pump to run under the power supplied by the auxiliary adapter. If the pump is audible, then the auxiliary adapter is functional. If the pump is not heard to run, then the auxiliary adapter (or UPS, power strip, or wall outlet) is not functional.
5. Once operation of the auxiliary adapter is confirmed, reconnect the main printer power cord and turn on the printer to resume normal operation.

3.1.2 Adjust the vacuum pressure setting (regulator adjustment)

This section instructs you when and how to adjust the regulator to change the nominal vacuum setting.

1. The correct time to take a vacuum-level reading is immediately after the vacuum pump turns off. The vacuum level normally declines continuously while the pump is idle. Do not take vacuum-level readings after the pump has been idle or while the pump is running. Take the reading as soon as the pump stops, which is the end of the pump cycle.
2. The control panel shows the current vacuum level as detected by the sensor in the vacuum assembly. This reading may fluctuate within a range, which is normal. The control panel also displays the nominal desired vacuum level.
    a. Observe the displayed vacuum level and listen for the pump operation. As described in step 1, take note of the vacuum level that is displayed immediately after the vacuum pump is heard to stop.
3. Determine what to do if the vacuum is too far beyond the nominal desired level.
    a. If the vacuum level is greater than 5.40 at the end of the pump cycle, the regulator is set too high. Turn the regulator adjustment screw (see Figures 19 and 20) counter-clockwise 1/8 of a turn. Repeat steps 2 and 3 as necessary until the vacuum is between 5.25 and 5.40.

b. If the vacuum level is less than 5.25 at the end of the pump cycle, the regulator is set too low. Turn the regulator adjustment screw (see Figures 19 and 20) clockwise 1/8 of a turn. Repeat steps 2 and 3 as necessary until the vacuum is 5.25 or greater.

3.1.3 Run automated tests to look for leaks

This section pressurizes each color channel (printhead or pair of printheads by color) one at a time and monitors how long it takes the vacuum to recover. At the conclusion of the test, a table may be viewed that shows the recovery times for each color in seconds.

If any one of the colors has a recovery time outside the expected limit, the control panel will indicate the suspected color. A nominal recovery time is 0.8 seconds.

- A longer recovery time on a single color indicates that the affected color channel is not working as efficiently as expected, i.e., there is probably a leak. This test can be used to help confirm a diagnosis of a leaking reservoir as described in section 2.2.2
- A longer recovery time on all colors indicates a dirty restrictor, as described in section 2.3.

4 Other tests

The printer has additional tests found on the control panel.

4.1 Air valves

The air valves may be tested by selecting “Tools | Service Printer | Ink System Tests | Air Valves”. This test allows you to manually toggle each valve individually between “Off” (allows vacuum to pass) an “On” (allows pressure to pass). Toggling the valve should produce a faint yet audible “click” from each valve. If a valve fails to click, that valve may be bad and the entire valve & manifold assembly will require replacement. If a particular valve has a softer click than the others and there is another observable symptom on that same color channel, it may indicate that the valve is not operating normally.

The observable symptoms of a valve failure may be ink dripping from the heads, indicating that the valve is sticking open after a purge and not allowing vacuum to act on the ink in the reservoirs. Alternatively, if the valve is stuck closed, then no ink will be forced from that color during a Purge, because pressure cannot reach the heads. The methods described in sections 2.2.2.1 and 2.2.2.2 can be used to verify if the valve is truly what has failed.

IMPORTANT: The manifold & valve assembly has internal parts that are extremely intolerant of contact with ink or printhead flush. If any liquid has entered the manifold assembly, it is highly likely that one or more valves have been contaminated and have failed. The only recovery option is to replace the manifold assembly.

4.2 Pressure pump

The pressure pump may be tested by selecting “Tools | Service Printer | Ink System Tests | Pressure Pump”. This test allows you to turn the pressure pump on and off at will. If the pressure pump is audible when switched on, then the pump is working.

NOTE: A “Vacuum Pump” test is found in the same submenu as the Pressure Pump test. This test, however, is not parallel to the Pressure Pump test and does not allow you to simply command the vacuum pump to run. Instead, this Vacuum Pump test is identical to section 2 of the Vacuum Pressure User Diagnostic described in section 3.1.2.

5 Pressure components

In addition to the components that create and carry vacuum (negative air pressure) on the printer, there are a number of components that create and carry positive air pressure. Positive air pressure is used when servicing (cleaning) the printheads and for emptying the printheads of ink prior to some printer repairs or transport of the printer.

5.1 Unique pressure components

These components have no function except to create pressure for the printhead servicing or related functions. They are idle and unused the majority of the time, but are still essential to overall printer operation and longevity of the printheads.

5.1.1 Pressure pump

The pressure pump is located near the ink pumps on both H-series and FB950. The pressure pump is identical to the vacuum pump located inside the vacuum assembly, and the two pumps may be swapped when appropriate for troubleshooting.

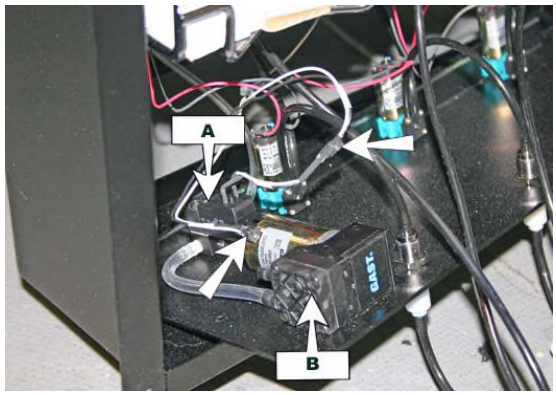


Figure 34 Pressure pump (B) on H-series. The pump plate has been accessed from the exterior of the printer. The valve (A) is found on older models only.

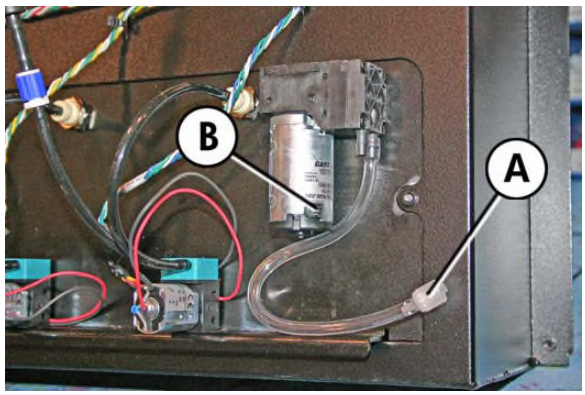


Figure 35 Pressure pump (B) on FB950. (A) is the connector for the long pressure tube in the track. This view is from inside the printer with the pump plate fully installed. Newer H-series without the valve (A in Figure 31) will match this appearance also.

5.1.3 Long tube in the track

A long, semi-rigid tube runs from the pressure pump through the track to the manifold assembly. See item “C” in Figure 6 for the connection location on the manifold. This tube is 1/8″ (3 mm) in outer diameter.

5.2 Shared components

There are numerous components that are shared by the vacuum system and the pressure system, and will carry one or the other depending on the moment in printer function. Most of these components are located on the carriage.

5.2.1 Manifold and valves

The manifold assembly (see Figure 6) receives both the long tube for vacuum and the long tube for pressure. The individual valves, one for each color, are switched by the printer to apply either negative pressure (vacuum) or positive pressure depending on the moment. The normal state of the valve is open to allow vacuum to enter the air tubes that descend from the valves to the printhead reservoirs.

5.2.2 Air tubes to the printhead reservoirs

The dual air tubes (see Figure 3) connect the air valves to the printhead reservoirs. Depending on the valve state either vacuum or positive pressure is allowed to pass through the tubes and act on the ink in the reservoirs.

5.2.3 Printhead reservoirs

The sealed printhead reservoirs (See Figures 22 and 23) allow the vacuum to be exerted against the ink to hold the ink in place, or become pressurized to force ink out through the printhead jets during cleaning or maintenance.

5.2.4 U-tubes

On FB950 and H45100 and H45500, all with two printheads per color, an opaque U-tube at the top of the reservoir connects the two printheads and allows air to move between them. A second U-tube at the front of the reservoir allows ink to flow between the two printheads. While similar in appearance, the U-tube for air and the U-tube for ink are different materials and are not interchangeable. The air-tube material has an adverse reaction to the ink and will deform. Generally these U-tubes do not fail, but occasionally it may be desirable to replace one due to suspected leakage.

6 Table of related part numbers

The table that follows provides HP part numbers any of the orderable components that have been described elsewhere in this document. This information and part availability is subject to change without notice; contact HP for the most current information.

The indication of “all models” in the “Used in” column refers to all printer models specifically addressed by this document only.

Table 1 Vacuum system part numbers

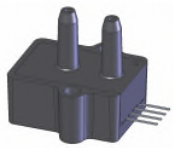
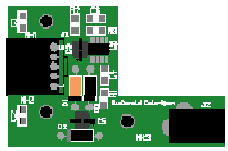
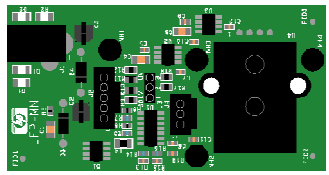
Common name	Part number	Used in	Note	Image (not to scale)
Regulator	CH971-91626 FRM,VAC REGULATOR,BHIL	All models		
Sensor	CH971-55394 ASSY,SNSR,VACUUM,GATOR,INK_DELIVERY	Older H-series only	The sensor is integrated onto the circuit board in the new version	
Switch	CH971-55392 ASSY,VACUUM_SWITCH, GATOR,INK_DELIVERY	Older H-series only		
Restrictor	CH971-91344 FRM,RESTRICTOR,ABCD HIJ	All models		No photo available
Aux power-in (original)	CH971-81359, ASSY,LVL1,GATOR,PRESS/VAC,+24V,LF	Older H-series only	**Not orderable, replace complete assembly**	
Aux power-in (Hi-Rel)	CH971-81410 ASSY,LVL1,PRESS/VAC,UV,+24V,LF	Newer H-series and FB950	**Not orderable, replace complete assembly**	
Reservoir	CH971-57266 ASSY RESERVOIR PIRANHA PRESS VAC	All models		

Table 1 Vacuum system part numbers

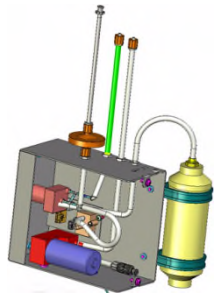
Common name	Part number	Used in	Note	Image (not to scale)
Vacuum pump	CH104-67002 FRM,N,PUMP,PRESSURE	All models	Exactly the same as the pressure pump	
Pressure pump	CH104-67002 FRM,N,PUMP,PRESSURE	All models	Exactly the same as the vacuum pump	
External 'bottle' filter	CH108-60004 FRM,AIR_FLTR,LARGE_VOL,L	Newer H-series and FB950		
Complete Assembly	CH971-91543 FRM,VAC_ASSY,N	All models	Backwards compatible to older H-series	
Auxiliary power adapter	CH971-91083 FRM,AUX_VP_PWR,ABCDHIJ,ROHS	All models		
Luer cap for printhead reservoirs	CH971-91589 FRM,PRINTHEAD_CAP,N	All models	Note incompatibility issue with Luer retention clamp CH154-67045	
Luer cap for tubes	CH971-91590 FRM,TUBE_CAP,N	All models		
Dual air tube	CH104-67020 FRM,LIQUID BLOCKER,NQ	All models		See Figure 3
Valve & manifold assembly	CH971-91491 FRM,ASSY,MANIFOLD,VALVES,N	All models		See Figure 6

Table 1 Vacuum system part numbers

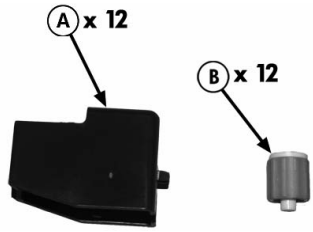
Common name	Part number	Used in	Note	Image (not to scale)
Printhead reservoir	CH104-67001 FRM,N,KIT,RESERVOIR	All models		
Long vacuum tube for track	CH154-67023 FRM,TUBE,VACUUM,LONG,Q	FB950 only	241″ (612 cm)	No photo available
Long vacuum tube for track	CH971-91547 FRM,TUBE,VACUUM,LONG,N	H-series only	166″ (421 cm)	No photo available
O-rings between printhead and reservoir	CQ114-67216 FRM,PH_RESERVOIR,2_O-RING_SETS,U	All models		No photo available
U-tube for air	CH154-67004 FRM,TUBE_U_AIR,Q	All models	Flexible tubing	
U-tube for ink	CH971-91227 FRM,TUBE_U,B	All models	Formed tubing	
Luer cap retention clamp (1)	CH154-67045 FRM,LUER_CLIP,NQ	All models	Does not include the tall Luer cap	
Luer cap retention clamp (set)	CH154-67044 FMK,LUER_CLIP_UPDATE,CARRIAGE, NQ	All models	12 clamps and 12 tall caps	
Tall Luer cap	Not Orderable, see Fittings Kit below	All models with Luer clamp		
Fittings Kit	CH971-91322 (Design) C.6 KIT,FITTINGS,BHILNQ	All models	Includes the component pieces of the tall Luer cap	No photo available

Table 1 Vacuum system part numbers

Common name	Part number	Used in	Note	Image (not to scale)
Mini 24VDC power supply	CH971-60068 PWR_SPLY,11W,24VDC,ROHS	All models		

For more part information and availability, check the HP Partsurfer at **http://partsurfer.hp.com** or the HP Parts Store at **http://www.hp.com/buy/parts**.