RIVIAN	TOOL USE INSTRUCTION	
	Tool Number: NCT04363932	**REV: 4.0**
	Title: Manual Kinetic Suspension Evac and Fill Machine	**DEPT:** Service Engineering

Author	Peter Langel	**Approver(s)**	

Revision Log:

REV	Revision Description (Reason for Change)	Author	Rev. Date
1.0	Initial release	P.Langel	6/17/2021
2.0	Increase Pressure Test Time	P.Langel	7/29/2021
3.0	Changed evac process. Updated fill volumes	P.Langel	8/17/2021
4.0	Changed Routine for Depress from D008 to D00A	P.Langel	9/27/2021

Reference

Labor Code: 187690024 Hydraulic Fluid (Drain and Refill)

PURPOSE: This equipment is used to evacuate and refill Hydraulic oil in the R1 Kinetic Suspension System. It uses both Pressure (Inlet side) and Vacuum (Outlet Side), to evacuate old fluid, and fill new fluid under vacuum.

Refer to confluence page on the procedure for the Hermes Software Routines

https://rivianautomotivellc.atlassian.net/wiki/spaces/VCON/pages/1885018174/Kinetic+Service

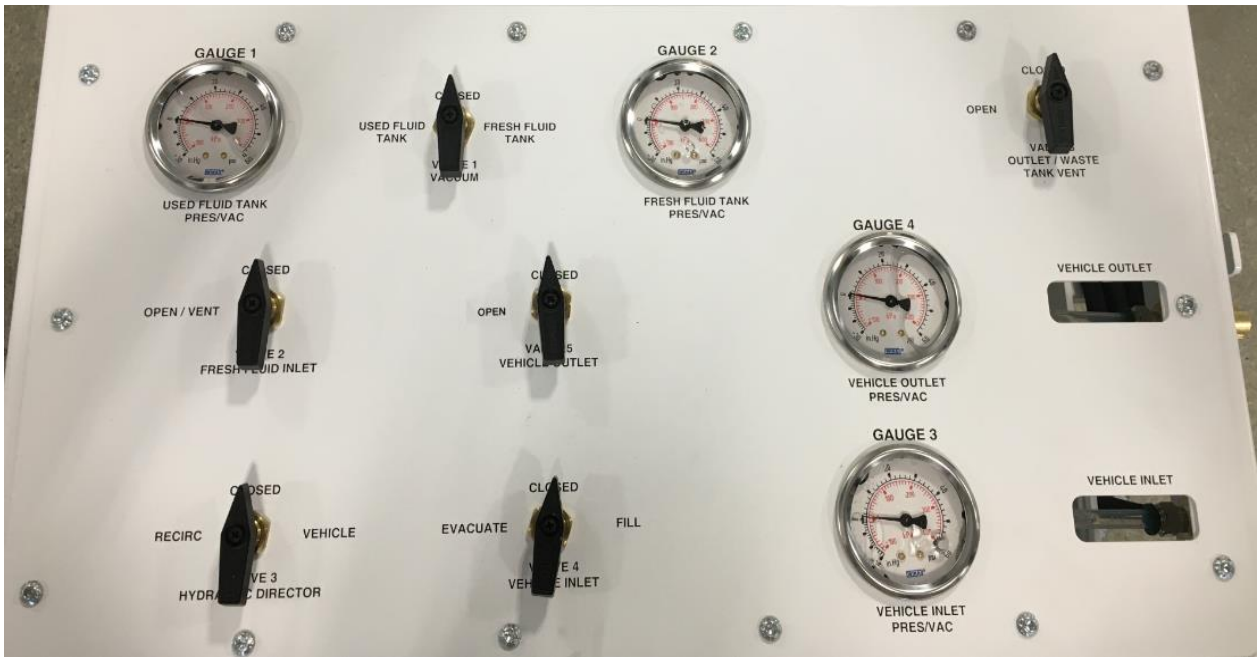
EQUIPMENT FAMILIARIZATION AND SYSTEM OVERVIEW:

This brief overview will guide you through familiarization of the components of the Kinetic Suspension Evac and Fill Machine

USING THE TOOL: DRAINING AND FILLING THE TANKS

KINETIC SYSTEM SERVICE PROCESS:

SECTION 1: CONTROL PANEL



Main Control Panel

1. Valves
    - Valve 1: 3-way valve directs vacuum to, Closed, Used Fluid Tank, or Fresh Fluid Tank
    - Valve 2: 2-way valve opens the Fresh fluid tank to draw in fluid under vacuum or vent to atmosphere
    - Valve 3: 3-way hydraulic director. Directs fluid to recirculate under vacuum or directs it to the vehicle
    - Valve 4: 3-way vehicle inlet. Directs compressed air to evacuate the system, or directs fluid to fill the system
    - Valve 5: 2-way veicle outlet. Opens or closes the off the Used fluid waste tank from the vehicle
    - Valve 6: Vents the Used fluid tank to atmosphere
2. Gauges
    - Gauge #1: Measures pressure at the Used Fluid Tank
    - Gauge #2: Measures pressure at the Fresh Fluid Tank
    - Gauge #3: Measures pressure at the Vehicle inlet
    - Gauge #4: Measures pressure at the Vehicle outlet

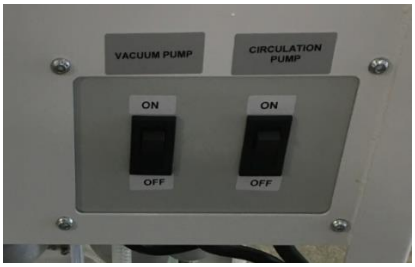
3. On/Off Switch Panel

   The Vacuum Pump and Circulation pump are wired into a main switch panel. All electrical equipment is controlled through this switch panel. The main power switch located at the vacuum pump is redundant and should be switched on at all times.

SECTION 2: CART ELECTRICAL

4. The cart operates on standard 110v power.
5. GFCI Plug: The machine is equipped with a Ground Fault Circuit Interuptor Plug. The reset button must be engaged when the unit is plugged in.

6. Switches: Power switches control the Vacuum Pump and the Circualtion pump. Thet are located on the side of the unit



If something is not functioning when the switches are turned on, check the following:

- Reset button for the GCFI switch is engaged
- Vacuum pump main switch located on the pump is turned on

SECTION 3: VACUUM PUMP

1. Vacuum pump main switch should be on at all times
2. Vacuum Pump Oil level must be between the min/max levels on the sight glass

If the Vacuum Pump Oil level is at minimum or below, it will result in poor vacuum performance

Remove the red fill cap

Turn on the pump

Very slowly add oil using **Robinair 13203 Premium High Vacuum Pump Oil**. The oil level will rise very quickly once the level is close to the minimum

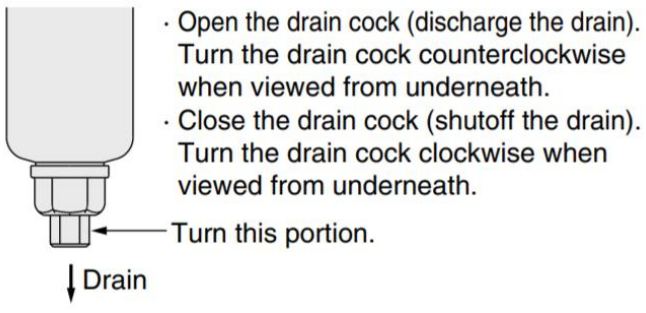
If the Vacuum Pump Oil level is too high:

The pump will need to be removed from the cart to access the drain plug located on the bottom of the pump

Vacuum Oil Mist Trap

The Vacuum system is equipped with an oil mist trap to prevent the vacuum pump from ingesting oil. Drain the cup frequently as required. It is ideal to keep the oil level in the drain bowl as minimal as possible to maintain system performance

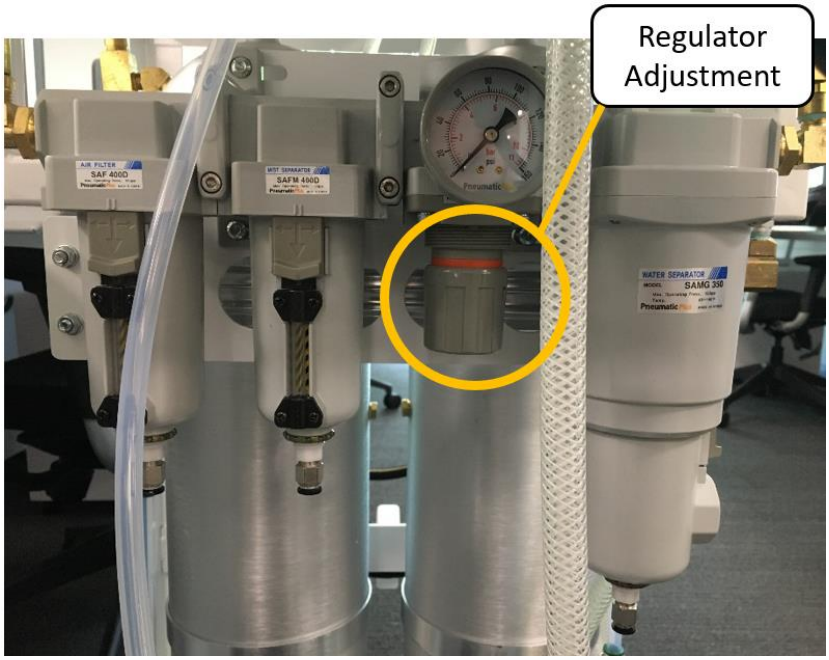
<How to open/close the drain cock>



SECTION 4: COMPRESSED AIR SUPPLY INLET AND REGULATOR ASSEMBLY

AIR REGULATOR ADJUSTMENT

1. Pull down the adjustment dial so the orange band is showing
2. Twist the regulator adjustment knob to raise or lower the pressure
3. Set the Regulator to 20 PSI for standard evacuation operation.



FILLING THE DESSICANT

1. The water separator must be filled with dessicant.
2. Push down on the arrow tab and rotate the dessicant cup counter clockwise
3. Fill the cup with blue deissicant that is included with the cart.
    a. Push out all air and reseal bag of dessicant as best you can and place it in a sealed ziplock bag
    b. Note: If the dessicant has turned pink, it has absorbed moisture from the air
4. Reinstall the cup by engaging the tabs and rotating counter clockwise

CONNECTING COMPRESSED AIR

The machine uses compressed air when purging old fluid from the vehicle lines. Depending on your shop air connection, the quick-connect may need to be changed. Industrial and T-Style connections are included with the machine.

1. Ensure all valves on the cart are closed

2. Connect compressed air supply

3. **If your cart is equipped with a valve at the regulator, rotate it so that it is pointing up**. **This valve can typically remain open at all times**. Later revisions of the machine do not have this valve as it is redundant.

SECTION 5: HYDRAULIC CIRCULATION PUMP

The Hydraulic Circulation Pump has 2 functions:

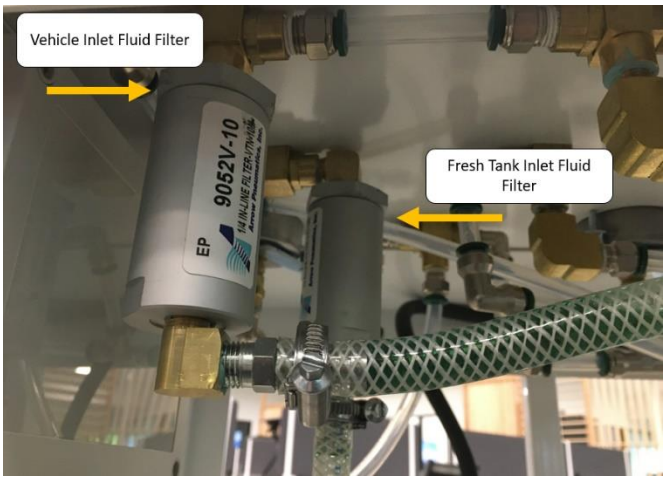
1. Recirculate fluid under vacuum to draw air bubbles out and have the best quality of fill
2. Push fluid into the vehicles kinetic system under vacuum

Note: If vacuum is too high during the degass routine, fluid will stop moving and cavitate in the pump. It is ideal to maintain vacuum at 25-26 in.Hg when vacuum degassing.

SECTION 6: FILTERS

The Tool is equipped with 2 servicable filters. Under normal circumstances these filters should not have to be replaced.

- Fresh Tank Inlet
- Fresh Tank Outlet



In the event one of the filters needs to be replaced use:

Mcmaster-Carr P/N 9800K51 Pipe-fitting Hydrualic Oil Filter 10 Micron

SECTION 7: FLUID COOLER

It is common for the fluid to become very warm during the vacuum degass process. The cart is equipped with an in-line fluid cooler to assist in keeping the fluid at optimum temperature. No service is required of the fluid cooler

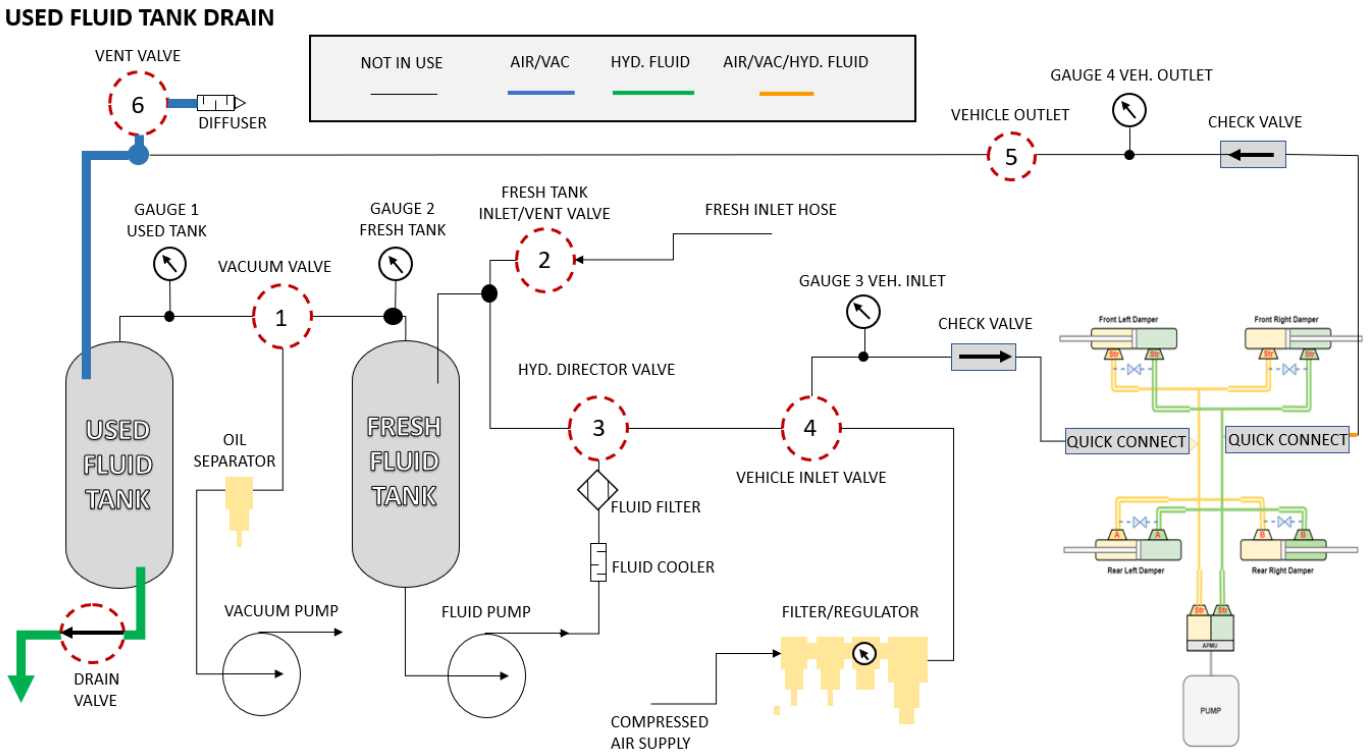
SECTION 8: HOSES

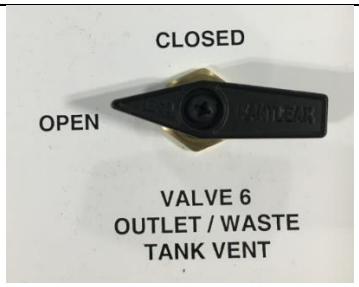
The Tool is equipped with 2 hydraulic connection hoses. **Inlet** an **outlet** are marked on the cart. The Inlet/Outlet hoses can be connected to the H1 and H2 sides of the system in any order. Wrap the hoses on the hanger and store them when not in use.

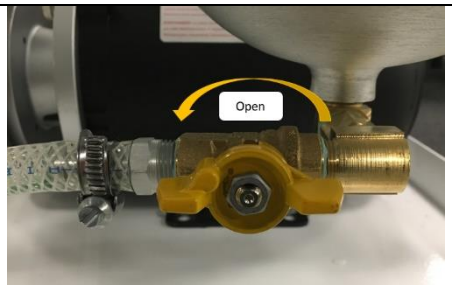
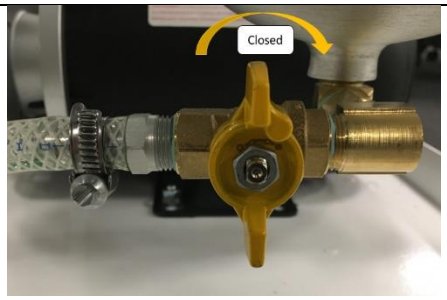
Tank Drain and Fill:

SECTION 9: DRAINING THE USED FLUID TANK

The machine is equipped with a Used fluid tank. Use the sight tube and the measuring scale on the side of the tank to gauge the level in the tank. The O-rings are used to set start and finish level on the sight tube. The drain valve is located on the bottom of the tank. The tank must be vented to atmosphere by opening valve #6 when draining



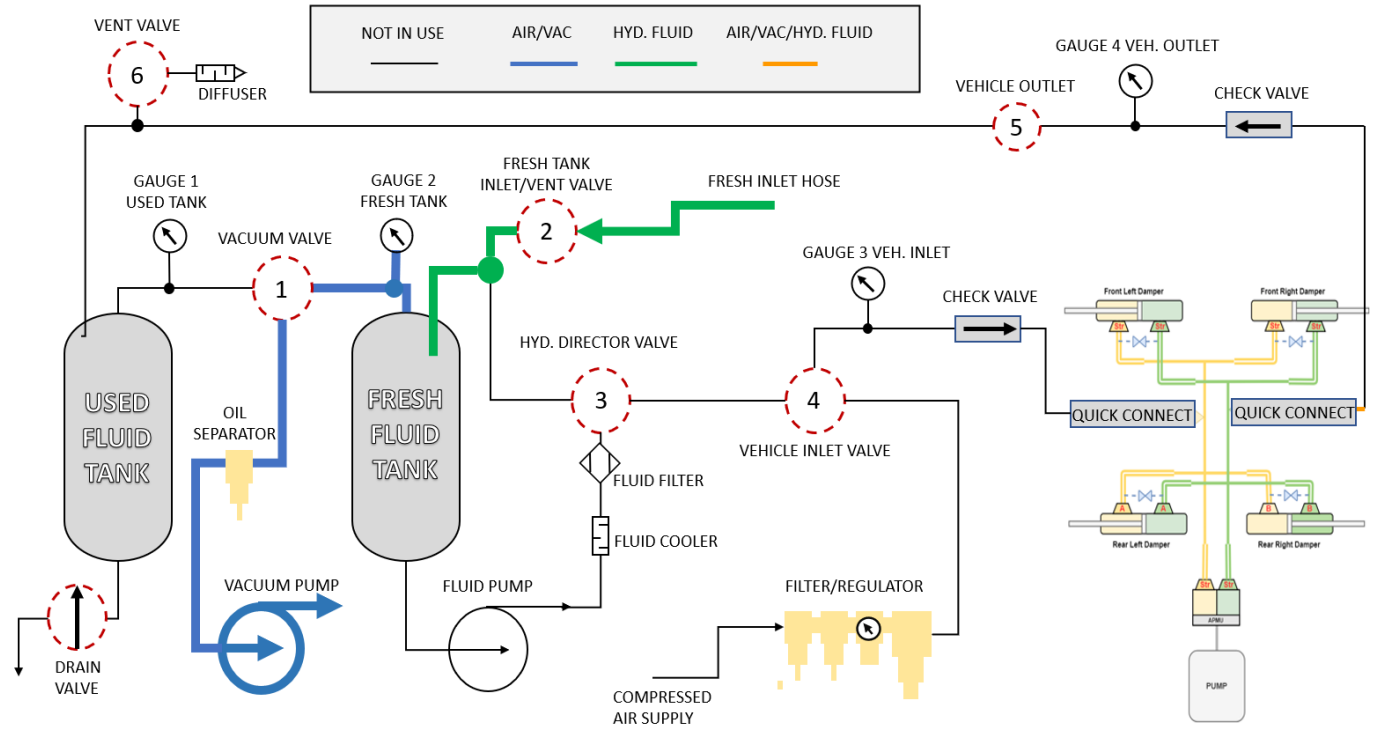
STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is <u>not</u> required.	
2	Turn Valve 6 to “Open” relieving the tank to atmospheric pressure	
3	Place the open end of the drain hose in a pan or bucket	

4	At the bottom of the Used Fluid Tank, rotate the drain-valve counter-clockwise to open.	
5	Drain the tank until empty or no more fluid is coming out	
6	Close the drain valve on the tank	

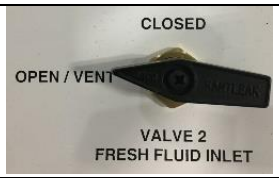
SECTION 10: FILLING THE FRESH FLUID TANK

The machine is equipped with a fresh fluid tank. Use the sight tube and the measuring scale on the side of the tank to gauge the level in the tank. The O-rings are used to set start and finish level on the sight tube.

FRESH FLUID TANK FILL



STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is <u>not</u> required	
2	Turn on vacuum pump	
3	Turn Valve #1 to “Fresh Fluid Tank”	
4	Place the open end of fluid inlet hose into a container of the fluid to be filled. Vacuum will draw fluid from the container	

5	Turn Valve #2 to "Open/Vent"	
6	Vacuum applied to fresh fluid tank will begin to rapidly draw in fluid. **Do not fill above the max fill line. This will result in excess fluid mist drawing into the vacuum pump**	
7	Fill the Fresh Fluid Tank to **28cm** on the tank scale. Once the desired level of fresh fluid tank is achieved, close valve #2.	
8	Close all other valves	
9	Turn off vacuum pump	

Section 11: Venting the Machine

With the hoses disconnected from the vehicle, If the there is pressure is trapped in the lines of the machine, you can vent the lines by doing the following:

To vent pressure from Gauge #1

- Open Valve#6

To vent pressure from Gauge #2

- Open Valve#2

To vent pressure from Gauge #4 or Gauge #1

- Open Valve#6
- Open Valve#5

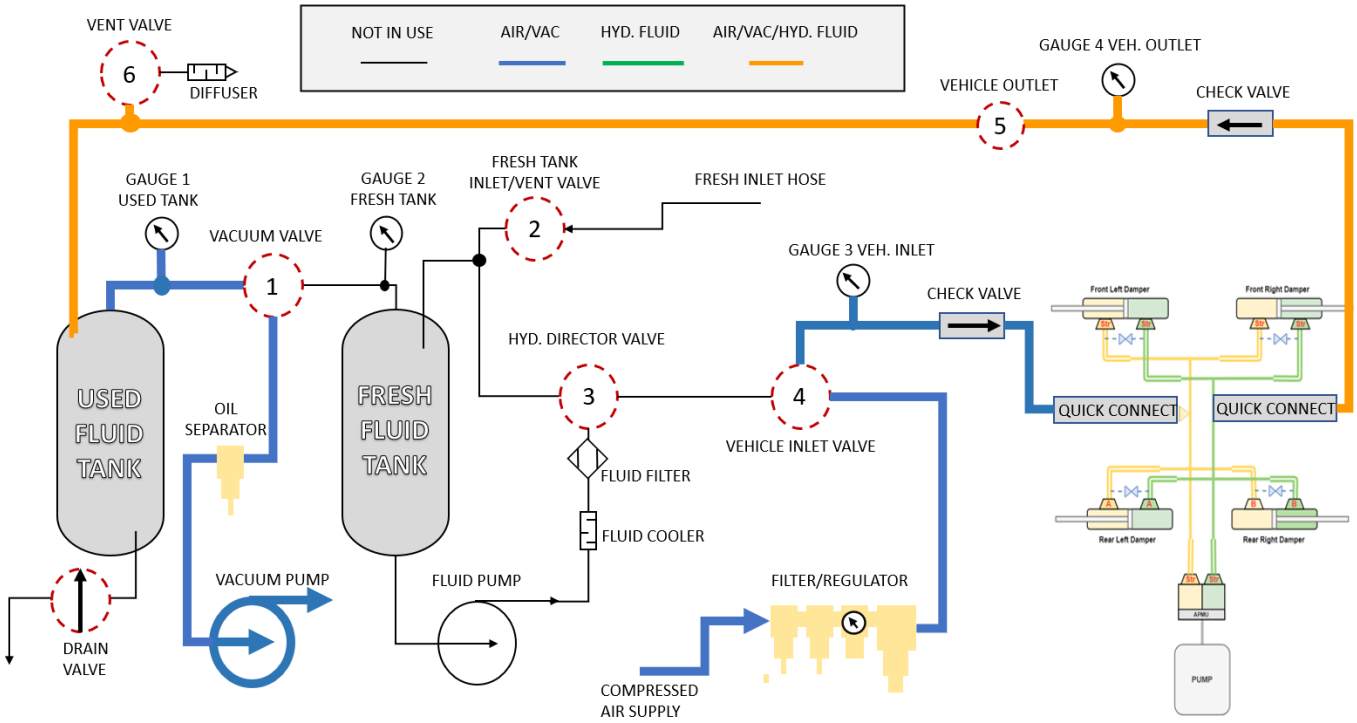
To vent pressure from Gauge #3

- Disconnect compressed air
- Open Valve#4

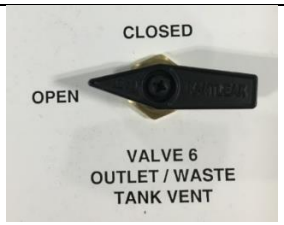
KINETIC SYSTEM SERVICE PROCESS:

OPERATION 1: EVACUATING THE SYSTEM

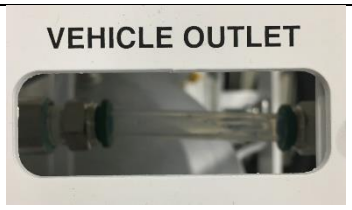
EVACUATION



STEP	DESCRIPTION	IMAGE
1	**Do not connect the hoses to the system yet** Hermes: Run the Kinetic System ROUTINE ID: **D00A - DEPRESSURIZATION ROUTINE**, **Input Length: 02** **Data: 4001** **Request Results: 1 Success** **Stop the routine after 45 seconds**	
2	Start with an empty Used fluid tank. Refer to **SECTION 9: DRAINING THE USED FLUID TANK**	
3	Start with all valves closed on the control panel. Compressed air is required.	
4	Connect the hoses to the vehicle. *Note: The hoses for the Manual Kinetic Evac and Fill machine are not H1/H2 specific when connecting to the vehicle.*	

5	Beginning with an empty Used Fluid tank, set the target level by moving the lower o-ring sight level to **~14.5cm** on the tank scale This is the approx. expected amount of fluid that will be removed from the system	
6	Set Air Regulator to **15 PSI**	
7	Turn Valve #6 to “Open” relieving the tank to atmospheric pressure	
8	Turn Valve #5 to Open. This is opens the waste tank to the vehicle	
9	Run ROUTINE ID: **D00A - HYDRAULIC SUSPENSION PUMP** in Hermes to drain the reservior **Input Length: 02** **Data: 6400** *Note: This routine needs to be closely monitored to prevent running the pump dry.*	
10	Run the pump until you stop seeing fluid flow in the Vehicle Outlet sight tube. This should take no more than 3 minutes	
11	Stop ROUTINE ID: **D00A - HYDRAULIC SUSPENSION PUMP**when fluid flow in the	
12	Turn Valve #6 to “Closed”	
13	Run ROUTINE ID: **D005 - CIRCUIT EMPTY** in Hermes to cycle the valves and begin flushing fluid from the system	
14	Turn the Vacuum Pump “On”	

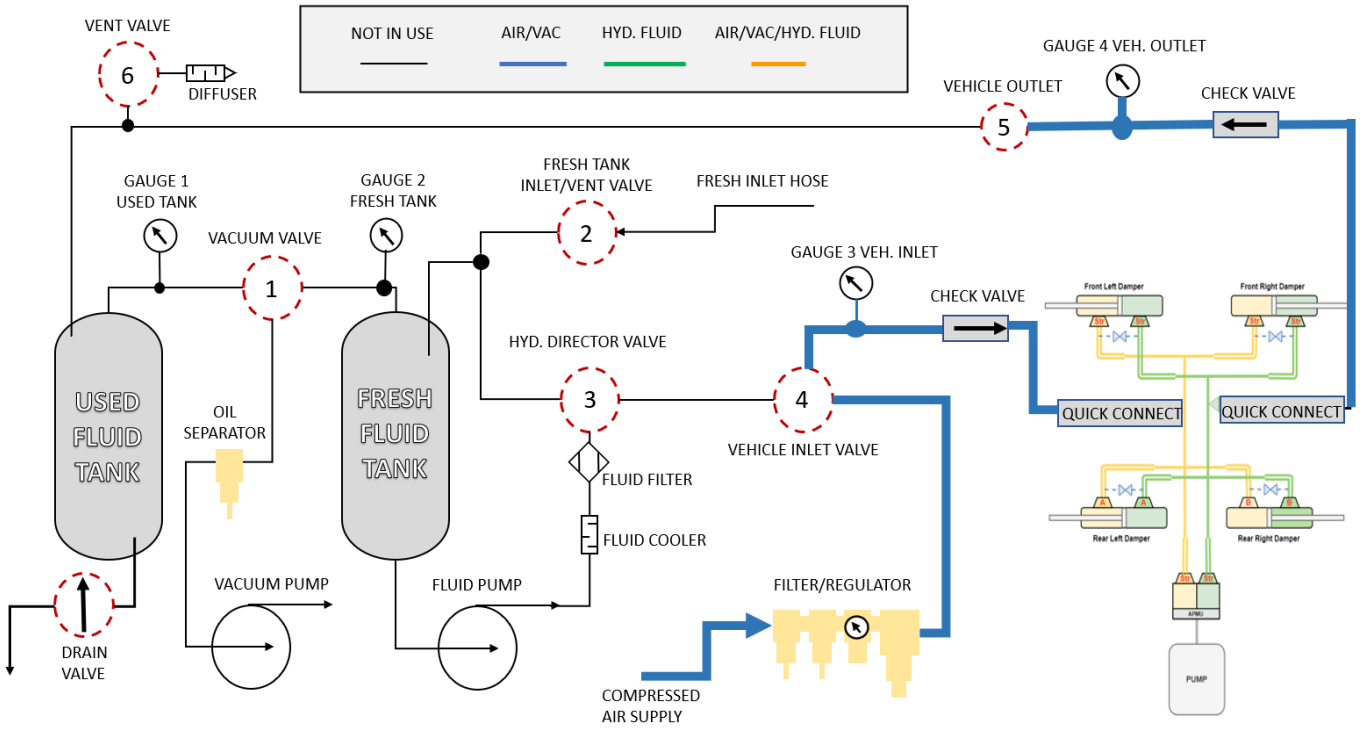
15	Turn Valve #1 to “Used Fluid Tank”	
16	Watch Gauge #1 Vacuum < 25 in.Hg	
17	Turn Valve #4 to part way to “Evacuate” as shown	

18	Watch Gauge #1 Vacuum. Maintain Gauge #1 between 10-20 in.Hg **Do not allow Gauge #1 to increase above -10 in.Hg towards + Pressure. This is bad for the vacuum pump.**	  
19	Evacuate the system for 15 Minutes or until there is minimum of fluid mist coming through the Vehicle Outlet Sight. *Note: Backlight the sight tube with a flashlight helps with visibility*	
20	Close Valve #4	

21	Check the level of fluid increase in the Used Fluid tank. If starting with a completely empty tank; it should read **~ 14.5cm** on the scale after draining the lines and reservoir. *Note: The amount of fluid removed from the vehicle should equate to approximately 3.6L*	
22	Turn the Vacuum Pump off	

OPERATION 2: PRESSURE TEST

PRESSURE TEST

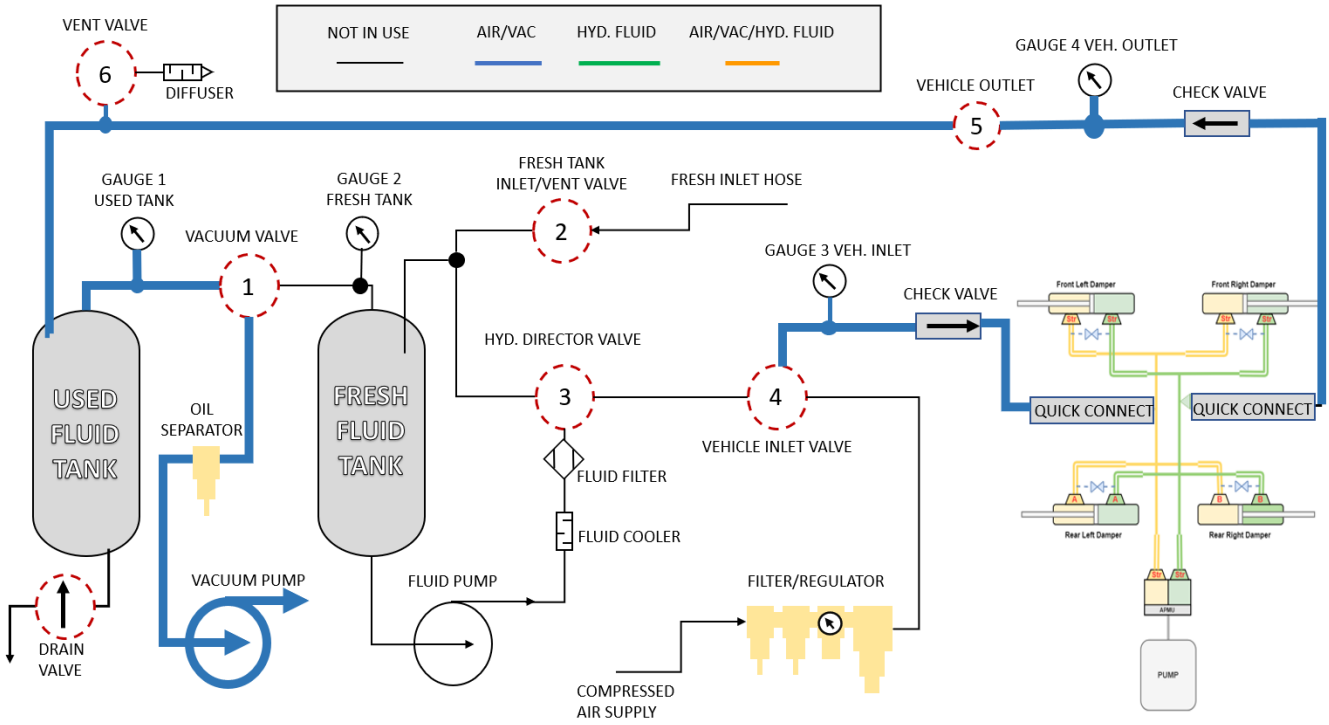


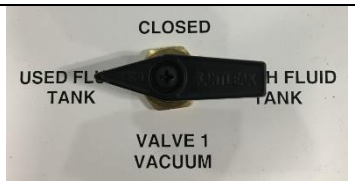
STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is required. Hoses are connected to the vehicle.	
2	Connect compressed air supply and set regulator pressure to 20psi	
4	Connect the hoses to the vehicle.	
5	Run vehicle software ROUTINE ID: **D006 - VAC FILL HYDRAULIC SUSPENSION** in Hermes to open all valves	

6	Turn Valve #4 to “Evacuate”	
7	Monitor Gauge #4 Vehicle Outlet for constant pressure ~20 PSI. Wait about 60 seconds for the system pressure to stabalize	
8	Close Valve#4 Vehicle Inlet and check for pressure drop at gauge #4 Time: <u>15 min.</u> Thre should be no change in pressure at Gauge #4 or #3 from your start pressure	
9	When the test is complete, slowly open Valve #5 Vehicle Outlet and Valve #6 Outlet Vent, to relieve pressure.	 

OPERATION 3: VACUUM TEST

VACUUM TEST

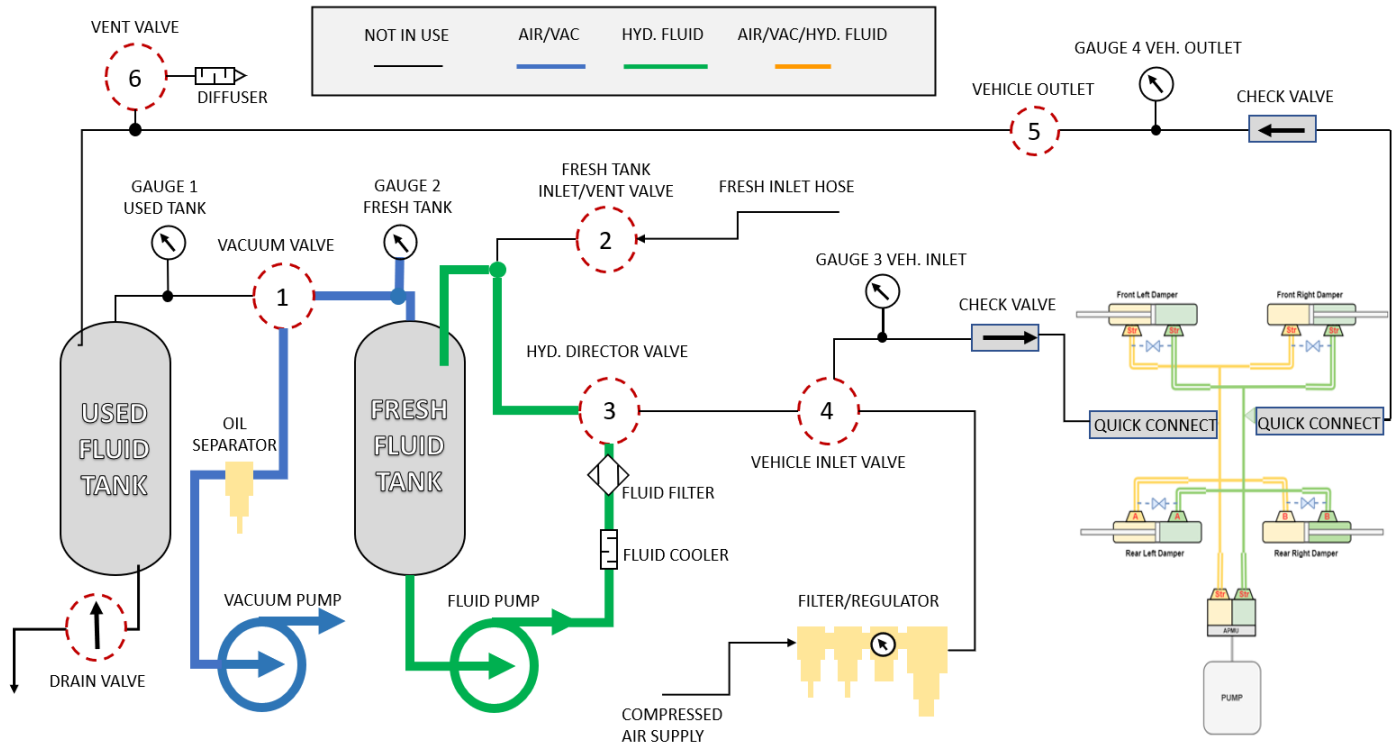


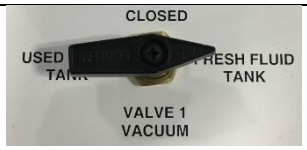
STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is <u>not</u> required. Hoses are connected to the vehicle	
	Run vehicle software ROUTINE ID: **D006 - VAC FILL HYDRAULIC SUSPENSION** in Hermes to open all valves	
2	Turn on vacuum pump	
3	Turn Valve #1 to “Used Fluid Tank”	
4	Turn Valve #5 to “Open”	

5	Monitor Gauge # 3 for pressure to drop to (-27.5 to 29in.Hg) Equalization Time: 60 Seconds	
6	Close Valve #5	
7	Monitor Gauge #3 for a consistent rise in pressure that would indicate a gross leak Test Time: 15 minutes	
8	Complete test if no leak is detected	

OPERATION 4: VACUUM DEGASSING THE HYDRAULIC FLUID

VACUUM DEGASS

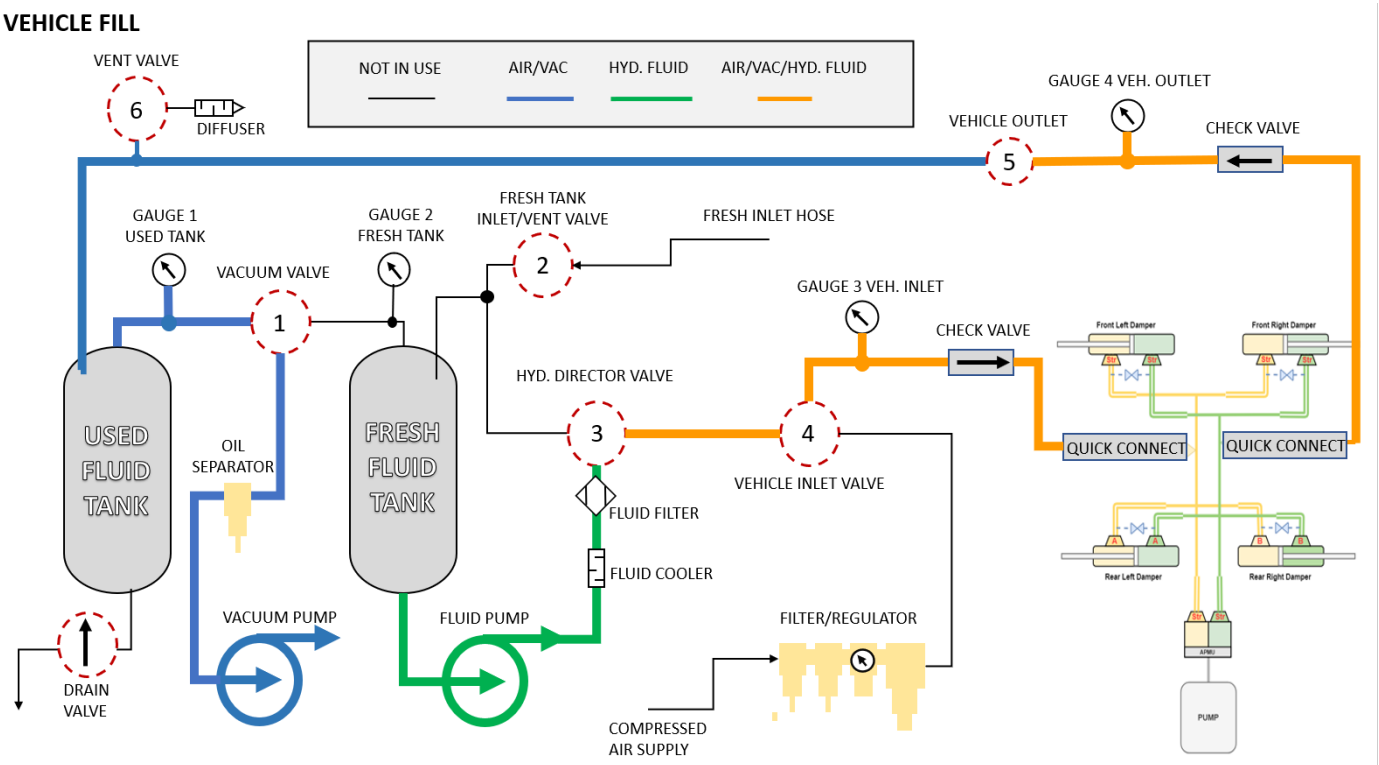


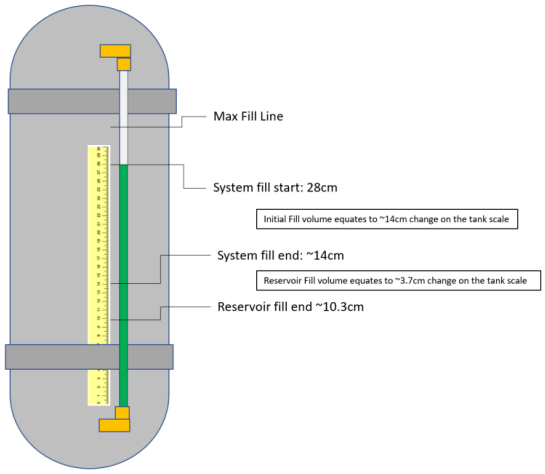
STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is <u>not</u> required. Hoses are connected to the vehicle	
2	Turn on Fluid Circulation pump	
3	Turn on the Vacuum pump	
4	Turn valve #3 to “Recirc”. This will recirculate the fluid	
5	Slowly Turn valve #1 to “Fresh Fluid Tank”. This will apply vacuum to the fresh fluid tank. The target is to achieve a stable vacuum of **25-26 in.Hg** at Gauge #2. Once target vacuum has been achieved close valve #1 and let the fluid circulate.	

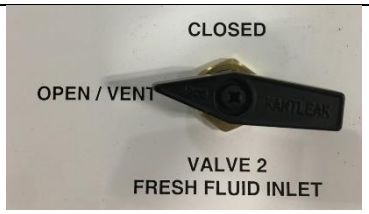
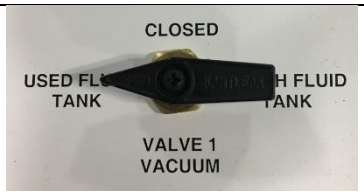
6	**IMPORTANT: Methods for maintaining target vacuum during degass and circulation** • Vacuum must be maintained at ~25-26 in.hg at gauge #2, while the fluid is circulated. • This can be achieved by slowly opening and closing valve#1 until the vacuum is stable. • If vacuum is too high (>26 in.hg) at gauge #2, you can slightly open valve #2 to vent and bring it back to ~25 in/hg. Close valve #2 when stable vacuum of 25 in.hg at Gauge #2 is achieved Observe fluid flow into hydraulic fluid pump from the tank and listen to the hydraulic pump. Ensure the fluid is continuously circulating and there is not any excessive caviation noise coming from the hydraulic pump.	
7	Once a stable vacuum is achieved without cavitation, allow system to degas for 10 minutes. If pressure level increases over this time. Turn Valve #1 to "Fresh Fluid", and feather it until 25-26 in.hg at gauge #2 is achieved.	
8	Once degas is complete, close all valves. Keep fresh fluid tank under vacuum until ready to fill vehicle. Circulation pump can be left on if proceeding directly to fill.	

OPERATION 5: FILLING THE SYSTEM

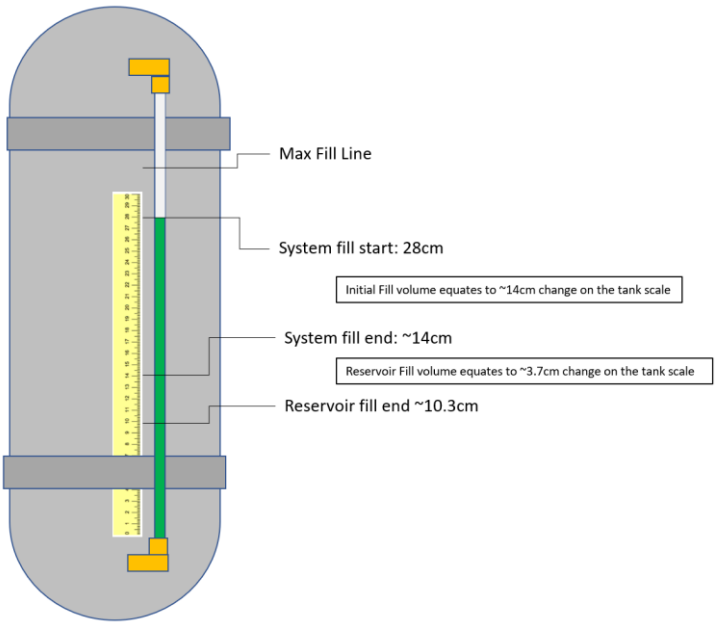
VEHICLE FILL



STEP	DESCRIPTION	IMAGE
1	Start with all valves closed on the control panel. Compressed air is not required. Hoses are connected to the vehicle. Fresh Tank level is starting at 28cm. ***Sight Level overview during Fill Process***  *Note: These numbers are for baseline approximation. The actual volume of fluid fill can vary by the number of components that were replaced.*	

2	Run vehicle software ROUTINE ID: **D006 - VAC FILL HYDRAULIC SUSPENSION** in Hermes to open all valves	
3	Set the starting level on the sight tube of the fresh fluid tank at 28cm on the scale using the upper O-ring.. Set the lower O-ring to the target level of 14cm on the scale. This is the initial fill level for the system.	
4	Slowly turn Valve #2 Fresh Fluid Tank to "open/vent" to bring the Fresh fluid tank to atmospheric pressure	
5	Turn Vacuum Pump **on**	
6	Turn Fluid Pump **on**	
7	Turn Valve #1 to "Used fluid Tank"	
8	Turn Valve #5 to "Open"	

9	Turn Valve #4 to “Fill”	
10	Pull Vacuum until ~28-29 in.Hg is achieved, and stabalized at Gauge #3 Vehicle Inlet *The vehicle system and machine lines are now under full vacuum*	
11	Close Valve #5 Vehicle Outlet.	
12	Turn Vacuum Pump **off**	
13	Turn Valve #3 Hydraulic Director to “Vehicle” *The machine will now pump fluid into the vehicle under vacuum*	
14	The pressure at Gauge #3 will begin to rise throughout the process and will eventually stabilize at ~15 psi Gauge #4 will also begin to rise and stabilize at ~15 psi as fluid fills the vehicle	

15	You will see the fluid level draw down in the sight tube of the Fresh Fluid Tank. Once the lines and system are completely full, fluid will stop flowing into the vehicle. Note: This process can take ~10 minutes. The volume of fluid filled and time can vary based on the components that were replaced. The volume change should be ~14cm on the tank scale from start.	
16	**Stop** ROUTINE ID: **D006 - VAC FILL HYDRAULIC SUSPENSION**	
17	Run software ROUTINE ID: **D00A - HYDRAULIC SUSPENSION PUMP** to activate the vehicle pump backwards to fill the reservoir. **Input Length: 02** **Data: 4001** **Parameters required: 40% duty (28 hex) in DISCHARGE direction (01)**	
18	Watch the sight level of the Fresh Fluid Tank as fluid draws down into the vehicle reservoir. Stop filling when the fluid level change of **~3.7cm** on the scale from start of the reservoir fill process.  *Note: This fill process can take ~ 15mins* *Take care not to overfill the reservoir*	

19	Once the proper fill volume has been achieved, turn Valve #4 to “closed”.	
20	Close all Valves	
21	Stop ROUTINE ID: **D00A - HYDRAULIC SUSPENSION PUMP**	
22	Move to Fill-Grade Check. Note: It may be necessary to take the vehicle for a test drive prior to running the fill grade check	

OPERATION 6: FINAL FILL-GRADE TEST

On-board vehicle diagnostic test method

The preferred method of Fill-grade test is to run the Fill-Grade operation in RiDE

STEP	DESCRIPTION	IMAGE
1	Raise the vehicle so the wheels are off the ground **IMPORTANT** Hydraulic Lines must be disconnected from the vehicle.	
2	Run ROUTINE ID: **D007 - FILLING GRADE CHECK** to test for proper fill **Note:** The routine must be completed before requesting results or else it will not give an accurate result. Refer to the routine page for determining test results Check pressure feedback using RiDE	
	Take the vehicle out for a test drive.	
	Lift the vehicle back up and run the Fill-Grade Test again	

Manual Hand-Pump Test method (Hermes only)

Only if you are unable to run the Fill-Grade Test Routine for any reason proceed to manual test using a Hydrualic Test Hand-Pump as a back-up.

STEP	DESCRIPTION	IMAGE
1	Prepare the Hydraulic Hand Pump	

2	Fill the Test Pump Reservoir	
3	Install a male ISO coupler into the Quick connect coupling. This will open the valve and allow you to bleed the pump and the lines into a drain pan.	
4	Pump several times into a drain pan to bleed out any trapped air from the pump. Remove the male fitting when bleed is complete.	
5	Connect the hand pump to one of the vehicle quick connects	
6	Run vehicle software ROUTINE ID: **D006 - VAC FILL HYDRAULIC SUSPENSION** in **Hermes** to open all valves	
7	Pump up the system until you reach 115 PSI using full and complete strokes on the pump as you go. 7 pumps or less is considered a good fill