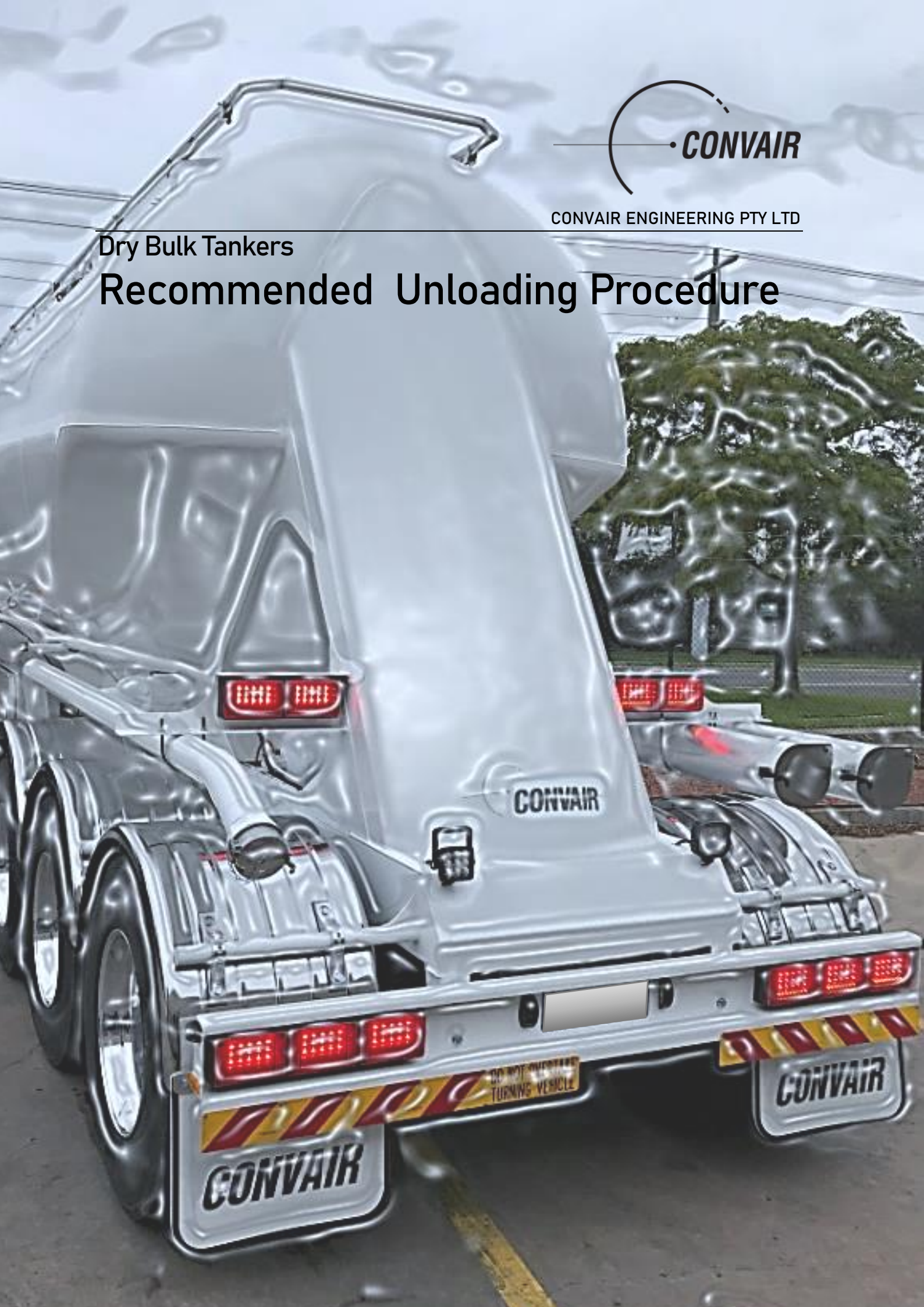




CONVAIR ENGINEERING PTY LTD

Dry Bulk Tankers

Recommended Unloading Procedure



RECOMMENDED UNLOADING OF PNEUMATIC DRY BULK TANKERS

PREVENTING PERSONAL INJURY OR DEATH

Operating a pneumatic tanker is serious business!

Compressed air has 900 times the kinetic energy of water under the same pressure, and the resulting explosive force can be fatal if a hatch is opened-, or if a hose clamp comes off while there is ANY pressure in the tank or the pipework.

NEVER open or adjust any hatch, cover or hose clamp anywhere on the tanker if the pressure gauge reads any higher than ZERO.

Stay clear of the discharge hose, which moves around with considerable force during unloading and can trip- or knock you over unexpectedly.

Always perform a pre-start check on your equipment before use (refer Convair pre-start check list).

PREVENTING SILO DAMAGE

Silos at the receiving plants are not designed to be pressurised.

A silo will develop pressure if it cannot vent the displaced air while the silo is being filled.

Displaced air needs to be vented to atmosphere. This is done by passing the air through a dust filter. These filters include a device which automatically cleans the filter. Failing to start these cleaning devices will result in the filter clogging while unloading, resulting in pressure building in the silo.

The tanker operator must always ensure that the filter (cleaning device) is started before commencing the unloading procedure.

It is essential that the tanker pressure be released slowly, and controlled so that there is the minimum amount of pressure left in the tank at the end of the unloading procedure. If this is not done, the final discharge of higher pressure results in a massive volume of air discharging into the silo, often more than what the silo filter can handle, potentially causing significant damage to the filter and even the silo.

Do not allow a sudden pressure drop from the tanker to occur.

Follow all plant instructions while unloading.

PREVENTING COMPRESSOR DAMAGE

To avoid damage to compressor, PTO and gearbox, a compressor must only be started or stopped with an open air flow path for the air to pass through.

NEVER dead-head a compressor!

As a minimum, check the pressure gauge to ensure that the vessel pressure is ZERO, and ensure that the AIR DUMP valve and the TOP AIR valve are both fully OPEN, before starting or stopping the compressor.

Have the compressor serviced every 6 months (refer owner's manual).

PREVENTING EQUIPMENT DAMAGE

There are two pressure relief valves, one to protect the compressor, and one to protect the pressure vessel (tank).

Refer to the owner's manual for set pressures and regularly check these pressure relief valves for correct operation.

Do not use any compressor or tanker that does not have a functioning pressure relief valve.

Observe the compressor intake restriction indicator during operation.

Have the tanker serviced at the required intervals (refer owner's manual).

TOP AIR

Unloading a pneumatic tanker requires pressure in the vessel.

The top air flow path has the least resistance and is the easiest and most efficient route to pressurise the tank.

Keeping the top air valve open during the unloading process protects the pressure relief valve from product back-flow and minimises the risk of air “rat-holing” direct from aerator to discharge.

Leave the top air valve open as much as possible.

OPERATE ONLY ONE CONE AT A TIME

The compressor is sized to provide only the amount of air required to effectively aerate the product (one aeration valve), pressurise the tank (top air valve), and transport the product (boost valve).

The compressor cannot provide the amount of air required to discharge more than one cone at a time.

Discharge only one cone at a time and aerate only the cone being discharged.

CONE UNLOAD SEQUENCE

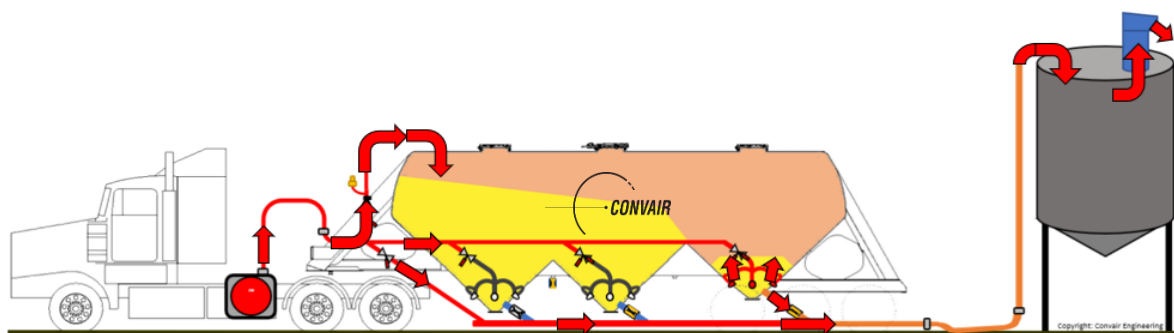
Unloading the rear cone first of a single trailer maintains load on the prime mover, in case only one cone can be unloaded.

Unloading the cone closest to the discharge connection enables the shortest/fastest discharge option (typically also the rear cone).

The unblocking procedure requires an empty cone to reverse product flow back into, and with minimum pipework and valves, hence recommended to DISCHARGE the cone closest to the product discharge connection first (typically also the rear cone).

To FLUSH the full length of the discharge manifold at the end of the flushing stage without having to increase pressure, always flush the cone closest to the discharge connection first, then the adjacent cone, etc., and flush the furthest cone last.

Refer pressure management below regarding separate DISCHARGE and FLUSH stages.

AIR FLOW PATH

PRESSURE MANAGEMENT

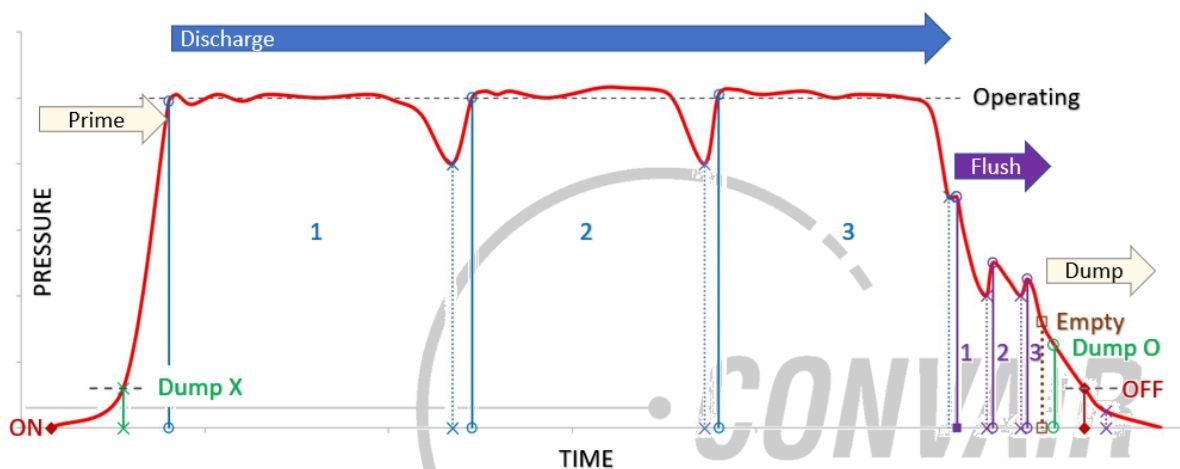
Rapid pressure decrease translates into very high flow rate, which can overload the silo dust filter hence any pressure reduction should be slow and controlled.

Rapid pressure reduction can also cause condensation inside the tank and pipework, potentially affecting the product and the equipment in a number of ways.

To minimise condensation, the pressure should be kept as stable as possible, especially avoiding rapid pressure drops and limiting the inevitable large pressure drop at the end of the unloading process to one slow, controlled stage.

The unloading process should therefore be done in two separate stages:

- first stage is to DISCHARGE the majority of product from each of the cones,
- second stage is to FLUSH remnant product from each of the cones.



During the discharge stage, immediately close the open discharge valve before the tank pressure drops more than ~20% below the operating pressure, and open the next cone’s discharge valve.

Repeat this with each cone, but do NOT flush last remnant product from any cone before all cones have had majority of its product discharged.

When the flushing stage commences, do NOT increase the tank pressure to operating pressure.

The flushing stage does NOT require significant pressure, it mainly requires flow rate and flow velocity as provided by the expanding tank air volume.

To retain a minimum operating pressure during the flushing stage, switch from one pod to the next QUICKLY, the moment that the cone is completely empty.

The main objective is to reduce the tank pressure SLOWLY, else condensation can occur inside the tank and if the tank pressure is managed as recommended, the lower residual pressure passing to the silo at the end of the unloading process will also protect the silo filter.

RECOMMENDED UNLOADING PROCEDURE

Complete the pre-start check list before starting the shift (refer Convair pre-start check list).

1 Upon arrival at unloading plant

- ▷ Compressor should be OFF.
- ▷ Air dump valve should be fully OPEN.
- ▷ All other valves should be CLOSED.
- ▷ Tank pressure should be ZERO.

2 Preparing to unload

- ▶ Ensure that all hatches and filler couplings are closed and secured.
- ▶ Connect- and secure the product discharge to the material discharge point with the discharge hose.
- ▶ Connect the equipotential bonding (where applicable).
- ▶ Connect the compressor or compressed air system to the air connection.
- ▶ Ensure that the silo fill line is open and the dust filter is working!

3 Starting the compressor

- ▶ Open the top air valve fully.
- ▷ The air dump valve should remain fully open, and tank pressure should still be ZERO.
- ▶ Start the compressor.
- ▶ Once the compressor is running at set RPM, close the air dump valve.
- ▶ The pressure in the tank should now increase slowly.
- ▶ Once the tank pressure reaches the unloading pressure, open the boost valve.
- ▶ Now start discharging the first cone (closest to the discharge hose connection).

4 Discharging the cones

- ▶ Open the aeration valve of the cone to be discharged.
- ▶ Open the product discharge valve of the cone to be discharged.
- ▷ Product is discharged from the tank.
- ▶ Monitor the unloading process and the pressure.
- ▶ Control the compressed air supply pressure during the emptying procedure by modulating the boost valve opening.
- ▶ Do not leave the tanker.
- ▷ A sudden drop in pressure on the pressure gauge indicates the discharge stage is completed for this cone.
- ▷ If the cone is fitted with aerators, they will start to become noisy at this point as well (aeration pads do not).
- ▶ Immediately close the product discharge valve on this cone, and close the aeration valve on this cone.
- ▷ Any remnant product remaining in the cone to be flushed LATER.
- ▶ Once the previous cone has been discharged, **QUICKLY** move to the next cone and repeat the same steps for discharging the cone above.
- ▶ Repeat this for every cone.
- ▶ Once the last cone has been discharged, **QUICKLY** close the boost valve, close any open discharge valve, and close any open aeration valve.
- ▶ OPEN the top air valve FULLY, then start flushing remnant from the cone closest to the discharge hose connection.

6 Flushing the cones

- ▷ Only the top air valve should be open at this point.
- ▷ The flushing stage uses air flow passing from the tank directly into the discharge manifold, with very little, or no boost air.
 - ▶ Open the aeration valve-, and the discharge valve of only the cone closest to the discharge connection.
- ▷ Any remnant product is carried out by air from within the tank only.
 - ▶ Observe the discharge hose and listen to the aerators (if fitted).
- ▷ If the tank pressure seems to increase during the flushing stage it means that there is a minor blockage. If this happens, allow the pressure to build automatically, which will flush the relatively small volumes without increasing the pressure unnecessarily.
- ▷ Do NOT increase the tank pressure by changing valve positions during the flushing stage.
 - ▶ Apply pneumatic vibrator (if fitted) of the relevant discharge cone.
 - ▶ When the discharge hose lies still and aerators hum constantly, QUICKLY close the open discharge valve and open the next discharge valve.

- ▶ Repeat this for all cones, until all product has been flushed from the tank.

7 Stopping the compressor

- ▷ The compressor should still remain running at this point.
- ▷ Do not increase tank pressure.
- ▷ The top air valve should remain open.
 - ▶ Open the air dump valve.
 - ▶ Open all product discharge valves.
 - ▶ Open the boost valve.
 - ▶ Reduce compressor RPM.
 - ▶ Wait for tank pressure to drop to ZERO, then stop compressor.

8 Before departing

- ▷ Compressor should be OFF.
 - ▶ Leave the air dump valve open. This ensures that the vessel remains at ZERO pressure at all times other than during the unloading process.
 - ▶ If the tanker is to remain empty for some time, leave all pneumatic pinch valves OPEN (if fitted) to avoid premature sleeve deformation and wear.
 - ▶ Disconnect the product discharge hose only when tank pressure gauge reads ZERO.
 - ▶ Turn off the silo dust filter and close the silo fill valve (where applicable).
 - ▶ Disconnect the equipotential conductor (where applicable).
 - ▶ Stow all hoses and tools before departing.

Note: The recommended unloading procedure applies to tankers fitted with rubber aerators. For tankers fitted with cloth aeration pads, the recommended unloading procedure will also work, but may be altered to suit the product handled.

BLOCKAGES

When a blockage occurs, the tank- and/or compressor pressure relief valve will activate.

Blockages can occur due to:

- ▷ blocked- or under-sized silo filter, or
- ▷ an over-filled silo, or
- ▷ too low air velocity causing “duning” of product in horizontal sections of pipework.

Although the reverse pressure differential unblocking procedure does not involve actual vacuum, the common reference to this process is “sucking” the product back into the tank.

UNBLOCKING PROCEDURE

- ▶ If the blockage is due to a full silo or blocked filter, open the top air valve and the air dump valve fully, then wait for the tank pressure to drop as close as possible to zero before stopping the compressor.
- ▷ Blocked silo filter or over-filled silo first need to be fixed by the plant operators before the reverse pressure differential unblocking procedure can start.

Pipe blockages due to “duning” can often be cleared by simply forcing the blockage clear by pressure, as follows:

- ▶ Leave the compressor running.
- ▶ Close top air valve, all aerator valves, all discharge valves.
- ▶ Open the boost valve and the air dump valve, fully.
- ▷ This directs all compressor air into the discharge line and may force the blockage clear by pressure.
- ▷ The dump valve is opened in anticipation of reverse pressure differential unblocking procedure, in case the blockage cannot be cleared by pressure.
- ▷ The compressor pressure relief valve will activate until the blockage is cleared (this is OK).

If the blockage is not cleared by pressurising the discharge line, proceed with the reverse pressure differential unblocking procedure:

- ▷ At this stage, the top air valve, all aerator valves, and all discharge valves should already be closed, and the boost valve and the dump valve should be fully open.
- ▶ Wait for tank pressure to drop to ZERO.
- ▶ If the compressor was stopped, start it again and bring it to operating RPM.
- ▶ When tank pressure is ZERO and the discharge line is under pressure (compressor relief valve goes off), quickly OPEN, then CLOSE discharge valve of the first (most empty) pod.
- ▶ Repeat quick opening and closing of this discharge valve until the blockage is cleared.
- ▷ By repeating this process, the reversed pressure differential draws (“sucks”) the product from the high pressure blockage area back towards the low pressure in the tank.
- ▷ When the blockage is cleared, the compressor pressure relief valve will stop releasing air, and you may hear product flowing back into the tank.
- ▶ Once the blockage is cleared, you can resume unloading.

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