

# Introducing ChillZilla

## Chart's New Liquid Nitrogen Supply Management System

By Tim Neeser

A wide variety of liquid applications ranging from food freezing to cryo-biological storage repositories to government lab test facilities can consume large volumes of liquid nitrogen ( $\text{LN}_2$ ) at low pressure. Historically these applications have been few in number when compared to the plethora of nitrogen gas applications, so the  $\text{LN}_2$  servicing solution has been to use a modified standard bulk tank initially set up for gas service. Modifications to standard tanks include adding a vacuum-insulated pipe (VIP) liquid withdrawal to reduce the heat leak into the liquid and adding a back-pressure regulator to control the top-end pressure of the tank.

While these solutions have been used for years for  $\text{LN}_2$  applications, they have limitations that can adversely affect the quality of the liquid supplied at the use point. For example, the VIP liquid withdrawal is not always specified, which results in ice forming on the piping—a clear indication of unwanted product losses. Used tanks, which are often

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installed, may not have the VIP liquid withdrawal feature at all, plus used tanks tend to have poor thermal performance, which again creates unwanted product losses. The regulators on standard tanks can be hard to set and have large dead-bands between opening and closing, preventing tight control of the liquid conditions. For the pressure builder, which controls the pressure in the vapor space (ideal for gas withdrawal), the existing design that comes with the standard tank may be undersized for  $\text{LN}_2$  applications.

These limitations can prove to be expensive to  $\text{LN}_2$  application processes. Failure to install a properly designed and manufactured bulk tank for storing and dispensing liquid

with consistent quality causes wasted energy in lost cooling power as there is no economizer circuit in liquid service! Poor control of the liquid conditions in modified standard tanks allows the outlet pressure to fluctuate so wildly that many times customers cannot utilize the lower one-third of the tank's capacity. This problem stems from the reduction in tank outlet pressure (tank vapor + liquid head pressure) at the liquid withdrawal point, which leads to a reduction in liquid flow rate at the application and results in inconsistent cooling.

In applications such as food freezing where the product is moving at a specified rate in the tunnel portion of the freezer, it is critical that the quality of the liquid being dispensed is consistent. This consistency enables the process to be tuned for maximum production throughput. If the process goes out of tune because of inconsistent liquid conditions at the application site, the only recourse a plant manager has (other than slowing down production) is to call the liquid supplier and expedite a tank refill in order to restore the liquid to pre-tuned conditions. This is an expensive fix as the  $\text{LN}_2$  delivery may be billed as an emergency refill, and the tank is unlikely to be at the desired refill point, so it can't take a full trailer load. The fresh liquid, however, resolves the tuning problem as it is usually colder than the existing liquid in the tank and lowers the overall liquid saturation pressure. More importantly, the pressure at the bottom of the tank is increased so the tuned  $\text{LN}_2$  flow rate is restored. The cryogenic food freezer, like any electrical appliance, wants to run on a constant supply pressure or voltage, so the  $\text{LN}_2$  flow rate or amperage draw remains constant. The  $\text{LN}_2$  refill acts like power being restored after a power outage.



Many bulk tanks used in liquid applications are not specified correctly and lead to inefficiencies and potential safety issues, such as the icing pictured here.

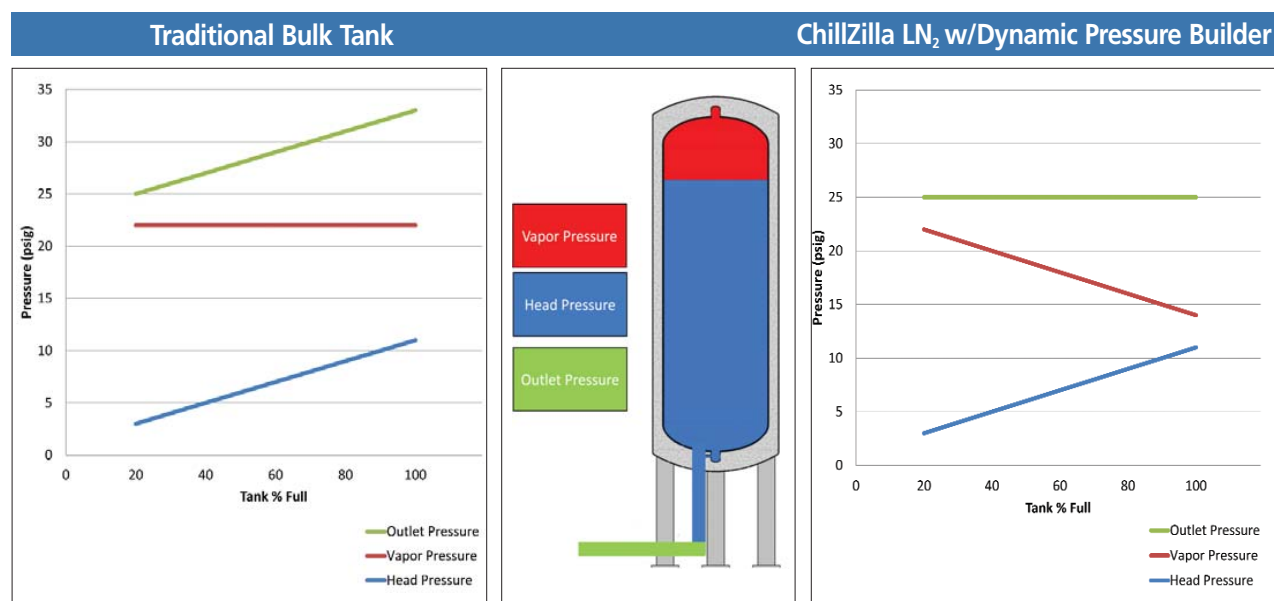


Figure 1

Chart Industries

Traditional bulk tanks are designed for gas service and control the vapor pressure in the head space. The ChillZilla LN<sub>2</sub> is designed for liquid service and controls the pressure at the bottom of the tank regardless of the liquid level.

## Creating a Competitive Advantage in Bulk Liquid Nitrogen Supply

Now, a new product is being introduced by Chart Industries ([www.chartindustries.com](http://www.chartindustries.com)) that represents a much improved system for liquid nitrogen supply management in LN<sub>2</sub> applications—the ChillZilla LN<sub>2</sub>. This specially designed bulk tank has lots of power so customers can control their liquid nitrogen storage supply to meet their chilling requirements.

The heart of the ChillZilla LN<sub>2</sub> is the Programmable Logic Controller (PLC) that receives inputs from the liquid level, pressure, and actual LN<sub>2</sub> temperature in the bottom of the tank. With this key information in real-time, the PLC output controls an electronic pressure-building isolation valve and an electronic vent valve. With programmable inputs, customers can set their requirements to operate the two valves with very tight parameters (+/- 2 psi). For example, in a typical food freezing application the pressure builder can now be set to 25 psig and the vent at 35 psig—resulting in tighter control of the liquid conditions. Unique to the ChillZilla LN<sub>2</sub>, these pressure set points are at the bottom of the tank, not at the traditional top vapor space. With this system not only is the band tighter than with traditional regulators, but the ChillZilla LN<sub>2</sub> precisely controls the outlet

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pressure regardless of the tank liquid level—a must as there is no final line regulator in liquid service!

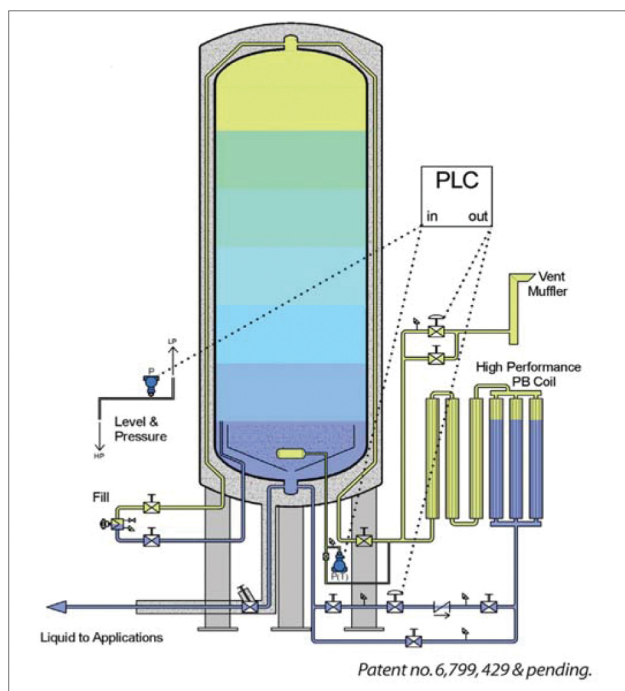
Dubbed “Dynamic Pressure Builder™”, the PLC program makes real-time adjustments. As the liquid level falls in normal use, the set point to turn on the pressure builder valve increases to compensate for the loss in liquid head pressure. This may sound insignificant, but as shown in Figure 1, the liquid head can be as much as 44 percent of the total pressure at the bottom of a tank! With the Dynamic Pressure Builder, the application always has a consistent outlet pressure regardless of tank liquid level. This key feature allows the customer to utilize 95 percent of the tank contents.

To control the outlet pressure at the bottom of the tank during the refill process, the driver still follows the normal procedure of adjusting the top and bottom fill valves to hit the “instructed fill target pressure” by monitoring the tank pressure gauge. However, the ChillZilla LN<sub>2</sub> pressure gauge is connected to the high-phase line (vapor pressure + liquid head = outlet pressure), not the traditional low-phase line (vapor pressure). Thus, unknowingly, the driver reduces the vapor pressure as the tank is filling, holding

the outlet pressure stable without changing the filling procedure. This also keeps the application online and unaffected by a tank refill process.

The ChillZilla LN<sub>2</sub> incorporates another key feature in its design, the automatic liquid de-saturation cycle. If the user has blackout (non-use) time periods programmed into the PLC, and if the liquid gets too warm, the vent can automatically be directed to open and blow down the tank to the desired outlet pressure, or even below it. Once the vent valve closes, the pressure builder can be programmed to automatically turn on and create the desired amount of sub-cool (the difference between the vapor pressure and the saturation pressure of the liquid). This feature is desirable in applications with erratic usage patterns that cause the liquid to take on heat (from being idle) and for those where consistent liquid quality is critical for the application. This feature is primarily driven by the PLC input from the actual LN<sub>2</sub> temperature in the bottom of the tank.

Rounding out ChillZilla’s features are the high performance two-stage ambient pressure building coil, the VIP withdrawal connection, and internal baffle. The standard coil on the ChillZilla will support



Chart's New ChillZilla LN<sub>2</sub> is engineered for liquid applications.

withdrawal rates up to 20 GPM and a second coil is available for demands up to 40 GPM. To support these flow rates, the VIP liquid withdrawal line is available in 1½" and 2" sizes with standard Chart VIP female bayonet connections. To promote stable liquid withdrawal during a product refill, the ChillZilla LN<sub>2</sub> incorporates a low-mounted internal horizontal baffle with a side wall bottom fill designed to direct the incoming liquid up the side of the vessel during bottom filling. The baffle also aides in deflecting unwanted heat from the vessel's bottom supports. Piping penetrations up the sides of the tank promote liquid stratification, which keeps the liquid colder at the tank bottom to feed the application.

This niche market for liquid applications is expanding fast as new uses for liquid nitrogen are developed every day. For customers who consume large amounts of LN<sub>2</sub> at high flow rates or simply want better control of their liquid supply, the new ChillZilla LN<sub>2</sub> is an excellent alternative to a modified standard bulk tank. Providing a turnkey system designed for liquid service supply provides customers with a safer and more productive solution for many years of satisfied service. ■

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# CHILLZILLA™

Smartest Monster in Cryogenics



## Bulk LN<sub>2</sub> Supply Management System.

Introducing ChillZilla™ LN<sub>2</sub> from Chart. The ChillZilla is engineered to supply consistent quality liquid nitrogen for optimum freezing performance. By measuring the liquid parameters, including the temperature inside the tank bottom, the ChillZilla automatically provides the precise liquid conditions and supply pressure to the application regardless of the tank liquid level.

- Dynamic Pressure Builder™ for precise LN<sub>2</sub> supply pressure
- PLC driven for precise liquid condition supply with automatic de-saturation capability
- High performance two-stage ambient pressure-builder vaporizer for maximum efficiency
- Large vacuum-insulated supply line provides 20 GPM flow (40 GPM available)
- Internal barrier baffle with dedicated side-wall bottom fill reduces mixing with LN<sub>2</sub> supply during transport refill and promotes liquid stratification

Search *ChillZilla* LN<sub>2</sub> online to see how the *Smartest Monster in Cryogenics* can put you in control of your LN<sub>2</sub> supply.

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