



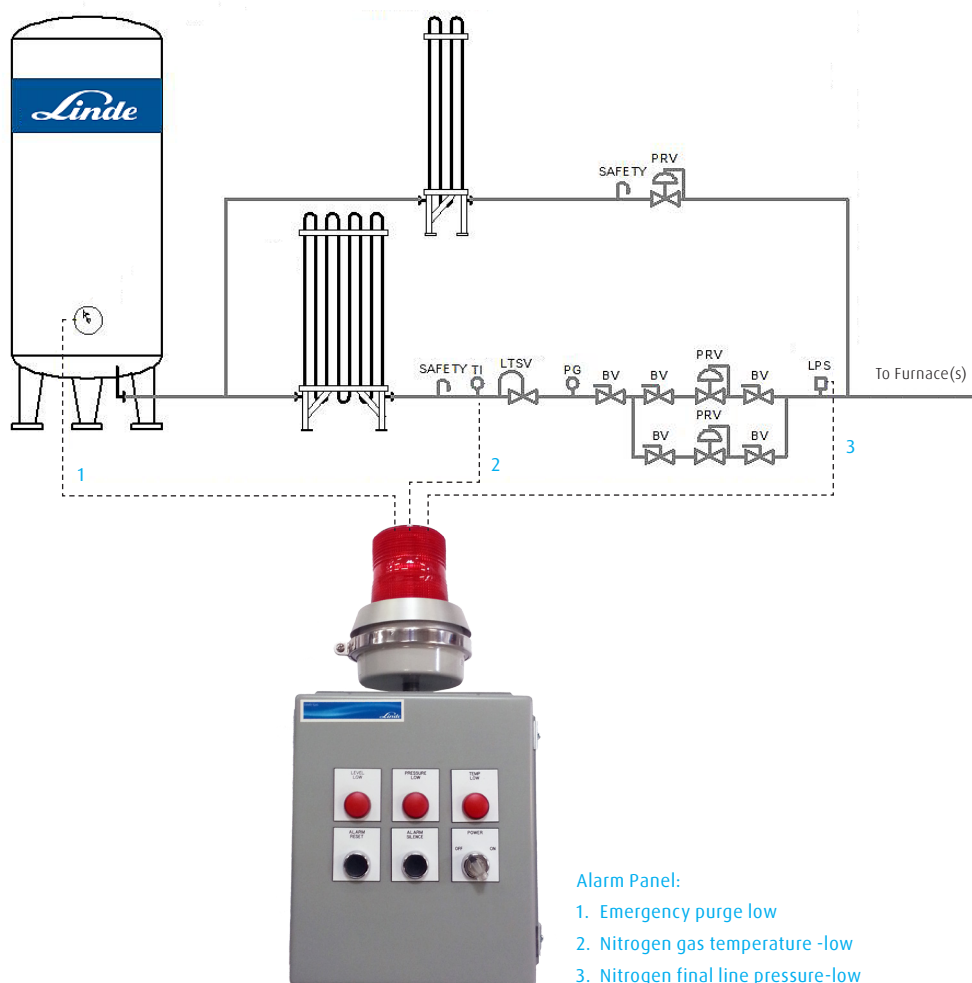
Safety solutions for special atmosphere thermal treatment applications.

At Linde we not only produce and distribute industrial gases, we also want to ensure that our customers use them safely and effectively. Linde's application engineers conduct safety training classes at customer sites and provide recommendations for custom safety solutions. A typical Nitrogen Safety Training would cover the properties of hazards associated with liquid and gaseous nitrogen, material compatibilities, storage tank fundamentals, and emergency contact numbers.

How Safe is Your Safety Purge?

The National Fire Protection Association (NFPA) is the industry accepted authority of industrial gases and furnaces. All heat treating facilities should familiarize themselves with NFPA 86 "Standard for Ovens and Furnaces". Within NFPA 86 there are specific requirements for Nitrogen Supply Systems used to purge flammable atmosphere furnaces. The following system has been developed by Linde to satisfy the requirements of the NFPA 86.

Safety Solution for Thermal Treatment Applications:



The following excerpts are outlined in the standard (NFPA 86, 2011 Edition):

"13.5.5.1D Where inert purge gas is required by this standard, the following shall apply:

- (1) It shall be available at all times and be sufficient for five volume changes of all connected atmosphere furnaces
- (2) If the inert gas has a flammable gas component, it shall be analyzed on a continuous basis to verify that the oxygen content is less than 1 percent and the combined combustible gas concentration remains less than 25 percent of the LFL."

"13.5.5.1E Bulk Storage systems shall be rated and installed to provide the required flow of special atmospheres to the user equipment if an interruption of the flow can create an explosion hazard."

"13.5.5.1F Where inert gases are used as safety purge media, the minimum volume stored shall be the amount required to purge all connected special atmosphere furnaces with at least five furnace volume changes wherever the flammable atmospheres are being used."

"13.5.5.2 Storage Systems for Special Atmospheres. Tanks containing purge media shall be provided with a low-level audible and visual alarm that meets the following criteria:

- (1) The alarm is situated in the area normally occupied by furnace operators.
- (2) The low-level alarm set point is established to provide time for an orderly shutdown of the affected furnace(s)
- (3) The minimum contents of a tank containing a purge medium at the low-level alarm set point is sufficient to purge all connected atmosphere furnaces with at least five volume changes."

"A.13.5.5 Vaporizers used for safety purging to convert cryogenic liquids to the gas state should be ambient air heat transfer units so that flow from such vaporizers is unaffected by the loss of power.

The use of powered vaporizers is permitted where one of the following conditions is satisfied:

- (1) The vaporizer has reserve heating capacity to continue vaporizing at least five furnace volumes at the required purge flow rate immediately following power interruption.

(2) Reserve ambient vaporizers are provided that are piped to the source of supply so that they are unaffected by a freeze-up or flow stoppage of gas from the powered vaporizer. The reserve vaporizers should be capable of evaporating at least five furnace volumes at the required purge flow rate.

(3) Purge gas is available from an alternative source that is capable of supplying five volume changes after interruption of the flow of the atmosphere gas to the furnace.

Vaporizers should be rated by the industrial gas supplier or the owner to vaporize at 150 percent of the highest purge gas demand for all connected equipment. Winter temperature extremes for the locale should be taken into consideration by the agency responsible for rating the vaporizers.

The industrial gas supplier should be informed of additions to the plant that materially increase the inert gas consumption rate so that vaporizer and storage capacity can be resized for the revised requirements.

A temperature indicator should be installed in the vaporizer outlet piping for use in evaluating its evaporation performance at any time.

A device should be installed that prevents the flow rate of gas from exceeding the vaporizer capacity and thereby threatening the integrity of downstream equipment or control devices due to exposure to cryogenic fluids. A break in the downstream pipeline or failure (opening) of the supply pressure regulator could cause excessive flow. Exceeding the capacity of an atmospheric vaporizer leads to a gradual decrease in gas temperature that can be remedied by decreasing the demand on the vaporizer.

In atmospheric vaporizers, in lieu of the flow-limiting device, a visual and audible alarm should indicate to operators in the vicinity of the furnace that the temperature of the vaporizer outlet gas has fallen below a minimum level, indicating a potential to exceed vaporizer capacity."

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