LACO TECHNOLOGIES

APPLICATION NOTE

NOTE #11-08

# VACUUM TRAP
# WATER REMOVAL COLD TRAPS

## SCOPE

This application note covers vacuum trap technology, specifically cold traps.

## BACKGROUND

Vacuum traps have two primary functions: protecting vacuum pumps from contaminants in the vacuum process, and protecting the vacuum process from vacuum pump oil. Contaminants that can affect a vacuum pump include particles, liquids, and variety of condensable vapors. Vacuum pumps that use oil such as rotary vane pumps or diffusion pumps can be a source of oil vapor contamination to a vacuum process.

## DESCRIPTION

Vacuum traps are designed to capture vapors, particles and even liquids. Two classifications of vacuum traps are cold traps and media traps. Cold traps are most effective at trapping condensable vapors, media traps are used to trap vapors as well as particles.

Cold traps are offered in three basic styles; liquid nitrogen, dry ice and traps chilled by refrigeration. Cold traps provide a cold surface to trap condensable vapors such as water and solvents by condensing the vapor into a liquid or solid on the trap surface and preventing its migration. The trapped vapor freezes on the cold metal surface and appears as “frost” on the trap surface. Cold traps provide superior vapor trapping ability to media traps, but can require daily or even hourly maintenance. Maintenance includes replenishing the cooling media (dry ice slurry or liquid nitrogen) to maintain low temperature as well as warming up the traps on a regular basis to remove condensed vapors. The selection of the proper cold trap depends on several factors. One important factor is the operating temperature. Traps typically range in temperatures from room temperatures (water cooled) down to -196°C (liquid nitrogen). A knowledge of the vacuum process (vacuum operating level and the nature of the vapors/contaminants) will help select the desired operating temperature of a cold trap. Cold traps are not only used to trap vapors to protect pumps, but are also commonly used with oil diffusion pumps to minimize oil backstreaming to the vacuum chamber.

The other category of vacuum traps is media traps. Media traps work at room temperature to trap oil, particles and other vapors. One advantage of media traps is their lower cost; media traps have lower maintenance costs compared to cold traps. Media traps typically have media with very high surface area to provide multiple sites to trap vapors and/or particles while providing high vacuum conductance (flow) through the trap.

A molecular sieve trap contains a synthetic zeolite sieve that effectively prevents backstreaming and traps water vapor. Many styles offer a replaceable insert for easy maintenance. Using the correct insert to match your application will improve performance. The list below shows several interchangeable inserts and their application advantage.

## DESCRIPTION (CONTINUED)

- **Copper Gauze:** Large surface area traps particles and is a barrier for oil vapors in mechanical oil-sealed pumps
- **Stainless Steel Gauze:** Same as copper, but with added corrosion protection
- **Molecular Sieve (Zeolite):** Reduces mechanical pump oil backstreaming and traps water vapor
- **Activated Charcoal:** Removes organic vapors
- **Activated Alumina:** Removes Lewis acids, polar compounds, other acids, water and particles
- **Pleated Media (polypropylene, fiberglass, etc.):** Traps high volumes of solids and particulates, typically have different micron ratings
- **Metal Mesh:** Traps large particles, typically to protect turbo pumps

Selection criteria to keep in mind when purchasing a vacuum trap are body style, port size and media desired.

**VACUUM TRAP COMPARISON**

| Effectiveness Rating<br>*** Very Good<br>** Good<br>* Fair<br>N/R Not Recommended | COAXIAL TRAPS | | MOLECULAR SIEVE | | COLD TRAPS | | PARTICULATE TRAPS |
|---|---|---|---|---|---|---|---|
| | Stainless Copper Element | Synthetic Steel Element | Activated Zeolite Charge | Alumina Charge | Dry Ice Slurry | Liquid Nitrogen | Polyester Element |
| **TRAP APPLICATIONS** | | | | | | | |
| PREVENT OIL BACKSTREAMING | ** | ** | *** | *** | *** | *** | N/R |
| TRAP WATER VAPOR | N/R | N/R | Trace amt. only | Trace amt. only | *** | *** | N/R |
| TRAP ACIDIC VAPORS | N/R | N/R | N/R | N/R | * | *** | N/R |
| **TRAP MAINTENANCE** | | | | | | | |
| TIME INTERVAL TO REPLACE ELEMENT | Six Months | Six Months | Vapor Load? | Vapor Load? | - | - | - |
| NEED ONLY CLEAN TRAP | No | No | - | - | Yes | Yes | Yes |
| REFRIGERANT HOLD TIME (HOURS WITH NO LOAD) | - | - | - | - | 24 | 2 to 4 | - |
| **TRAP CHARACTERISTICS** | | | | | | | |
| TRAPPING MECHANISM OPERATING TEMPERATURE | Room Temp | Room Temp | Room Temp | Room Temp | -79°C | -198°C | Room Temp |
| LIMITING PRESSURE (TORR) | $10^{-4}$ | $10^{-4}$ | $< 10^{-3}$ | $< 10^{-3}$ | $10^{-3}$ | $10^{-5}$ | $10^{-3}$ |
| CAN LOWER PUMP BASE PRESSURE | - | - | Yes | Yes | - | Yes | - |

## BENEFITS

Choosing the appropriate vacuum trap for your application needs can protect the pump and process from vapors and particles and by minimizing oil backstreaming. Some type of trap is recommended for most all vacuum applications.

## RELATED PRODUCTS

LACO Technologies manufactures both dry ice and liquid nitrogen vacuum traps while stocking a range of media traps.