

Pumpdown Time and Pump Implementation

Pumpdown Time

The vacuum pumps employed in your evacuation process must perform in the time allowed based on your takt time, number of units to be produced/hour or per/day.

Before this phase of your process, a couple of operations may improve your pumpdown time, namely nitrogen purging or oven drying. Otherwise, your refrigeration circuit or coil is going to contain a fair amount of moisture, affecting the pumpdown time either slightly or severely, depending on the level of residual water and other non-condensables in the system.

Typical pumpdown times for manufacturers range from 10-20 minutes, using 15-20 m³/h pumps, permitting a gradual vaporization of the moisture as opposed to employing oversized pumps which can pumpdown too quickly, turning the moisture into ice and forming sludge when refrigerant is added.

Pump Implementation

There are two basic ways pumps are employed in manufacturer's production lines, manifold and individual (carousel). They differ fundamentally in their approach.

Manifold

The first method is a manifold system, which consists of one large capacity pump connected in parallel to several refrigeration circuits via a multi-coupling manifold.

This method has several disadvantages. If one of the refrigeration circuits has a leak or contains too much moisture, it will be impossible to attain a good vacuum in the time allowed in either the defective system or in any of the other systems connected to the same manifold. It is difficult to determine which of the refrigeration circuits is the bad one; it can be isolated but not without adding a lot of extra time to the process.

Unless there are multiple manifold systems employed, the manufacturer will have to keep a spare pump on hand in case of failure of the one working pump, otherwise the production will be halted. On a carousel with many smaller pumps, if one breaks down, it is not too impactful on the production line.

The only advantage to this method is the initial installation cost. A 45 m³/h pump costs roughly as much as 2-3 smaller pumps.

Individual (Carousel)



Most manufacturers' evacuation realization consists of a moving production line or carousel where each refrigeration circuit or other product is attached to a single smaller rotary pump (10-20 m³/h). This method eliminates every one of the disadvantages of the manifold system while adding additional benefits.

Each system is evacuated individually, preventing an isolated defect from interfering with other good products. If a pump needs to be removed for maintenance, production can continue with a limited impact. Furthermore, additional pumps can be used to replace ones taken out for maintenance or added to the line to increase production as needed. Production is consistent and free of bottlenecks.

So, the rule of thumb should be 1 pump per circuit or 1 circuit per pump.

Vacuum Checklist

Keep the following in mind when designing a floor plan for evacuation or check your existing line to see if it conforms:

- ✓ The ultimate vacuum of the pump must be in the range of 10⁻² mbar
- ✓ The residual balanced pressure should not exceed 1 mbar
- ✓ The optimum pump capacity or pumping speed of the vacuum pump is 10-20 m³/h
- ✓ The pump type with the best performance is a dual stage oil bath rotary vane pump
- ✓ The ideal implementation of pumps is on a moving production line or carousel

This article is excerpted from VTech's publication "High Vacuum and the Refrigeration Industry." Please see past issues of VTech e-news for previous installments and look for future contributions from this handy resource. Copies are available upon request.