

Trap Manifold Design

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November 9, 2008

Executive Summary

A trap manifold is needed when the customer's objective is to trap a sample of gas. In this case the gas can be used to judge the amount of emissions from a sample of soil over a period of one month (testing period). The design of a trap manifold first begins with the customer (sponsor) specifications. With the design specifications from the customer, the designer should ask the customers if there is a catalog or internet site where existing parts may be found. A pump, manual valves, quick connects, and reducers are typically used to construct a trap manifold. A trap manifold was constructed with manual valves, quick connects, and reducers were bought from Swagelok. The designer worked with the technical sales representative at Swagelok to select the correct parts for the customer's application. The pump (part number: NMP 05 M) that initiates the flow in the systems was bought from KNF Inc.

Keywords

Trap manifold - A housing for all the mole sieve traps that can be easily accessible.

Testing period – The one month period that the gas is trapping is preformed.

Reducers – A mechanical connection that connects two tubes of different diameter.

Quick connect - A fitting that is designed to attach to a line quickly and efficiently.

Manual Valve - A devices that regulate the flow of gases, liquids, or loose materials through piping by opening or closing ports or passageways.

Introduction

The design of a trap manifold first begins with the customer (sponsor) specifications. With your customers specifications designing of the trap manifold can begin. There are two ways of designing a trap manifold, one being that all the parts of the design will be made completely by the designer and the other way is buying existing parts from either a catalog or from the internet. This paper will be focused around buying existing parts and using them to create a working trap manifold that is low cost and quick to assemble.

Objective

A trap manifold is needed when the customer's objective is to trap a sample of gas. In this case the gas can be used to judge the amount of emissions from a sample of soil over a period of one month (testing period). The traps are to be designed with a minimum flow rate of 150ml/min and be able to trap a sample of Nitrous Oxide (NO_2) from a volume of 150ml of atmospheric air. The traps also have to be easily accessible and easy to exchange with new traps when the testing period is over.

Procedure

With the design specifications from the customer, the designer should ask the customers if there is a catalog or internet site where existing parts may be found. With the catalog or internet the designer should start narrowing down the parts that could be used in the final trap manifold. First by starting a device that initiates flow throughout the system, this is done with a low power pump. By looking at the pump's data sheet, the flow rate along with the pressure and weight can be used to select the correct pump for

this application. From “[KNF’s micro diaphragm gas sampling pumps performance data](#)”, a NMP 05 M pump can be used to circulate the gas through the system of traps.

Next the sizing of the traps should be designed. Circular tubing should be used since it can be machined with threads on it for easy and air tight connection with any component that it may be attached to. The length of the tubing can be calculated from the area of the tube as shown in equations 1 and 2,

$$Area = \pi tr^2 \quad (1)$$

$$Length = \frac{Volume}{Area} \quad (2)$$

where r is the radius of the tube and the volume is volume of gas the customer wants to trap. The shape of the traps should be made so that packaging of the trap systems is as small as possible without restricting any flow through it.

Finally the customer needs the traps to be easily exchangeable. This can be done by having the traps connected to a manual valve/quick connect configuration. The manual valve is needed close off the flow of air to the traps when they are disconnected from the trap manifold. The quick connects allow for quick replacement of the traps. With the diameter of the traps, a [manual valve](#) can be bought from a catalog. With the diameter for the tubing that circulates the gas throughout the system and the diameter of the manual valve, a [quick connect](#) can be bought from a catalog. If the diameter of the valve and tubing are different then reducers will be needed to connect the tubing to the quick connect. [Reducers](#) can be bought in the same catalog as the manual valve and quick connect. It is highly recommended that the valves, quick connects, and reducers are bought from the same company because the technical sales representative can work with the designer to select the correct parts for the customer’s specifications.

After all the necessary parts are selected the designer should build the trap manifold in a CAD program. The purpose for making the trap manifold in CAD is to give the customer a visual representation for the trap manifold. From here the customer will agree with the design purposed or the customer will ask the designer to change a dimension or part in the design to better suite the customer's specifications. The CAD model also provides the designer any and all the dimension needed to build the housing for the traps.

Results

With the customer's specifications, a trap manifold was constructed with manual valves, quick connects, and reducers were bought from Swagelok. The designer worked with the technical sales representative at Swagelok to select the correct parts for the customer's application. The pump (part number: NMP 05 M) that initiates the flow in the systems was bought from KNF Inc. With the data sheet this pump meets the correct specifications for the flow rate along, the pressure, and weight. The completed design of the trap manifold was built in NX6 as shown in figure 1.

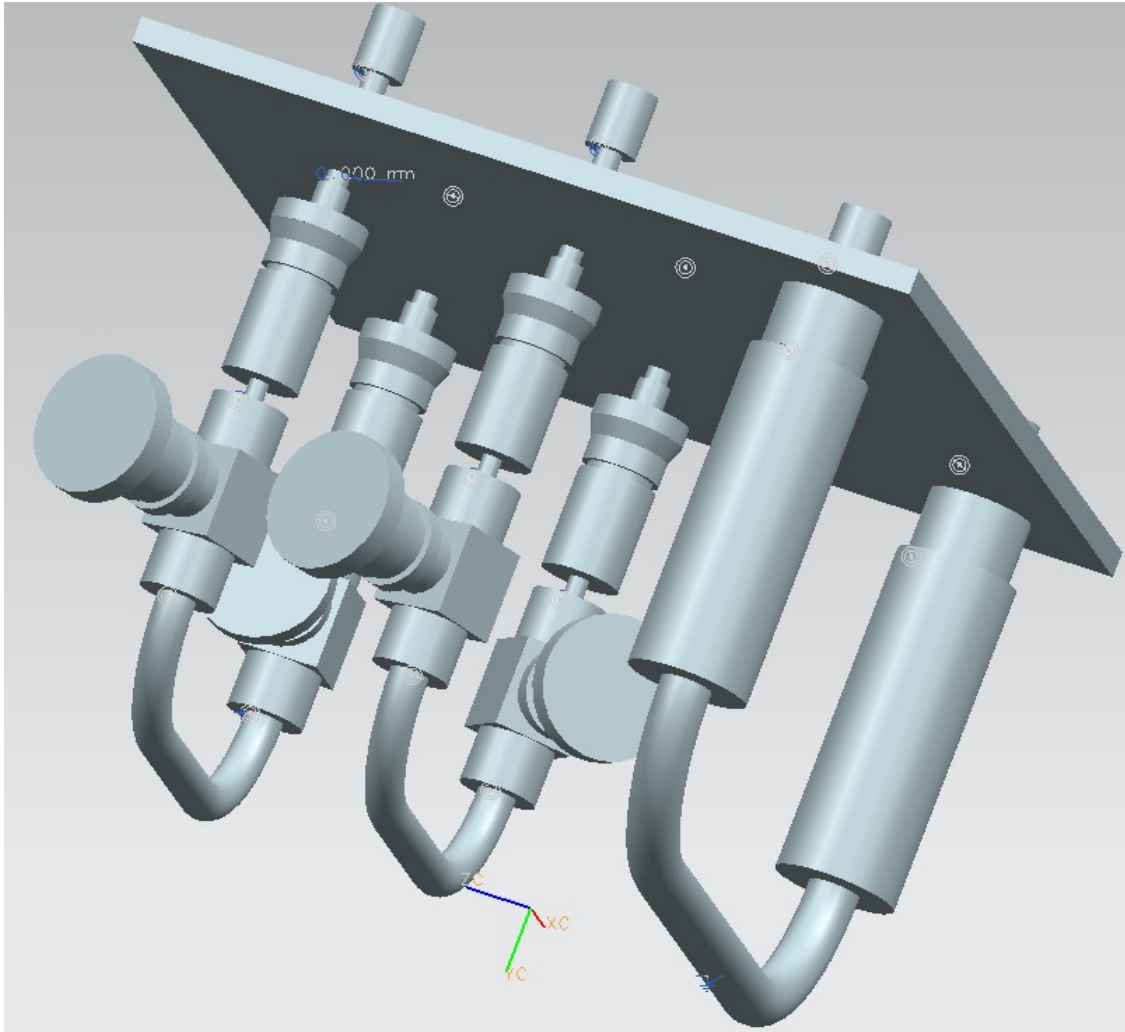


Figure 1. Model of the Trap Manifold

Recommendations

When designing a trap manifold it is recommended that the designer uses existing parts from company catalogs. Since the research and testing has already been performed on the parts, the designer can save time and money by buying parts from existing companies. Talking to every technical sales representative the designer can is recommended. The representatives are looking for business so they should be willing to work the designer to select to correct parts for the customer's specifications.

Reference:

KNF. “NMP 05 M Datasheet.” 2008. http://www.knf.com/pdfs/nmp05-09-015_20-21.pdf.

Swagelok. “QC, QF, QM, and QTM Series.” 2008. <http://www.swagelok.com/downloads/webcatalogs/EN/MS-01-138.pdf>.

Swagelok. “H and HK Series Bellows – Sealed Valves.” 2008. <http://www.swagelok.com/downloads/webcatalogs/EN/MS-01-36.pdf>.

Swagelok. “Gaugeable Tube Fittings and Adapter Fittings.” 2008. <http://www.swagelok.com/downloads/webcatalogs/EN/ms-01-140.pdf>.