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Interchangeability: Practical and Legal Considerations

Different manufacturers' gas detector components are not identical and provide different results. Interchanging raises costs and may needlessly delay the end user's work.

by Bryan Truex

Claiming that one manufacturer's detector tube and pump system parts and components are interchangeable with the parts or components of another manufacturer's system implies sufficient standardization of the parts and components has taken place to permit substitution with no loss of function or suitability. The claim implies the interchangeable part or component is a virtual duplicate of the part it replaces, and that it provides identical performance. However, no such standardization exists.

There are no industry-recognized standard performance specifications for detector tube and pump system parts and components. The parts and components of different manufacturers' detector tubes and pump systems function differently, have different specifications, have different physical dimensions, meet different quality standards, and are not identical.

The National Institute for Occupational Safety and Health's "A Study of the Interchangeability of Gas Detector Tubes and Pumps" showed great variability, significant errors, and decreased accuracy from interchanging detector tubes of various manufacturers with detector tube pumps of other manufacturers. In the NIOSH tests, the two main sources for errors were differences in the pump's suction pressure per unit of time and the flow rate through the reagent material per unit time. Changes in the suction pressure or flow rate cause inaccurate measurement.

However, even if the pump used in a mixed system has the same flow rate and sample volume as the system manufacturer's pump, there is no assurance of the same system accuracy. Each manufacturer's pump must precisely match the airflow resistance of the detector tube and the reaction kinetics of the chemical reagent system in the detector tube.

The contact time of the target gas with the reagent material increases if interchanging pumps and tubes of different manufacturers causes the flow rate through the reagent material to be slower than the flow rates during the detector tube and pump system factory calibration. This increase in contact time produces a shorter stain than the intended stain for the gas concentration. In this case, the detector tube would provide an incorrectly low measurement of the gas concentration, potentially a very dangerous situation if toxic gases are being measured. In the case of a process application, the low reading may result in an increase in the amount of an undesirable component in a chemical or gas stream, degrading the end user's product.

Conversely, if the flow rate through the reagent material is faster than the flow rate during factory calibration, it provides a longer stain than intended. In this situation, the detector tubes provide an incorrectly higher measurement of the gas concentration. This is potentially dangerous in applications such as measuring for oxygen deficiency.

In gas pipelines, refining, chemicals, and many other process applications where the detector tube reading is used to control the concentration of an undesirable component such as moisture or hydrogen sulfide, or to ensure a minimum amount of a desirable component, these false low or high readings can result in rejection of the deliverable gas or chemicals, or the end user's having to accept a reduced price because the product appears to be of lower quality. False high readings may additionally, needlessly result in the premature evacuation of a work area or in delays in re-entering a previously evacuated area, costing far more than any slight savings from interchanging parts and components of different manufacturers.

Other Factors Affecting Accuracy

In addition to changes in contact time, interchanging detector tubes can reduce system accuracy and reliability for the following reasons:

- Improperly packed reagent material may cause channeling, an irregular course of discoloration of the indicating layer.
- Loose control of tolerances of the internal diameter of detector tubes result in inconsistent flow rates and incorrect reagent contact time.
- System leaks result in less than the required sample volume and contact time. In mixed systems, these leaks may be caused by poorly matched tolerances between the detector tube's exterior diameter and the interior diameter of the pump inlet tube holder. The variance in exterior detector tube diameter even exists among manufacturers who all use piston pumps. Some manufacturers use detector tubes with as many as four different exterior diameters.
- Differences in chemical reagent reaction times or the required number of pump strokes can occur.
- The ability of the detector tube reagent or filters to remove environmental effects or the effects of interfering gases differ.

The Safety Equipment Institute's certification program of detector tubes, in accordance with ANSI/ ISEA 102-190 (R1998),

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proves that different detector tube and pump systems supplied by different manufacturers have different system performance specification for the same gas measurement. Each manufacturer calibrates each batch of detector tubes against a detector tube and pump system standard using the manufacturer's detector tube pump, the manufacturer's calibration fixture, and the manufacturer's calibration gas standard. It is a mistake to believe detector tube and pump systems are manufactured identically and perform identically simply because the pump draws the same volume.

Likewise, the detector tubes of different manufacturers are different. The reaction

may cause a system failure, exposing the purchaser and end users to possible product liability, negligence, and breach of warranty claims.

OSHA described some of these quality differences in an article in *Applied Industrial Hygiene* in November 1986. OSHA noted the coefficients of variation and recoveries varied for all three manufacturers tested. One manufacturer's product was affected by humidity, but the other manufacturers' products were not. The report confirms quality can affect performance, and quality is not equal among different manufacturers of detector tube and pump systems.

Interchangeability may increase users' and sellers' legal and financial risks.

principle, reaction time, air flow resistance, number of strokes, range, minimum detectable limit, effect of coexisting and cross-interfering gases, environmental operating conditions, and many other specifications may be different. Proprietary changes in detector tube pre-tubes, pre-layers, and reagent systems may cause different manufacturers' detector tubes for the same gas application to perform differently.

Differences in the quality of parts and components from different manufacturers introduce additional system errors and reduce accuracy. In *Direct Reading Colorimetric Indicator Tube Manual*, Peper and Dawson of the AIHA Gas and Vapor Detection Systems Committee stated in 1993:

"The manufacturing quality control of the detector tube is a critical determinant of the tube's accuracy. Improper preparation of the reagents and solid support can cause incorrect results."

Sample volume also affects accuracy. A poor-quality pump may fail to draw a complete sample because of a failure to hold critical tolerances, because of poor workmanship, or because of defective material. SEI's certification tests demonstrate that the quality of all manufacturers' parts and components are not equal. Some manufacturers' detector tubes and pumps have passed SEI's certification tests, but others have failed. Even if another manufacturer's parts and components were tested and certified as acceptable, no assurance exists that the other manufacturer will continue to provide the same level of quality in the future. Poor quality of any part or compo-

Why Manuals Matter

Detector tube and pump system performance is a function of the quality of each manufacturer's instructions, warning, and operation and maintenance manual. The adequacy, clarity, and completeness of a manufacturer's instructions, warnings, and operation and maintenance manual affect whether:

- the part or component is used correctly,
- the part or component functions properly, and
- the system performance specifications are achieved.

A review of different manufacturers' literature shows that the adequacy, clarity, and completeness of instructions, warnings, and manuals are not of equal quality. The lack of a system manual for mixed systems that addresses all of the different manufacturers' parts and components, as well as inadequate or conflicting instructions and warnings, poor training, and a reluctance to use conflicting manuals, can introduce errors in mixed systems and cause the improper and unsafe use of the product.

Many specifications of a detector tube are proprietary, so manufacturers do not publish them. A large portion of each manufacturer's part and component specifications are:

- not apparent by observation,
- not disclosed through sale of the products,
- controlled only by the manufacturer,
- subject to change at any time by the manufacturer without notice, and
- unknown to other manufacturers.

Unless these specifications are voluntarily provided by a manufacturer, other manufacturers or brand name (private label)

sellers may not know such proprietary information. The fact that some of each manufacturer's specifications are unknown to the other manufacturers, coupled with the fact that the part and component specifications may be changed at any time without notice, almost ensures that interchanging parts and components of different manufacturers' systems will sooner or later result in unequal performance and cause a system failure.

Warranty Implications

The user of a detector tube and pump system needs supporting materials. With a mixed system, no manufacturer has design and manufacturing control over the system. No manufacturer's manuals, instructions, and warnings apply to this hybrid system. If interchangeability is adopted, the user loses the system performance specification, the system manual, and the warranty from the manufacturer of the tube and pump system.

Furthermore, other manufacturers' parts and components may incorporate conflicting warnings and instructions that confuse the user. Inconsistent instructions and warnings may encourage the user to ignore all manuals.

Under the concept of interchangeability, system design responsibility is placed upon the buyer. The product user has the responsibility of ensuring that the components, when used together, interface properly and provide an accurate measurement. Interchanging parts or components of different detector tube and pump systems may make measurements obtained with such mixed systems void for use as evidence in court or in front of regulatory agencies.

In cases where a detector tube and pump system manufacturer expressly instructs users not to use its detector tubes or pump with detector tubes or pumps of other manufacturers, interchangeability may constitute an "intentional wrongful act" and may expose the recommending party, as well as the end user, to punitive damages. In some cases, the directors or officers of a company selling or using such a mixed system may be held personally liable in the event of damages or injuries. ■

Bryan Truex, founder and former owner of Sensidyne Inc. and a consultant for Straughan Technical LLC, has more than 25 years' experience in detector tube technology. Houston-based Straughan Technical (www.straughan.net) is the exclusive U.S. distributor for Gastec detector tubes and other gas detection equipment such as dosimeter tubes, respirator fit test equipment, and badges.

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THE PROMISE: You can trust Gastec components. The accuracy is in the system. Gastec tubes and pumps are designed, manufactured, and calibrated to work together. Only authentic Gastec components offer this assurance of quality. More than 30 years of manufacturing experience goes into every Gastec tube and pump, manufactured under the ISO 9001 certified quality system. Call today. Join the thousands of health and safety professionals who trust in Gastec.



Smoke Tube Kit



Dosimeter Tubes and Holders



Portable Pyrolyzer

Smoke Tube Kit

The qualitative fit test kit provides a fast, safe and reliable method to meet OSHA 29 CFR 1910.134. Kit contains six reusable smoke tubes, caps, aspirator bulb pump, and carrying case. Motorized 200cc pump sold separately.

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Direct-reading tubes for on-site, time-weighted average (TWA) measurements for dozens of gases or vapors—no pumps, charts, or lab analysis required. Accurate for sampling periods as short as 15 minutes or as long as 24 hours. The capability of numerous intermittent readings from a single tube reduces sampling costs. Corrosion-resistant, high-impact plastic tube holder clips to collar or shirt.

Portable Pyrolyzer

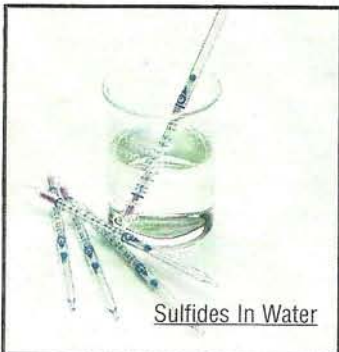
For on-site measurements of freon and other fluorochlorocarbon and halogenated hydrocarbon gases.

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Sulfides In Water

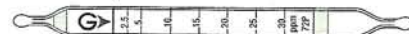


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