Leakage Detection and Measurement

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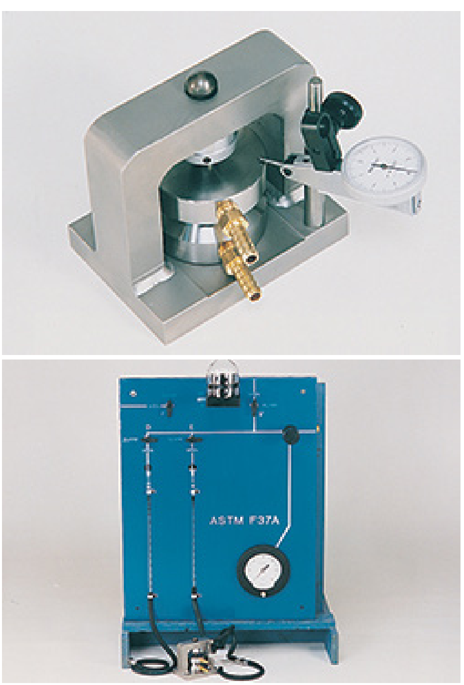
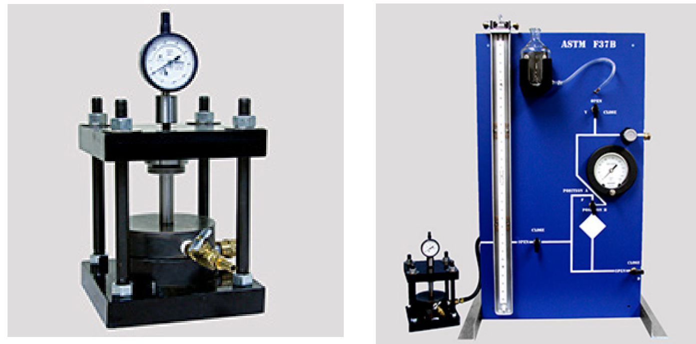
The primary purpose of any gasket is to seal or contain a gas or liquid and prevent it from escaping containment. The three basic functions of leak testing are: determining if there is leakage or not (detection); measurement of leak rate; leakage location. There are many methods of leak detection for solving problems but unfortunately there is no single method that fits every application, but the methods usually fall into one of two categories: QUANTITATIVE and QUALITATIVE. These described leakage testing methods may not be required of you but may be part of your customer's or end user's process. At times, you may be asked to perform such a test as part of your application development process.

EXAMPLES OF QUANTITATIVE TESTS:
<u>ASTM F37 is a standard qualitative test:</u>

The industry standard for quantitative comparison of materials is the ASTM F37 "Test method for Sealability of Gasket Materials". It is the standard used by manufacturers and uses alike. The testing is done at room temperature with an approved test apparatus: Method A and Method B (typical fixtures and apparatus are shown below). These standard tests are primarily used to determine the relative sealing performance of gasket sheet or roll product and are usually listed on the manufacturer's specification sheet.



F-37 Method A



F-37 Method B

Method A is restricted to liquid measurement and Method B may be used for both gas and liquid leakage measurements. These methods are suitable for evaluating the seal characteristics of a gasket material under differing compressive flange load (within the limits of the fixture). When desired, the methods may be used as acceptance tests when the test parameters are agreed upon between a supplier and purchaser: fluid, internal pressure of the fluid, flange compressive load on the specimen. Details of the test methods and fixtures can be found on the ASTM website.

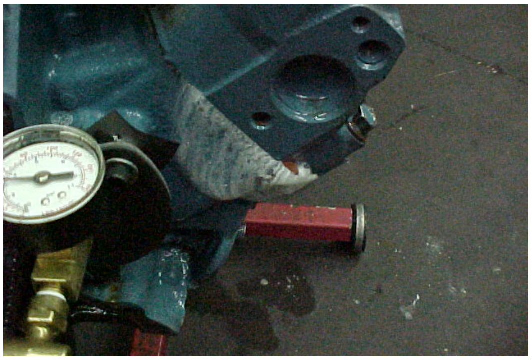
<u>Flowmeters:</u> Flowmeters come in various forms including tapered bore and ball type which can be inexpensive and available in a variety of low-flow rates. Mechanical or digital measurement devices are widely used for larger flows.

This type of meter can be used on the pressure side of the test apparatus making sure that the test pressure is within the rating of the meter. Air or Nitrogen are the normal source of pressure; however, a correction should be made for pressure. Information for this calculation is usually included in the instructions.

QUANTITATIVE LEAK DETECTION:

<u>Water-immersion bubble test</u> is a traditional and primitive technique of leak detection. It can detect the location of a leak. If the bubbles can be collected, this method can be quantitative. Increasing the charging pressure within safe limits will amplify leakage. The disadvantages range from a low sensitivity, high operator dependency and having to dry the parts after testing.

Soap solution bubble test: Instead of submersing the assembly in water, a gas pressurized assembly is sprayed at the gasket joint with a soap solution and observed. Soap bubbles will appear at the site of any leaks. In general, larger bubbles will indicate a surface leak whereas, tiny, shaving cream bubbles will indicate interstitial leakage (gas leakage through the gasket material). It will only detect external leaks).



The soap solution will leave a residue which may have to be removed.

Pressure decay test method consists of pressurizing the closed gasketed assembly with high pressure gas, usually dry air or nitrogen. Then the assembly is isolated from the gas source and the internal pressure is monitored over time. If the pressure drops fast, there is a large leak, and if slowly, a smaller leak. Soap solution can also detect the location of the leaks externally. This method is commonly used by engine manufacturers at the end of the assembly line to detect missing gaskets and other sealing issues. Go/no-go limits can be set. The advantage of this method is that it is non-destructive and is often used as final test at the end of a production line.

Vacuum decay test or pressure rise test works in the opposite way of the pressure decay test. It involves evacuating the assembly to suitably low pressures, after stabilizing the pressure, and measuring the increase in pressure. Only parts that can withstand external pressure can be evaluated in this way. Thin-walled plastic parts cannot be evaluated due the danger of collapsing. Like the pressure decay method, this is non-destructive.

Note: The results of both tests can be quantified mathematically using the volume and pressure change.

Leak detection using blacklight lamps can be used to detect leaks after the fact. Engine manufacturers often used blacklight after an engine test cycle to detect oil or coolant leakage. Fluorescent dyes present in engine oils and coolants are easily detected in a darkened inspection area. It is the last test before painting and shipping.

Tracer gas leak testing

Describes a group of test methods characterized to detect and measure a tracer gas flowing through a leak. The commonly used tracer gases are helium, and a mixture of nitrogen and hydrogen. In a ‘Sniffer’ test, the assembled unit is pressurized with the tracer gas and an operator with a specialized detector searches for tracer gas leaks. This operator method is not very efficient as it is highly dependent on an operator. An alternate method is to enclose the assembled unit in an airproof container and have the detector measure the concentration of tracer gas in the chamber. The tracer method would be used only in the most critical of applications. Other derivative tests using tracer gases are sometimes utilized. *Note: The tracer gas methods are mostly used where a contained gas must remain in a closed container such as in a closed refrigerant system and similar applications.