WHAT IS A HOLE?

IMPROVING LEAK TESTER RELIABILITY BY UNDERSTANDING THE PROCESS

Almost every manufacturing process has the capability of producing "defective" parts that do not meet the required quality standards. In Extrusion Blow Moulding, the quality of the final product can be affected by variations in processing parameters, materials and ambient conditions.
Of all defects, holes are one of the most serious and is the subject of this document.

The most common cause of holes in containers is contaminants in "regrind "material. Cardboard particles, introduced when handling flash or scrap bottles is the main contaminant and every effort should be made to eliminate its use from the production area.

Although properly designed leak testing equipment will detect over 99.99% of all holes, it is important that they are properly set up and calibrated. All too often, to create a hole, bottles are stabbed with either pins or knives, or have holes drilled or melted in with a hot wire. The result is that the "test" bottle is not produced to any repeatable "industry" or plant standard.
The purpose of this document is to give engineers, and QC personnel a greater understanding of the subject . This knowledge will help you to ensure the product you ship to customers is to the highest quality standard.

What is our definition of a hole?

Anything that allows the contents of a container to leak.

How do we ensure that a leak tester is set properly to detect holes?

By introducing a known leak into the system, and verifying that the tester performs as required. This can be a bottle with a hole or a test orifice fitted to the leak tester.

Making a test bottle

1. The worst way of inflicting a hole is to stab the bottle with a knife because the hole produced does not represent any particular sized hole and is impossible to duplicate.
2. Stabbing the bottle with a pin produces a hole that starts out almost the diameter of the pin but within a few seconds it rapidly shrinks down to a smaller hole. The final diameter is not repeatable because the amount of shrinkage depends on many factors.
3. Drilling a hole is better than the two previous methods because material is removed not just displaced, but the final hole will be smaller than the drill. Try drilling a piece of rubber to understand what happens when you pull the drill out of a material with elastic properties.
4. Melting a hole with a hot wire can work well but the final hole is dependant on skill and a steady hand.

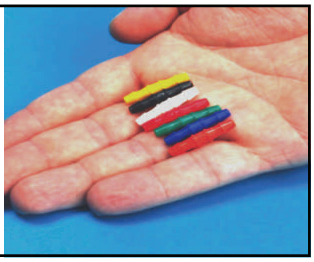
The best method of introducing a known leak into the leak detection system is to use a "reference" orifice. There are a variety of these devices on the market, and even the very accurate laser drilled ruby orifices cost only a couple of pounds.

Continued overleaf . . . .

TechTip

When is a hole not a hole? . . .When it is a tube!
This might sound like some kind of joke, but unfortunately the answer has some serious implications.
The leakage flow rate is dependant not only on the hole size, but also how *long* the hole is.
Try this simple experiment:
Blow through a 20mm length of 5mm diameter plastic tube.
Now blow through a few meters of the same tube.
Notice how much harder it is?
Even though it is the same size hole!
As you can see a leak tester would have more difficulty in finding the "longer" hole. So did you realize that drilling a "small" (eg 0.3mm) hole in different wall thickness will cause the leak tester to give totally different results?
The way to ensure that the test hole performs the same regardless of the container wall thickness is to use a separate precision test orifice. This can be fitted to the leak testers sensing line, or in the side of a test bottle. We offer colour coded orifices in a wide range of diameters, usually with push-on barb fittings.
The orifices work on the "sharp edge" principle so the flow is immune from the effects of hole length.

Precision test orifices are produced by laser drilling a hole in an industrial grade ruby. This ensures that the "leak" is totally repeatable and dimensionally stable.



Want to calculate the flow through a hole?
In the 18 century Mr. Poiseuille, a French surgeon, was interested in understanding the physics of flow through the small capillary blood vessels. As he couldn't find a flow calculation formula that took into account the length of a tube he set about to invent one. Unfortunately the Poiseuille formula does not take into account the friction effect of the surface roughness of a hole, or the "effective aperture". Also, ignoring the transition from laminar to turbulent flow, the formula is not totally accurate. Running a series of tests, has enabled us to produce a correction factor for the formula that corrects the formulas inaccuracy.

How to use standard test orifices

1. Fit the orifice to a bottle
This method is certainly better than drilling holes in bottles, but it does not simulate the temperature a freshly moulded bottle might have.

2. Connect the orifice to the leak testers sensing line with a manually operated tap. Turn on the tap and watch the leak tester reject bottles!

3. Use our automatic self test (**AST**) optional feature that is available on all our new AccuSense leak testers.
This feature can also be supplied as a retrofit to older models of tester.
AST works by automatically energizing a solenoid valve at any desired interval, which introduces the test hole. The leak tester monitors its own reject output to check that the container is rejected. In the event that the container passes, the alarm beacon is turned on.
A unique feature of our system is that the container has to be seen by a photocell to have actually left the conveyor line. This ensures that the physical rejection of faulty containers actually happens not just the energizing of the reject output.

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