GAUGE SAFETY

This Product Information page explains the "safety" of open front and solid front gauge cases, as well as large volume versus small volume pressure elements.

The following excerpts from ANSI B40.100-2005 are helpful in understanding the problem. (Solid front and open front cases are defined in the standard.)

> **4.3.6.1** "It is generally accepted that a solid front case... will reduce the possibility of parts being projected forward... .an exception is explosive fail-
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> **4.2.7.2** "....It is generally accepted that solid front cases with pressure relief back will reduce the possibility of parts being projected forward in the event of failure...."
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> **4.2.7.1** "1Fatigue failure... generally occurs... as a small crack... Such failures are usually more critical with compressed gas media than with liquid media. Fatigue cracks usually release the media fluid slowly so case pressure build up can be averted by providing pressure relief openings in the gauge case. However, in high pressure elastic elements... .fatigue failure may resemble explosive failure."
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> **4.2.4** "The following systems are considered potentially hazardous... Compressed gas systems.... pressure systems containing any explosive or flammable mixture or medium.... systems where high overpressure could be accidentally applied..."
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> **4.2.6** "Fire and explosions within a pressure system can cause pressure element failure with very violent effects, even to the point of completely disintegrating or melting the pressure gauge... Failure in a compressed gas system can be expected to produce violent effects."

These excerpts demonstrate that the standard recognizes there are some types of failure which cannot be contained within any case. It may only be stated that a solid front case has a better chance than an open front case of protecting the gauge user.

One of the factors which determines the violence of an explosion, especially when caused by overpressure with gas, is the volume contained within the Bourdon tube. Just before rupture, the Bourdon tube generally is distorted to a shape containing a larger volume than its original volume; this volume of compressed gas contains energy proportional to the burst pressure and, the larger the volume, the more energy is released when the Bourdon tube ruptures. This is the reason that a low volume Bourdon tube tends to be "safer" than a large volume Bourdon tube.

A more important consideration, however, is the pressure at which the Bourdon tube ruptures. If, by a design, a Bourdon tube is designed to rupture at a relatively low pressure, there is much less energy released. Conversely, a Bourdon tube designed to withstand very high overpressure before failure will release much more energy when failure does occur. Bourdon tubes designed to fit smaller cases (such as 1008, 1009 and 100mm) are smaller in diameter and shorter than those which fit 41⁄2" Duragauge® gauge cases. These smaller tubes must be made with thinner walls in order to obtain the necessary deflection under pressure, and consequently have inherently lower burst strength, even though our Unisystem tubes have been designed for as high a burst pressure as possible. For instance, a 15 psi Unisystem Bourdon tube will rupture at approximately 400 psi, while a 15 psi Stainless Steel Duragauge Bourdon tube will fail at approximately 2000 psi. When the Duragauge gauge fails, the results are much more violent.

It must be pointed out, however, that if both gauges are exposed to 1000 psi, or in fact, to any pressure over 400 psi and under 2000 psi, the Unisystem will rupture, releasing process fluid, while the Duragauge system will not leak at all. We believe that it is more important to minimize the possibility of leakage, than to purposely produce products with lower rupture pressures which might fail less violently, but also tend to fail more often because of the lower pressure required to rupture the tube.

A higher pressure Bourdon tube will rupture at a much higher value, subjecting the case to a much higher pressure build up. Higher pressures, however, generally involve liquids, which result in much less violent failures than gasses, because liquids, being essentially non-compressible, do not store anywhere as much energy as gasses do.

A metal (stainless steel or Aluminum) solid front case will survive an explosion that may fragment a plastic (phenolic, polypropylene, ABS, etc.) case. Open front gauges will not perform like a solid front design in the event of a violent failure. All of our industrial and process products, however, solid or open front, supplied with a pressure relief plug, will safely relieve case pressure in the event of a slow leak in the pressure system.

Certain gauges have been tested", resulting in the pressure relief plug blowing out, without damage to the window. There is no ANSI standard test for cases – other tests, such as DIN or "Shell Oil" are used, but no test simulates a high pressure gas rupture of the Bourdon tube, or an explosion inside the tube. Most tests merely introduce pressure into the case through the socket, at a rate far slower than that which occurs during an explosive failure, and therefore will not truly demonstrate the advantages of a solid front case.