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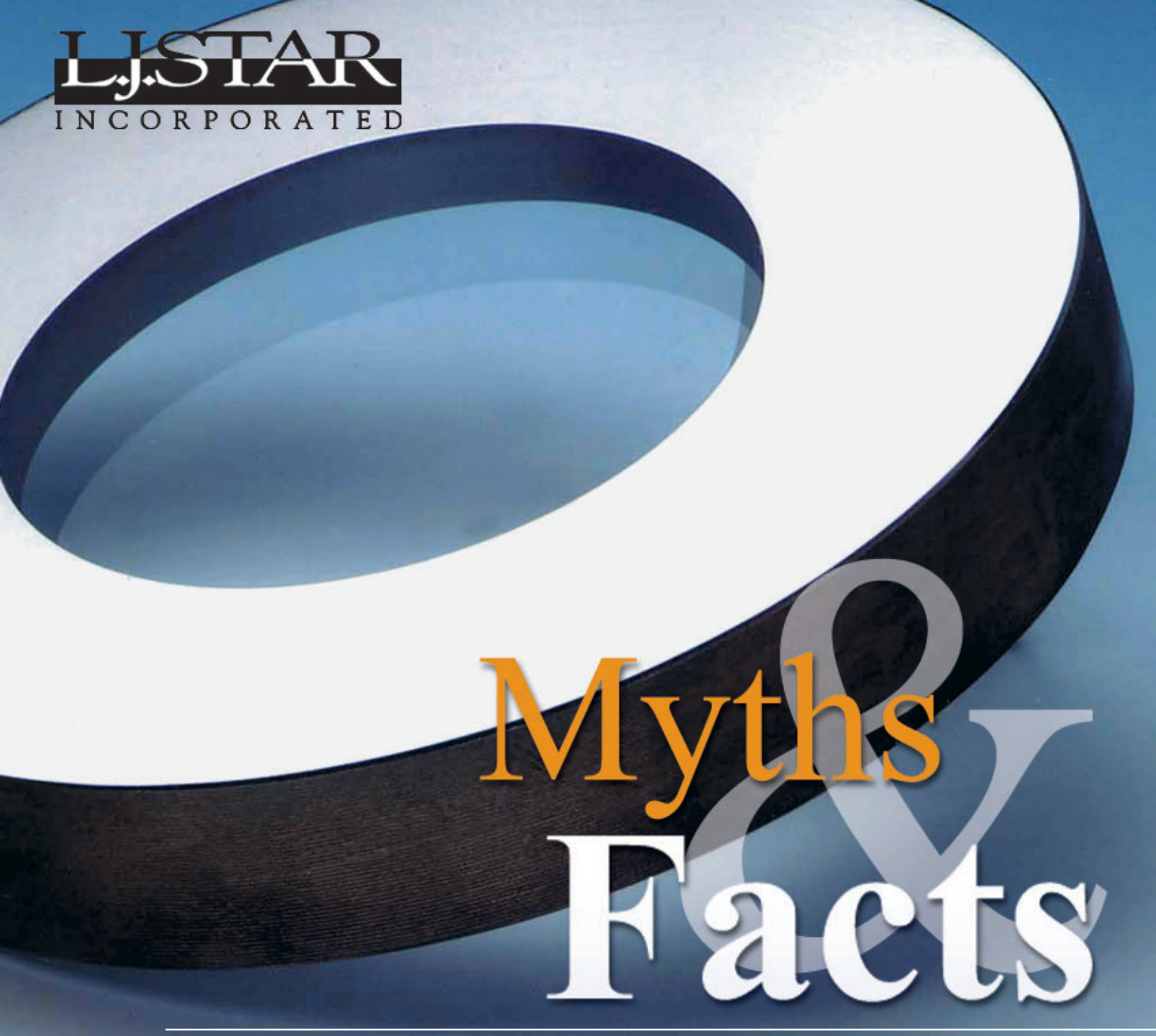


Supplement 1

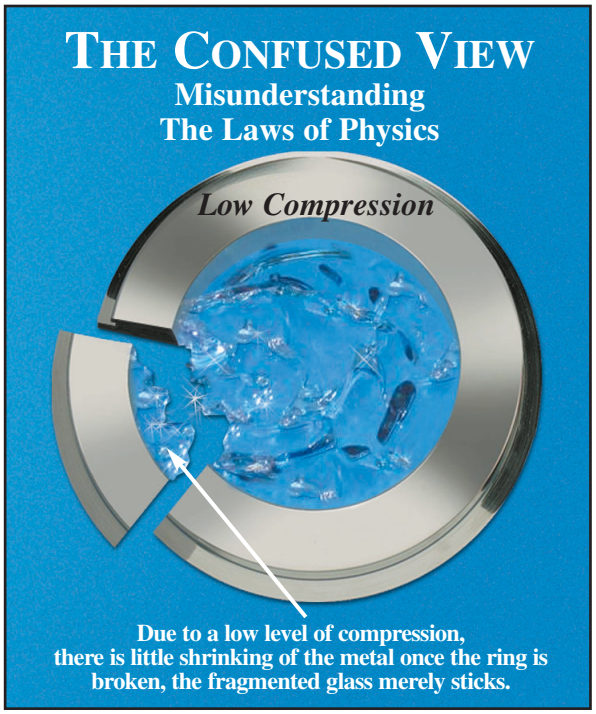
Competitive Claims and Misconceptions About Metaglas® Sight Windows

In the 25 years since Metaglas® mechanically prestressed safety glass windows were introduced, they have become widely used and well respected worldwide. And significantly, in that time not one has ever failed in service. L. J. Star has technically documented every superior attribute of Metaglas windows. Even so, the Metaglas window concept is still sometimes the subject of misperception and misinformation in the marketplace.

This piece has been created to set the record straight. If you require substantiation of any of our "Fact" answers, contact us. You will be well satisfied with the level of expertise in glass technology and metallurgy, and applications information available to you from L. J. Star Incorporated.

Some CONFUSED VIEWS

Confused View:
In a misdirected demonstration, a competitor has cut a wedge into a standard Metaglas® disc and removed the glass intact. The claim made on the basis of this demonstration is that being able to remove the glass in this way proves that there is little or no fusion between the Duplex stainless steel ring and the borosilicate glass element. The erroneous implication is that the Metaglas window is prone to failure.

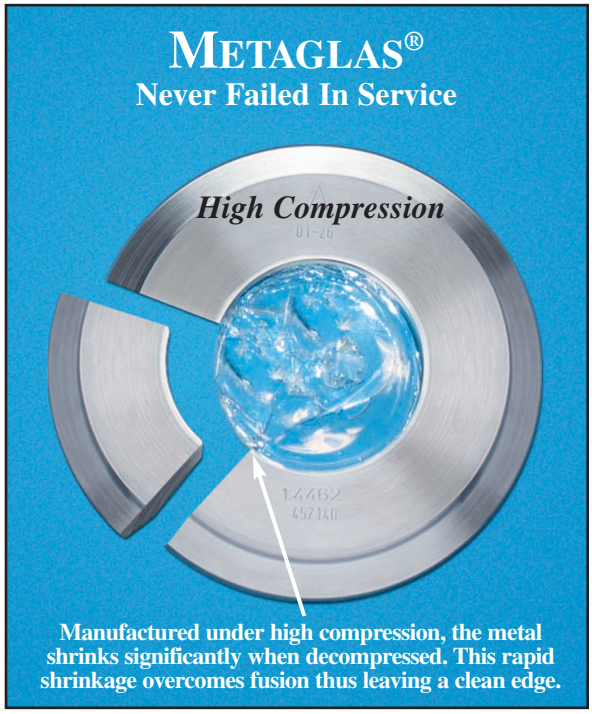


Fact:
This statement is simply false and the demonstration proves nothing of any significance. In the demonstration, the Metaglas window's fusion is broken only because the compression provided by the steel ring was compromised, a condition that cannot possibly happen in actual service. The fact that the glass can be removed when the primary bonding force is compromised is, then, a desired result.

The Metaglas window's glass/steel interface is, in fact, largely the result of the strong compressive forces on the glass disc that were created as the steel ring cooled and began to approach its theoretical diameter. As the compressive pressure on the glass built up, the steel and glass faces fuse, conforming against one another, into a virtually impervious dynamic interface, one that has never failed in service.

The demonstration proves only that the force created by decompression of the steel ring (and the glass disc as well) is greater than the strength of the fusion. Considering the magnitude of the compression involved, this is hardly surprising. Indeed, one should be very concerned if the glass cannot be separated when the metal ring is compromised. This would indicate that little compressive force was ever applied.

It is important too that the quality and sheer strength of the fusion of glass and metal in a Metaglas window cannot be duplicated using a Hastelloy® ring and soda-lime glass. Due to the inherent coefficients of thermal expansion, the glass/metal interface of such a window is necessarily formed under significantly less compressive force, and cannot approach the strength of the fused glass/metal Metaglas interface.



Confused View:
Duplex stainless steel is not a good selection for producing glass/steel windows because its poor thermal properties lead to cracking at the point of fusion, possibly compromising the integrity of the unit.

Fact:
The tiny hairline cracks that form, rarely, at the glass/metal interface in Metaglas windows are of no consequence, having no effect on either optical or physical characteristics of the finished unit. They are simply a peripheral result of the powerful compressive forces that make Metaglas windows the safest windows available.

In fact, a major reason that Duplex stainless steel is the alloy of choice for Metaglas windows is that its coefficient of thermal expansion makes it possible to create a dynamically fused interface with the borosilicate glass.

Also important in many applications: Duplex stainless steel has improved chemical resistance from attack and to chloride-stress cracking compared to 316 stainless steel, twice the yield strengths of conventional austenitic steels, and it is more impact resistant than ferritic alloys.

Confused View:
A prestressed glass/metal window using a Hastelloy ring provides a greater view diameter than one formed of Duplex stainless steel due to the excellent thermal properties of Hastelloy.

Fact:
The composition of the metal ring of a prestressed glass/metal window has little to do with determining the optimal viewing area. The key determining factor is the thermal coefficient of expansion of the glass. Since the usual alternative material, soda-lime glass, has a higher coefficient of expansion than borosilicate glass it accommodates less compression and, thus, provides a larger viewing area. Less compression, however, means less physical strength, so a tradeoff in safety must be considered.
Large-diameter Metaglas windows achieved by using soda-lime glass elements have long been offered by L.J. Star as an available option for some applications, but the majority of Metaglas® windows are ordered with borosilicate glass to assure the added safety, compatibility and durability Metaglas provides.

Confused View:
Competitive prestressed glass/metal windows are available in glass-wetted models that do not need additional coatings for application with glass-lined reactors.

Fact:
A Metaglas window requires no additional coating if the ring is formed of Hastelloy or another alloy compatible to the application. These are readily available options.

A more important factor in applications involving glass-lined reactors is the nature of the glass used in the window. The Metaglas borosilicate glass element is the better choice for glass-lined reactors - and for virtually any application where corrosion is a potential problem - since it is significantly more resistant to acids and alkalines than the soda-lime glass used in competitive units. In fact, in order to ensure against long-term clouding or structural weakening in these instances, windows formed of any type soda-lime glass should be provided with a protective coating.

Confused View:
In applications involving extreme, cyclic conditions of thermal and chemical stress, Metaglas windows are less rugged and durable than glass/metal windows using Hastelloy rings and soda-lime glass.

Fact:
The exact opposite is true. The high thermal coefficient of expansion of soda-lime glass compared to that of the confining Hastelloy ring results in inferior thermal stress resistance. Also, the chemical resistance of soda-lime glass is markedly inferior ($^1/_{10}$) to that of borosilicate glass.

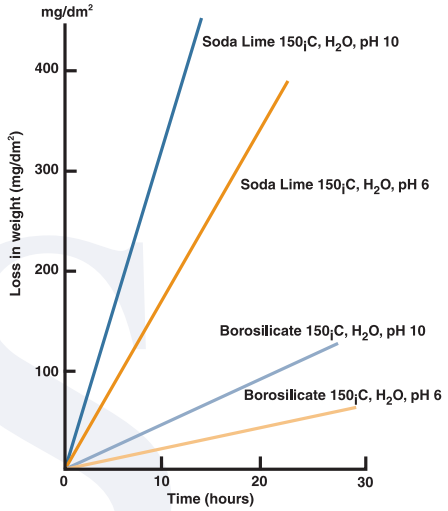
Confused View:
The borosilicate glass used in Metaglas windows is less than ideal in demanding industrial applications.

Fact:
Borosilicate glass has been recognized as the gold standard for demanding applications for almost 30 years. Its physical strength, corrosion resistance and temperature tolerance are superior to all other commonly used formulations. And, when borosilicate glass is integrated into a mechanically prestressed metal/glass window, these desirable properties are further enhanced.

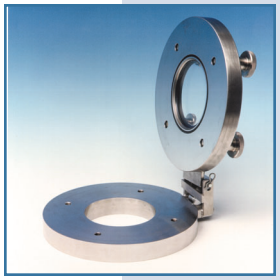
The common commercial substitute for borosilicate glass is actually a soda-lime formulation. Soda-lime is described by some manufacturers as a boron glass plus. The *plus* presumably offers some unidentified advantage. Though it may be offered under a brand name that implies that it is a boron glass, its properties are significantly inferior to true borosilicate glass. It has rather poor optical properties (a bluish-green tint) and significantly less mechanical strength when formed as a mechanically prestressed glass/metal window combination.

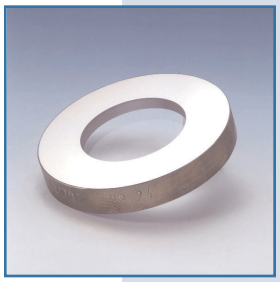
Confused View:
Because of its superior corrosion resistant properties, Hastelloy is a better choice than Duplex stainless steel for use with prestressed metal/glass windows.

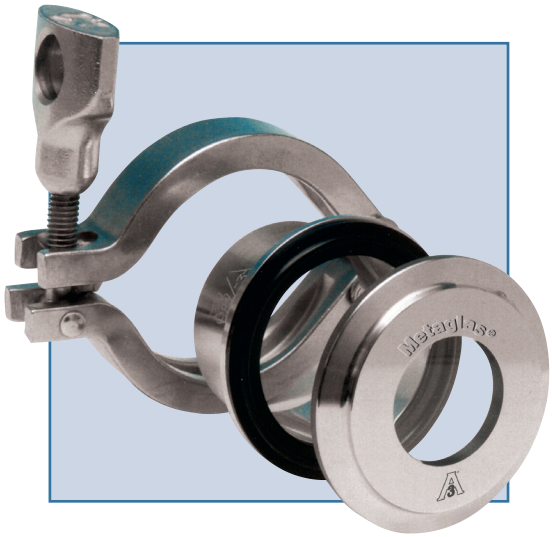
Fact:
The corrosion resistance of Duplex stainless steel exceeds the demands of most applications and is a good deal less expensive than Hastelloy, all else being equal. However, for really demanding applications Metaglas windows are available in Hastelloy, Monel®, and Inconel® as well as carbon steel. The fact that the majority of Metaglas windows use duplex stainless steel is simply because it provides the most cost-effective response to most application needs.



Borosilicate glass is ten times less subject to erosion than soda-lime glass in both acid and base processing applications. Chart reprinted from "VGB KRAFTWORK-STECHNIK", by Dr. A. Peters.







Rated at 150 psi, a *Metaglas*® window was still leak-tight at 12,000 psi!

To satisfy code requirements, we rigged a standard 150 psi rated Metaglas window to a hydro test stand. At 800 psi nothing had happened. Reaching 2,500 psi the window was partly crazed. At 6,000 psi the top surface was fully crazed, but it still remained leak-tight up to 12,000 psi.

Metaglas Is Manufactured To The Highest Standards

Metaglas®	Borosilicate Glass	Impact & Pressure & Thermal Shock	Sanitary Construction	Pressure & Thermal Shock
to DIN 7079	to DIN 7080	FM Approved	3A 65-00 Approved	TÜV Approved

LJSTAR
INCORPORATED

P.O. Box 1116
Twinsburg, OH 44087
Tel: (330) 405-3040 Fax: (330) 405-3070
Web Page: www.ljstar.com
E-mail: view@ljstar.com