Things Are Not Always As They Appear

By Tom Lincir, President and Founder, Ivanko Barbell Company

Some manufacturers attempt to serve the marketplace according to how things appear. Others attempt serve the marketplace according to how things really are. The "appearance people" have mastered the art of making things look good on the surface, or sound good in their description. The "reality people" have a more daunting challenge — persuading customers to look beneath the surface, and to consider attributes that they cannot see, touch, or feel. The tools of the "appearance people" are words and pictures. The tools of the "reality people" are engineering and science. We use science to prove what we have already observed and learned about real world phenomena.

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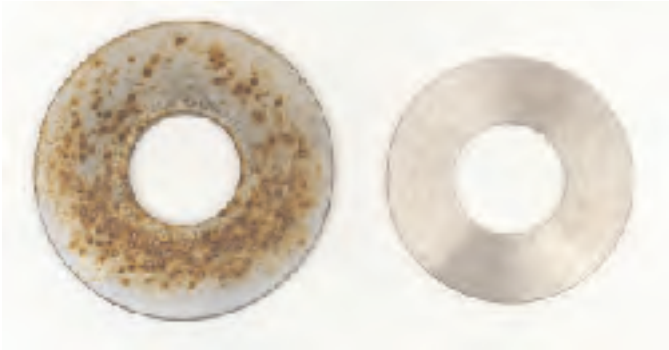
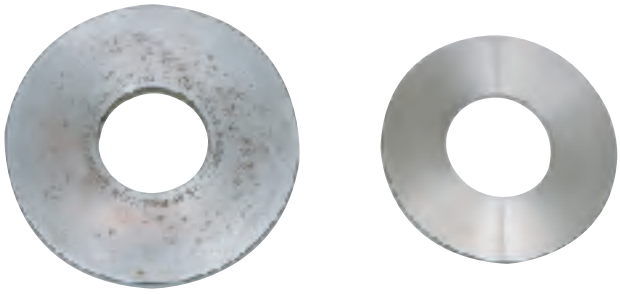
Let's look at a few illustrations of these principles. The first concerns the properties of stainless steel versus chrome. Both look good on the surface. What's the science underneath? To answer this question, we conducted the now famous Ivanko "Roof Test" in which we placed Ivanko stainless steel plates on the roof of our building along with Ivanko chrome plates. The chrome plates were actually what some choose to call "hard chrome". We have manufactured "hard chrome" products since 1983, but we use the term "chrome" in describing them, because in our opinion, the word "hard" overstates the coating's true durability. The "roof test" was conducted to help clarify the extent to which this is true.

After two years of exposure to the elements, the photos elsewhere on these pages represent the reality of stainless steel versus chrome or "hard chrome". In the "before" pictures, the chrome plate exhibited considerable rust, while the stainless steel plate is only slightly blemished. In the "after" pictures when the plates had been cleaned and polished, the chrome plate showed residual pitting and discoloration while the stainless steel plate cleaned up "good as new". The chromed plate would have to be replaced in any club where members care about how things look.



Before Cleaning: After two years of "Roof Test" exposure, the chrome plate on the left exhibits considerable rust while the stainless steel plate on the right is only slightly blemished.



After Cleaning: The cleaned and polished chrome plate on the left exhibits residual pitting and discoloration, while the stainless steel plate on the right cleaned up "good as new".

We have been criticized by certain "appearance people" that our roof test was not scientific. That's because appearance people tend to think science must appear elaborate and difficult to understand in order to be valid. However, we believe our simple methodology is in good scientific company. After all, one of the most famous scientists of all time, Galileo, used roof test methodology to verify his newly developed theory of projectile motion. He did this by throwing objects from the roof of the Leaning Tower of Pisa. We rest our case.

"…Galileo, used roof test methodology to verify his newly developed theory of projectile motion…"

The second illustration concerns the difference between two methods of affixing collars to the sleeves of an Olympic bar — the difference between conventional welding and what is called "interference fit" technology. Over the years, we have observed numerous examples of Olympic bars whose welded collars have eventually separated from the sleeve. To our knowledge, none of these failures occurred while someone was lifting a loaded bar overhead. To make sure this would never happen with an Ivanko Olympic bar, we sought an alternative to welding that would more strongly fuse the collar to the sleeve. After much experimentation, trial, and error, we settled on "interference fit" technology/ Then we employed scientific methods to prove what we had already learned from experience.

To engineer an interference fit, the inner diameter of the collar is made intentionally too small for the outer diameter of the sleeve. First we heat the collar to expand it. In this state, the collar just barely presses onto the sleeve. When the components cool, the collar contracts around the sleeve, fusing the surfaces together in a way that is much stronger than conventional welding could ever be.

As "reality people", we have the daunting challenge to explain why Ivanko's "interference fit" is superior to a weld, when most customers already believe that the word "weld" indicates a strong attachment method. Why do we fight this uphill battle? Why don't we just weld the collars to the sleeves and go with the flow? What's the science underneath the surface?"

"In Olympic bar manufacturing, we use computer simulation to assess consequences without having to actually crack a weld and have the equipment cascade onto a person doing an overhead press."

In this example, the scientific analysis we employed is actually at the other end of the spectrum from our "roof test" methodology. Here we used computer simulation of engineering models to determine the strength of our "interference fit". And we used what is called "finite analysis" to determine the comparative strength of welding.

In nuclear weaponry, computer simulation is used to assess consequences without having to actually explode a bomb and destroy buildings. In Olympic bar manufacturing, we use computer simulation to assess consequences without having to actually crack a weld and have the equipment cascade onto a person doing an overhead press.

The pressure at the interface between the collar and sleeve was run through extensive computer simulations according to following equation:

where:

$$P = \frac{E\delta}{R}\left[\frac{\left(r_o^2 - R^2\right)\left(R^2 - r_i^2\right)}{2R^2\left(r_o^2 - r_i^2\right)}\right]$$

P = interface pressure
E = modulus of elasticity
d = total radial interference
R = transition radius
Ro = outer radius
Ri = inner radius

As the chart below indicates, the computer simulation and finite analysis showed that the interference fit is stronger than welding, whether welded at one end or at both ends of the components. This strength doubles when a step of .020" is added as a precaution in case the interface pressure is overcome.

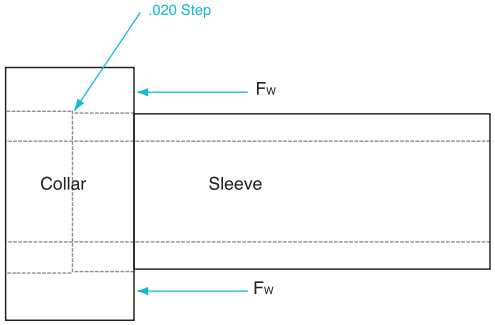
	One End Welded	Both Ends Welded	Ivanko Interference Fit No Step	Ivanko Interference Fit .020" Step
Load at Failure (lb)	21,600	51,500	63,000	139,000

This 139,000 psi interface pressure across the entire surface area translates to a force of 841,484 pounds required to push the collar off the sleeve. At this force, you would actually pull the steel apart before the two components would separate.

These comparisons assume no human error. That is, if the welder is working off a hangover on Monday morning, or hurrying to get out of town on a Friday afternoon, we assume that he or she still makes perfect welds to hit the numbers on the chart.

Diagram 1

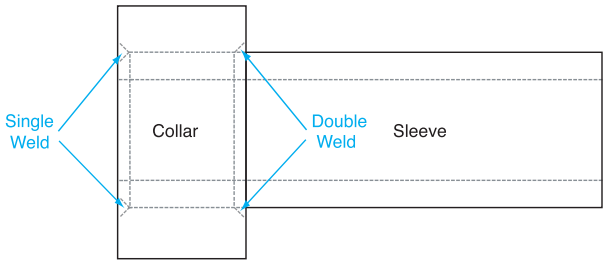
Cross section of a collar inserted into the sleeve with a .020" step that must be overcome to separate th components.



The addition of a .020" step increases the interface pressure from 63,000 psi to 139,000 psi for the interference fit compared to 51,000 psi for welding at both ends.

Diagram 2

Cross section of a collar inserted into the sleeve, showing the welding points for single welds and double welds.



In the battle between perception and reality, the reality people have the more daunting challenge. We can't bring ourselves to just give you what looks good or sounds good. We have to use science to verify phenomena that you cannot see, feel, or touch. And we have to write articles like this to explain why we do what we do.

Perhaps Rudyard Kipling's poem, "The Gods of the Copybook Headings" sums it up best. It's a poem about people who use words and pictures to purvey a version of reality that serves their commercial purposes:

We were living in trees when they met us. They showed us each in turn
That water would certainly wet us, as Fire would certainly burn;
But we found them lacking in Uplift, Vision and Breadth of Mind,
So we left them to teach the Gorillas while we followed the March of Mankind.

Ivanko's Stainless Steel Olympic Bar: Computer simulation and finite analysis prove what we cannot otherwise see or feel — that the "interference fit "of the collar to the sleeve is over 2-1/2 times as strong as welding at both ends.

Ivanko Barbell Company was founded by Tom Lincir in 1967, and it is the leading provider of professional and commercial grade barbell and dumbbell products worldwide. Your comments or questions are welcome. Write Tom Lincir at Ivanko Barbell Company, P.O. Box 1470, San Pedro, CA U.S.A. 90733. Or phone (310) 514-1155, fax (310) 514-1363, or email tom@ivankobarbell.com.

"So we left them to teach the Gorillas while we followed the March of mankind." — Rudyard Kipling, 1919