Imported Barrel Evaluation

October 2018

Executive Summary

Molders Services has requested a full analysis of two competitor's barrels which were imported from China. This barrel was sent to us for evaluation after premature failures were experienced due to excessive wear in the ID. The barrels were 135mm and 32mm injection barrels, both sold as having high wear Tungsten Carbide bimetallic inlays comparable in performance to the Xaloy® X800 product.

After receiving the barrels, a destructive test method was utilised, which enatiled cutting off 6" sections from the ends and preparing multiple samples for analysis including inlay chemistry, backing steel chemistry, physical properties, abrasion resistance and barrel construction methods.

Results from every test showed the Chinese barrels to be not only inferior to the performance characteristics of the X800® (Tungsten Carbide), but also inferior to X102® (standard bimetallic) inlay.

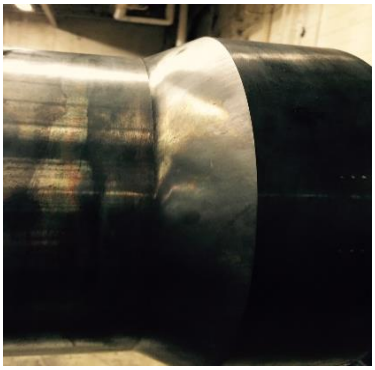


Exhibit A 135mm Injection Barrel with bell end sleeve

Exhibit B 32mm Injection Barrel with bell end sleeve

The bimetallic inlay of the imported barrels exhibited an extremely low hardness of only 32Rc on the 135mm imported barrel and 46-48Rc on the other which resulted in a very poor performing inlay ---both are far below industry standards. The hardness of the Xaloy X102® and X800® inlays are over 60-67Rc. The ASTM G65 abrasion tests showed the 135mm imported barrel to have 27% less wear life compared to Xaloy X102® and 440% less wear life than the Xaloy X800®. The construction method of the 135mm imported barrel was a thin walled bimetallic liner pressed inside a housing or a 2-piece barrel construction which could lead to poor heat transfer, poor strength and pressure carrying capacity. The backing steel of the liner insert was a low carbon, low strength steel that should never be used on an injection barrel of this size. In time this barrel would have developed stress induced failures and broken. The 135mm imported barrel yield strength was close to 40,000 psi as compared to the Xaloy BM58® backing steel of 85-90,000 psi. In short, this barrel represents technology used by U.S. barrel producers back in the 1960's.

Bimetallic Inlay Chemistry

The chemistry of the test barrels made by a competitor was measured with our Oxford X-met metal analyzer. Three spots at different locations of the barrel were measured and listed below. Clearly, the imported barrel is nothing close to a high-performance wear resistant inlay in X800® as it was represented to the customer. There is no tungsten carbide in this inlay and a very low hardness. We can say the same to its performance compared to the Xaloy X102®. The high nickel and low iron and boron content give it very low hardness properties and very poor abrasion resistance.

Barrel Inlay Chemistry

Element	Xaloy X102®	Xaloy X800®	135mm Import Barrel	32mm Import Barrel
Ni - Nickel	1.75-4%	35-45%	27%	11.3%
Cr - Chromium	1%	1.8-4%	5%	4.3-4.8%
B - Boron	0.8-2%	1-2%	-	2.1%
Fe - Iron	Balance	1-5%	66%	81-83%
Si - Silicon	2%	0.5-2.5%	0.9%	1.1%
W - Tungsten	-	40-55%	0%	0%

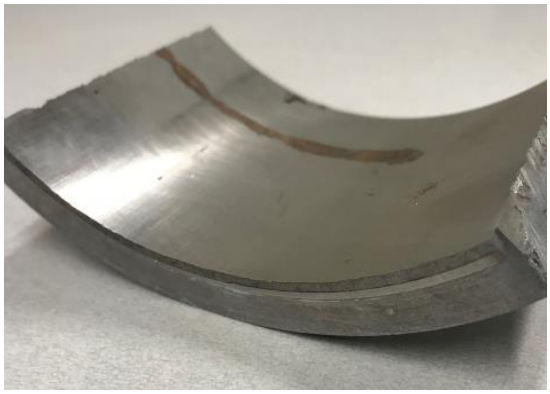


Exhibit C: Specimen from 135mm Imported Barrel which was a thin walled liner pressed into a housing

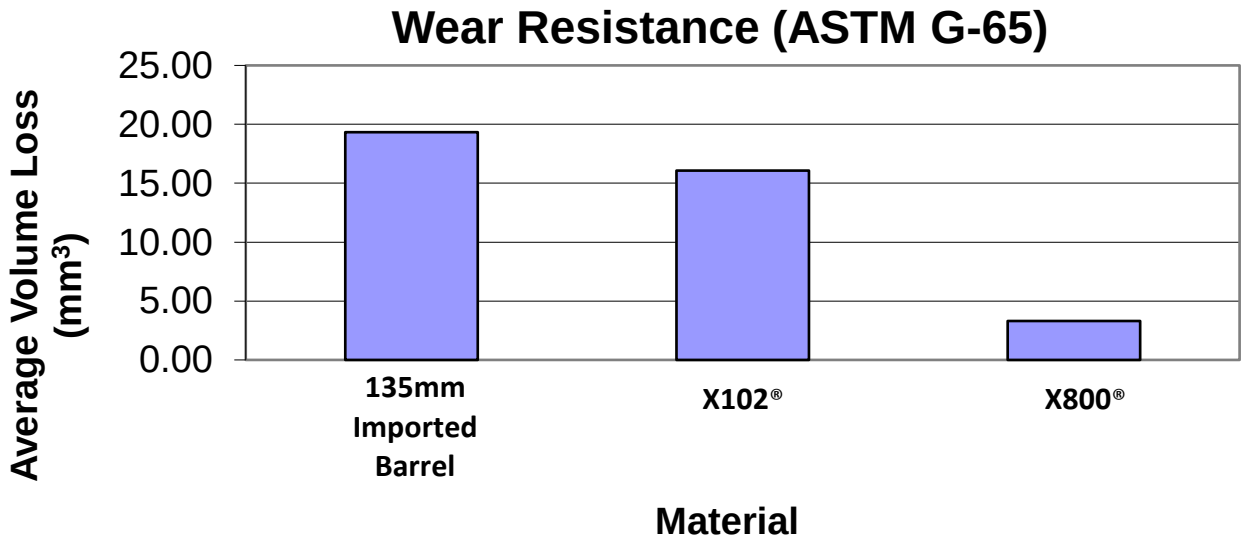
Bimetallic Inlay Hardness

Hardness value of the 135mm imported barrel was measured in 3 locations with an average hardness of 32 HRC, and the 32mm barrel was 46Rc while standard hardness of both X102® and X800® range from 58 to 64 HRC. This softness of an inlay cannot withstand the abrasion of today's resins and will result in premature failure.

	Xaloy X102®	Xaloy X800®	135mm Import Barrel	32mm Import Barrel
Inlay Hardness	58-64Rc	60-64Rc	32-34Rc	46Rc

Wear Resistance

Specimens were cut from the 135mm barrel and run through the industry standard ASTM G65 abrasion test. This is a test that forces a spinning rubber wheel against the sample specimen while sand is fed between the two. Essentially grinding sand or abrading it against the bimetallic inlay sample. After a given number of cycles the volume of inlay removed by the sand is recorded. There are 3 samples run for each inlay to reach an average wear. The chart below shows the volume loss of all 3 inlays: X800®, X102® and the 135mm imported barrel.



Backing steel

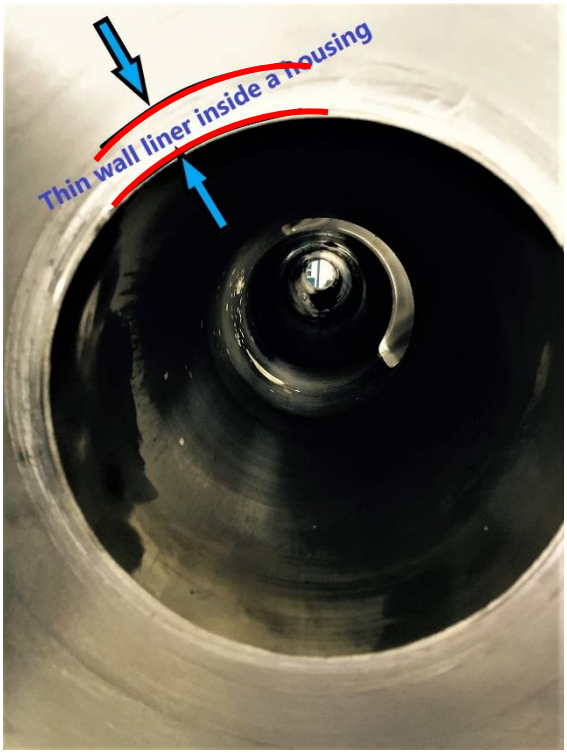
Chemical analysis of the 135mm imported barrel backing steel via X-met shows it is low or mild carbon steel similar to ANSI 1040 or 1045 grade steel. The hardness of this backing steel was

measured at 24-28Rc. The yield strength of this steel is 40,000 – 45,000 psi. The comparative yield strength for the Xaloy BM58® steel is 85,000-90,000 psi. Using a backing steel for an injection barrel with this low of strength will result in a premature failure due to excessive stress and more importantly, dangerous to run in such a high-pressure injection molding environment. Even the 32mm barrel was below our acceptable standards for injection barrel strength

Backing Steel Properties	Xaloy BM58®	Xaloy BM63®	135mm Import Barrel	32mm Import Barrel
Hardness	28-32Rc	30-36Rc	24Rc max.	27Rc
Tensile strength (psi)	115,000 min	128,000 min	65,000	130,000
Yield strength (psi)	80-85,000	90-95,000	35,000	-

Construction Methods

The last 6" of the 135mm barrel was cut off to run all these tests, after which it was clear there was a thin wall bimetallic liner pressed inside a housing. This is an unacceptable method to construct a barrel of this size.



There are many well documented problems with this method. The strength of the barrel is now compromised as compared to a single piece construction method. The thermal heat transfer from the outside heater bands to the melt stream inside the barrel has now been reduced since there are gaps between the liner and housing.

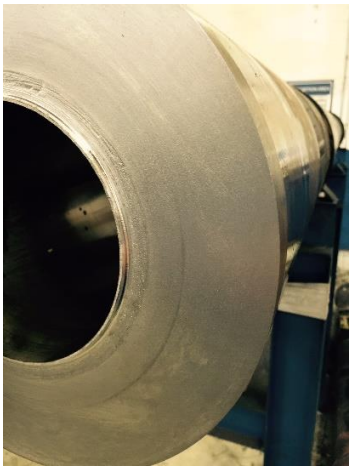


Exhibit D: 135mm Injection Barrel with bell ends sleeve

There is a high risk of molten plastic getting between the liner and housing through thermocouple holes and discharge barrel end face that is under high pressure. These are all common problems associated with poorly constructed barrels.

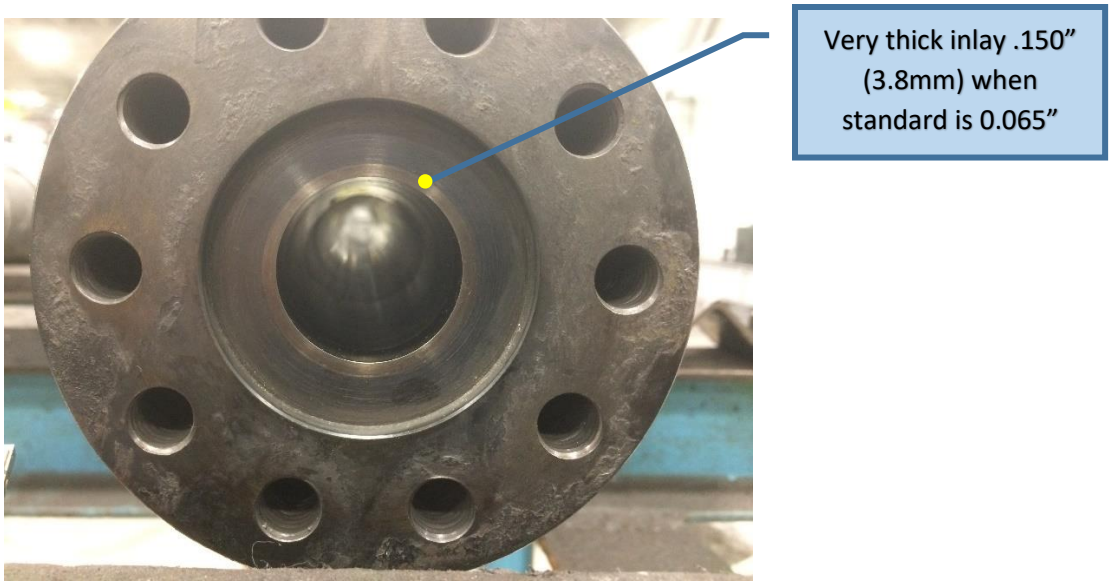


Exhibit E: 32mm Injection Barrel with bell ends sleeve

Conclusion

The performance of these imported barrels, in our opinion, is markedly inferior to the performance of the Xaloy® product in every category: wear resistance, pressure carrying capacity, reliable construction materials and construction methods. There is an increasing instance of barrels being imported from Asia into the Americas, and as far as we know, none of which have been at the quality and performance levels of premium U.S. made barrels. The facts above are representative of many other barrels we have witnessed/inspected as well. The demands and expectations of the American processors and OEM machine builders have developed over time, as have the materials and manufacturing methods of U.S. barrel producers.