



LowElast

Improved Retention Forces for Crimped **L605 Stents** and Reduced Recoil



LowElast reduces / eliminates the crimping problems of L605 stents. It is the solution for your challenging L605 crimping process.

Balloon expandable stents are crimped on a balloon catheter prior to implantation of the stent. Good adhesion of the stent is desired to ensure a tight fit on the balloon with a high retention force to facilitate a safe implantation procedure.

However, the elastic strain of metal stents causes a “spring-back”¹ effect. Due to the elasticity of metals, the stents reopen slightly (spring back) after releasing the crimp force. The spring back is only about 0,1 mm in actual stent diameter, but large enough to reduce the retention force significantly. For L605 (Co-Cr) stents, this spring back effect, and hence retention force, is a major problem.

The elastic strain is the result of the yield strength ($R_{p_{0,2}}$) divided by the elastic modulus (E):

$$\epsilon_{\text{elast}} = R_{p_{0,2}} / E$$

The elastic modulus is a constant factor which cannot be changed without changes to the alloy composition. The modulus of L605 is approximately 243 GPa, while that of 316 LVM stainless steel is only 193 GPa. This means that L605 shows a steeper Hookian straight line region in the stress-strain curve and less elastic strain would be expected. However, the yield strength of L605 is much higher: about 650 MPa for annealed L605 tubes compared with 350 MPa for annealed 316LVM.

$$\Delta\epsilon = \frac{\epsilon_{\text{elast}}(\text{L605})}{\epsilon_{\text{elast}}(\text{316LVM})} \approx 1,5$$

L605 exhibits approximately 50 % higher elastic strain than 316LVM which causes the already mentioned spring-back problems during crimping.

MeKo has developed a special heat treatment called **LowElast** to reduce the yield strength of L605. The process is applied after laser cutting the stents from the full-hard tubing. As the treatment is very stable, the value of the final yield strength can be chosen by the customer. The significantly reduced yield strength causes only a slight reduction in ultimate strength (UTS). For example: a 25 % reduction in yield strength results in only a 5 % smaller UTS, which is acceptable.

With **LowElast**, the crimping behaviour of L605 is comparable with 316LVM. Several MeKo customers report that only by use of **LowElast** a high retention force for L605 stents is attainable.

Thus far, high crimping forces have been used to “over-crimp” the stent to compensate the spring-back effect. This causes a high risk of damage to the balloon catheter. With **LowElast**, crimping forces can be reduced to minimize such affects on the balloon.

Why the annealing of the tubes cannot be as good as **LowElast**?

First: After annealing the tubes are not perfectly straight. A straightening process is necessary to address this. Because L605 exhibits a high work hardening, the yield strength rises significantly with the straightening procedure. Each annealed tube needs an individual straightening depending on the amount of distortion. Thus each tube shows slightly different mechanical properties after straightening. In addition, the mechanical properties differ from tube lot to tube lot. Altogether, the crimping process and the mechanical behaviour of L605 stents vary and are unpredictable.

Second: Annealing of L605 is an extremely sensitive process; much more difficult for example than 316LVM. Therefore MeKo has engineered and built unique furnaces which allow us to perform heat treatment processes especially adapted to L605. With these furnaces MeKo has developed a special heat treatment method **LowElast** to optimize the mechanical properties of L605.

LowElast minimizes the variation of the mechanical properties in L605. MeKo’s unique furnaces lead to very stable and reliable values for the yield strength, UTS and break elongation. MeKo’s customers have confirmed the existence of consistent mechanical properties. They are observing reliable crimping procedures.

With **LowElast** it is also possible to re-anneal tubes that have been provided already in annealed condition in order to optimise the yield strength. However, the possibilities to influence the mechanical properties of L605 are limited with this approach and are not as reliable. The best way is to begin with “as drawn” (cold worked status) L605 tubing and to anneal the stents only once with **LowElast**. This ensures the best results.

For the L605 stent system lower yield strength and stable adjustable mechanical properties result in

1. high retention forces of the L605 stent on the balloon
2. lower crimping forces
3. less over-crimping with less risk to damage the balloon
4. stable mechanical properties

1. The spring-back effect is similar / comparable with the “stent recoil” effect. The different name should allow a clear differentiation

MeKo Laser Material Processing

Im Kirchenfelde 12-14
31157 Sarstedt / Hannover
Germany

Tel. +49 5066 7079-0
Fax +49 5066 7079-99
E-Mail laser@meko.de

