

# case study

## The Challenge

Plastics Engineering Laboratories (PELabs) consists of a group of engineers, who help design and develop products with plastic parts. Fibrex Medical asked PELabs to help them develop the Fibrex Catheter Patency Device. The catches that held the device housing together presented some interesting design challenges: Besides holding the interior components in place, the unit had to survive being dropped and the housing had to be easy to open, in case of an emergency.

## The Solution

PELabs chose COSMOSWorks to analyse and refine the catch design. "We designed the snap-fit and release mechanism so that it will not fall apart through handling or when dropped. The housing is strong enough so that a doctor can use it, and the catches are small but not delicate," said Tom Ellis, PELabs Laboratory Manager. PELabs also used COSMOSWorks to simulate how the plastic's physical properties would change with temperature and time, before deciding on the final size of each component.

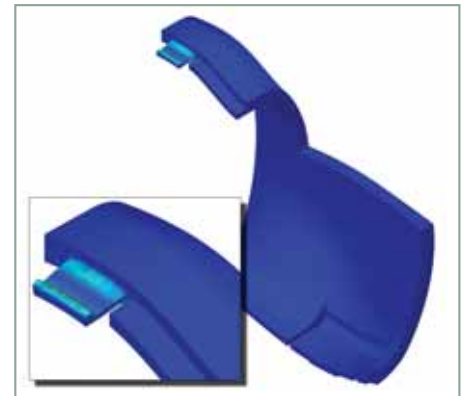
Plastics Engineering Laboratories (PELabs) consists of a group of mechanical, electrical, optical and chemical engineers with more than a century of joint experience in developing products with plastic parts. The organisation uses a wide variety of CAD and CAE tools to develop a diverse range of plastic products, and has a full-service facility to test products and materials. An affiliate, The Plastics Group, offers PELabs access to manufacturing facilities for prototyping and production.

## Groundbreaking catheter cleaning technology engineered with COSMOSWorks

Physicians may place catheters in a central artery for such purposes as dialysis, drug delivery or nutrient delivery. Over a period of time, the catheters can become so obstructed by the growth of a body product called fibrin that fluids cannot pass through them. To remove and replace such a catheter means cutting through skin that grows around the insertion point – an invasive, uncomfortable and possibly dangerous procedure.

To avoid this catheter removal and replacement, PELabs helped Fibrex Medical design and develop the Fibrex Catheter Patency Device – a medical device that cleans catheters in the human body. The product takes a thinner catheter than the one already in place and pushes it through the existing catheter to the point of blockage. A physician then winds a shape memory wire through the inner catheter, where it coils around the catheter and strips the fibrin, which is then reabsorbed by the body, cleaning the tube. The wire is a nickel-titanium alloy with a shape memory that is activated by temperature. Its special properties make it possible to push a straight wire through the tube, which, as it becomes warmed by body heat, helps revert it to a precoiled shape for cleaning the end of the catheter.

Each catheter-cleaning device is designed to be used up to four times for cleaning the same catheter – some have more than one channel – and then to be discarded. The device also has a radio-opaque marker,



so that the physician using a fluoroscope can see that the coil has reached the right place for deployment, and that it has the right stripping action during deployment.

### Complex control handle

The physician controls the device by means of a control handle – an assembly of mostly plastic parts. The handle housing measures about nine inches and utilises a rigid two-piece clamshell design. A lever emerges from the housing that enables advancement and retraction of a guide tube for the wire, and a wheel that controls a storage drum for the wire. The catches hold the housing together presented different problems. Besides holding the interior components in place, the unit 1) must survive a chance drop, and 2) the

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## Summary and metrics

With the help of COSMOSWorks, PELabs was able to:

- > Design and analyse catches for the Fibrex Catheter Patency Device, which were strong enough to withstand dropping and could also be easily opened in case of an emergency
- > Save approximately 25 percent of prototyping time by avoiding physical performance verification of the catches
- > Save further time by moving directly to mould creation.

doctor must be able to open the housing if an emergency occurs. PELabs' Laboratory Manager, Tom Ellis, used COSMOSWorks to analyse and refine the catch design, which had been created with SolidWorks by PELabs designers.

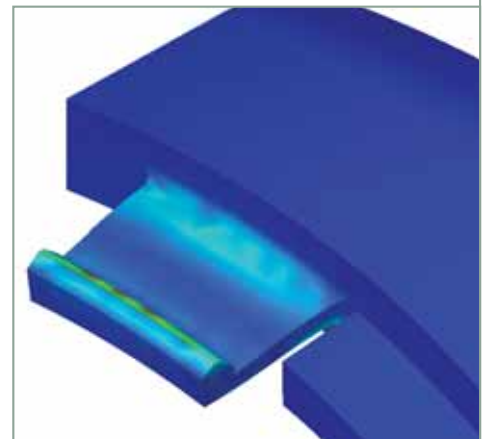
He described the catches as snap-fit levers that spring over a catch. "Four of them snap the casing together strongly enough to keep the handle secure, but still reenterable" he said. "They have a fairly complex shape, matching the curvature of the housing."

## Opening the catches

The manner in which the catches fit also varies. "Two catches have to be pressed in by a thumb, and two need to be pulled apart without applying force to the sides," Ellis said. "We designed the snap-fit and release mechanism so that it will not fall apart through handling or possibly being dropped. The housing is strong enough so that a doctor can use it, and the catches are small but not delicate."

PELabs designed the catches to work as described, but the designers were not sure of the forces the doctors would have to apply. "There was a risk of extensive pressure required by the fingers, and analysis made it possible to vary the design to avoid such undesirable forces. Using COSMOSWorks, the designers changed the geometry, with particular reference to the thickness and length of the catch beam, because those parameters critically affect the holding force generated by the beam portion of the catch."

The engineers performed three analysis runs, varying the geometry a little each time, before deciding on the final size of



each component. Ellis said that these analyses with COSMOSWorks gave them enough confidence to go directly to the mould – a very expensive decision if any parts fail to work.

## Uncommon material properties

PELabs personnel have unusual experience and insight concerning plastic materials because of their background and testing facilities. Ellis explained that PELabs designers and analysts often vary the plastic properties used with COSMOSWorks, because they want to see what happens to the various materials in the long term or when exposed to harsh environments.

PELabs uses COSMOSWorks Professional, and in addition to linear static analysis, also uses buckling and drop analyses for plastics products.

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