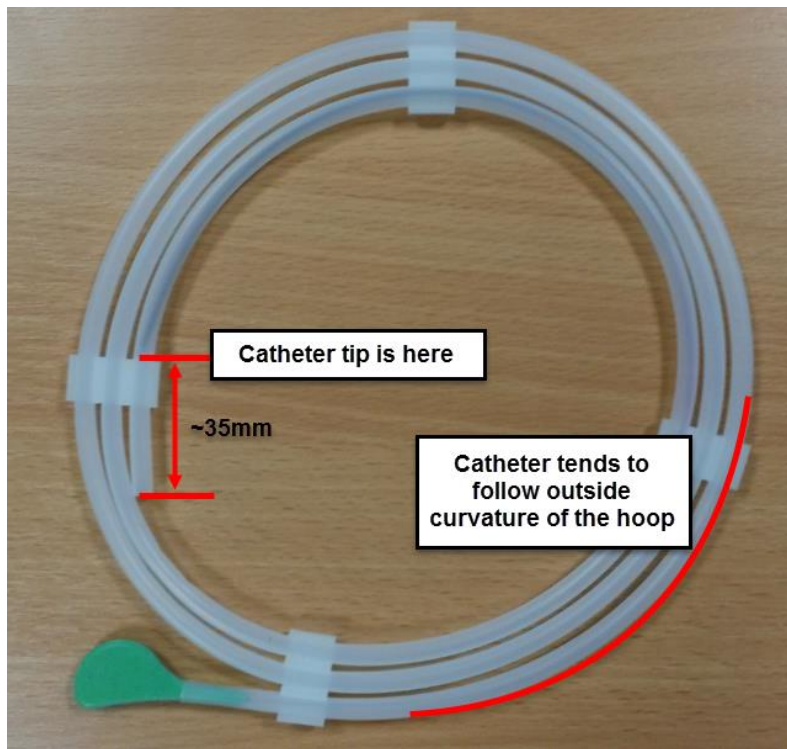


## Problem 2

### Feasibility of creating Mathematical Model to determine hoop dimensions

In Medtronic we manufacture catheters (long flexible tubes of small diameter) which are packaged in a protective hoop. These hoops are manufactured from long plastic extruded tubes which are curved into a spiral shape. We would like to know if it is possible to develop a mathematical model which can help us in determining the required hoop length for a given catheter length.

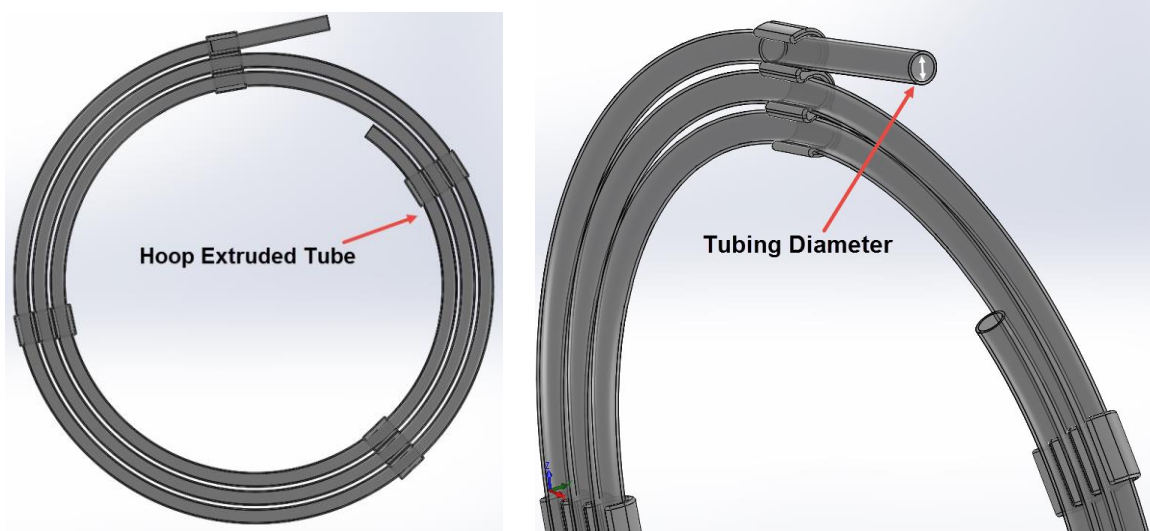
At present we specify the length of the extruded tube used to make the hoop based on the length of the catheter but since in practice the catheter does not travel down the center line of the hoop extrusion, it does not need to be quite this long. For example, in the image below, there is 1515mm of catheter within the hoop (which is 1525mm long) and the catheter tip is approximately 35mm from the end of the tubing.



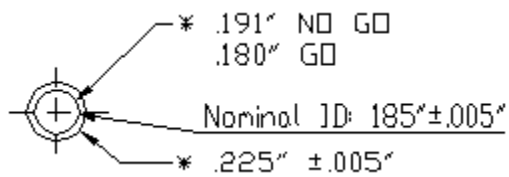
There are a couple of key dimensions which will constrain what we can do in terms of hooping product:

1. **The inner diameter of the plastic tubing** used to create the hoop. This needs to be big enough to accommodate the catheter but small enough to ensure that the catheter is reasonably well constrained during distribution & storage. It also impacts what is possible in terms of hoop wind OD.

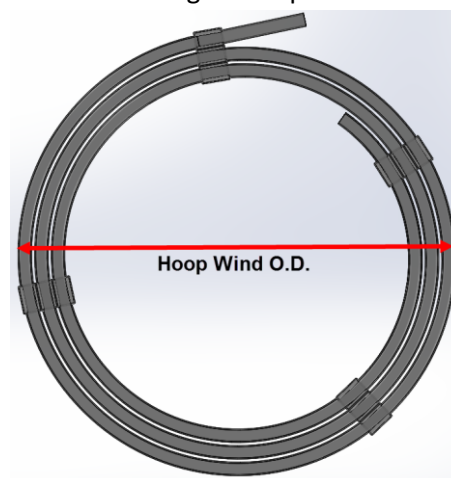
## Problem 2



**Typical tubing dimensions:** I.D.: 0.185", O.D.: 0.225"



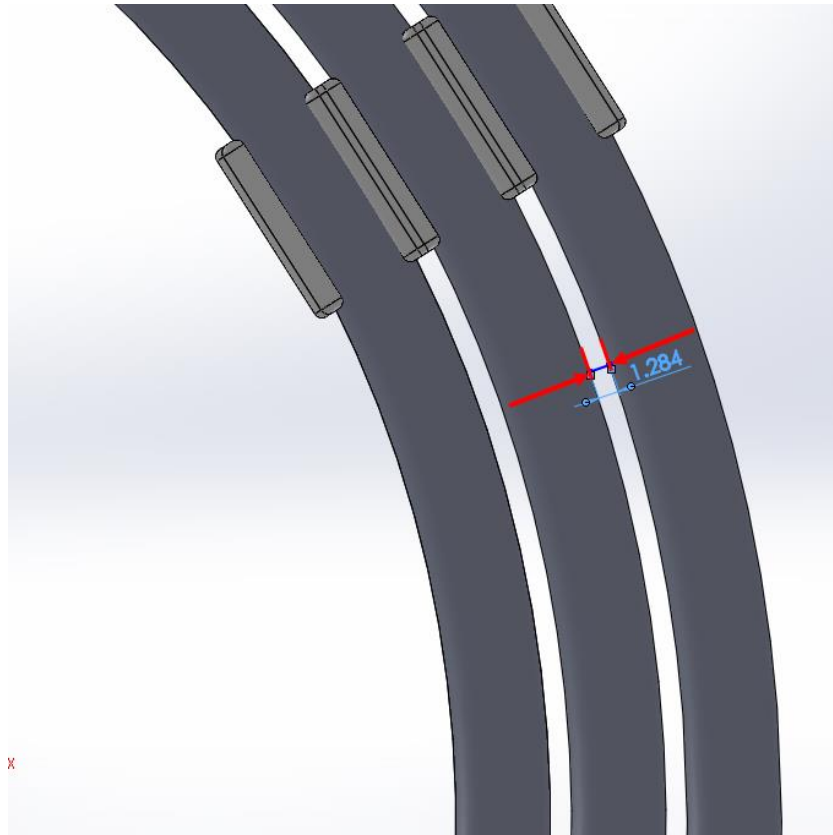
2. **The wind O.D. of the hoop** – the hoop is contained within a pouch, which is in turn contained within a cardboard carton so the wind diameter will dictate the size of the pouch and cardboard shelf carton. In order to ensure that the catheter packaging is as user friendly as possible we do not want to have too large a hoop wind O.D.



**Typical hoop wind O.D.: 7.25"**

## Problem 2

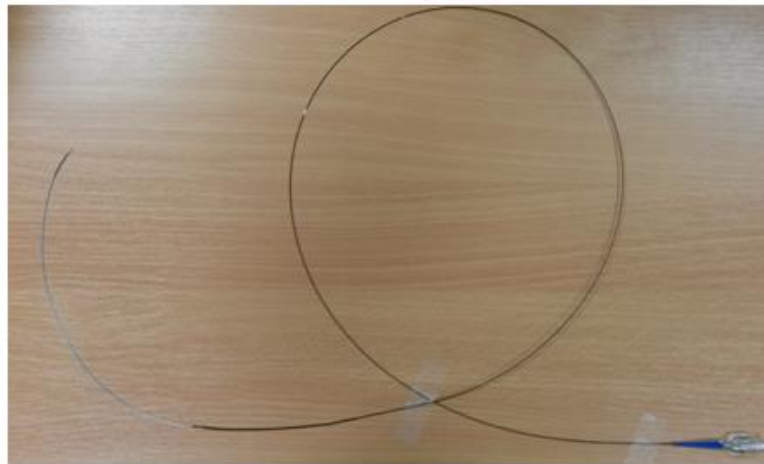
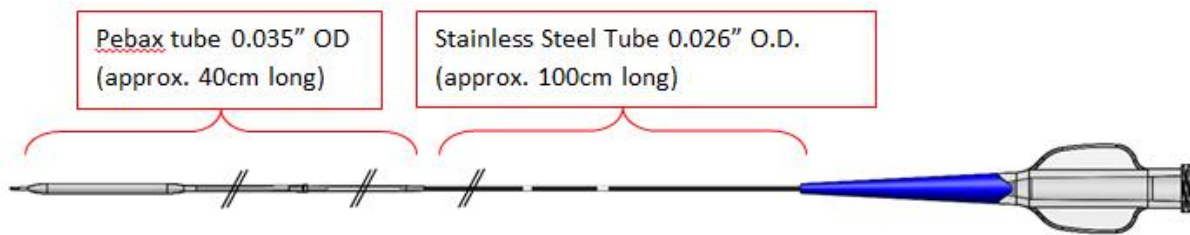
3. **The distance between each wrap of the tube extrusion** – this is dictated by the dimensions of the clips used to hold the wind in place. As you can see from below, this is typically around 1.3mm



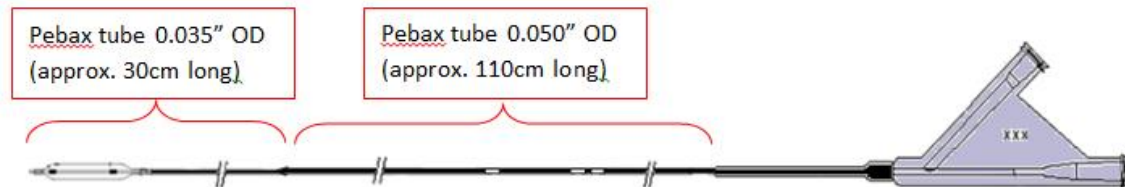
## Problem 2

### Description of catheters

#### Type A:



#### Type B:



## Problem 2

Type C:

Open Pebax tube w/ coiled wire  
support 0.068" OD (approx. 25cm long)

Stainless Steel wire 0.020" OD  
(approx. 125cm long)

