Calibrating shaped tubes from a round tube (left column), from an elliptic tube (center column), and by keeping the cross-section unchanged (right column). The top row shows the final product and the bottom row the cross-section in the welding station. The arrows point in tube running direction.

Calibrating Shaped Tubes

What are shaped tubes?

Shaped tubes are tubes with any symmetrical or non-symmetrical but closed cross-section (see picture, top row), which are formed from an initial tube (bottom row) by using calibrating stands (Turk's Heads). It is a good idea to select an initial cross-section that approaches the final cross-section: If the final tube has nearly the same height and width, it should be formed from a round tube (left column). Otherwise, if the shaped tube is either quite large and flat or quite high and narrow, this means it differs extensively from the square form, an elliptic cross-section should be used (center column). It is also possible to calibrate by keeping the cross-section unchanged (right column). During this process, only the developed length decreases.

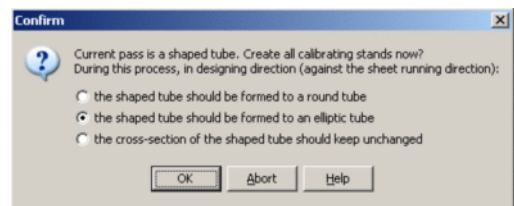## Designing the calibrating passes

The designer proceeds backwards: The customer requires a shaped tube with desired cross-section and desired dimensions. From this specification the flower pattern for all calibrating stands has to be developed until the welding station is reached. In each calibrating stand, the developed length has to be multiplied by the calibrating factor. That is why the developed length decreases (and the tube length increases) during this process. Furthermore the deformation degree of the last stand should be smaller than the one of the previous stands in order to get higher accuracy. By using a pure CAD system, these steps are quite tedious and time-consuming.

Designing with PROFIL

After defining the desired shaped tube (e.g. by importing a CAD drawing or within PROFIL by using the tool box), the designer selects the machine with a certain count of calibrating stands. In each stand the calibration factor is defined, which increases the developed length against the sheet running direction (ask your machine supplier). Furthermore the deformation degree is pre-set, which allows to partition 100% total deformation to each stand arbitrary.

Afterwards the designer calls the function **Shaped Tubes Calibration**. The software checks if a closed shaped tube is present and opens a window for selecting the welding pass cross-section.

More info: **www.ubeco.com**

Selecting the welding pass cross-section

Three methods are available how the defined shaped tube should be formed (against the sheet running direction):

The shaped tube should be formed to a round tube. The calibrating passes are created dependent on calibration factor and deformation degree. Finally, a round tube is created at the stand that has the deformation degree zero for the first occurrence (normally the welding station, a calibrating stand is possible, however). Because there are many possible cross section patterns for the calibrating stands, PROFIL has a built-in random generator that calculates 10 different solutions for the problem. 9 of them are thrown away and the best with the minimum horizontal deviation of centroid of the area is kept. So a different result will be shown, each time the function is called for the same shaped tube repeatedly.

The shaped tube should be formed to an elliptic tube. This method should be used if the shaped tube is either quite large and flat or quite high and narrow, this means it differs extensively from the square form (with same width and height). High deformation would be required to calibrate this kind of shaped tube from a round tube. Better is to calibrate it from an elliptic tube. The input window **Aspect ratio major/minor axis of the ellipse** requests to enter the desired ratio. The value must be between 1.1 and 16.0. PROFIL decides by itself dependent on the position of the final shaped tube whether a flat or upright ellipse is created. Get further details from the selection "to a round tube".

The cross-section of the shaped tube should keep unchanged. The deformation degree is ignored and dependent on the calibrating factor the straight length of each profile element is increased.