Armhole know-how

In part two of our series on sweater geometry, **Sunil Kumar Puri** discusses how to measure the arm hole correctly

The arm hole of a sweater is measured from point to point i.e. from the point where the under sleeve and over sleeve join the main body, i.e. A and C in Fig 1. The arm AC hole is the hypotenuse of the triangle ABC formed by the arm hole where AB is the adjacent and the BC is the opposite side.

It is unnecessary to know the value of angle CAB alone. It is, however, important to know the value of the opposite - the distance between B and C. Knowing this value enables accurate positioning of the sleeve on the body. By knowing this value it is possible to measure the garment side length.

This point will be (total garment length – the shoulder drop – the arm hole opposite) and the seam margin must be added to it. So as per Fig 1, applying the Pythagoras Theorem gives $a^2 + b^2 + c^2$ BC = $\sqrt{(AC^2 - AB^2)}$. The arm hole angle with the garment base or back of the neck can be calculated using the scientific calculator as described before. The arm hole angle and opposite in this case will be: BC = $\sqrt{(21^2 - 5^2)}$ = $\sqrt{(416}$ = 20.39 which rounds up to 20.4.

The angle CAB will be $\sin^{-1}$ 20.4/21 i.e., inverse of the sine of opposite/hypotenuse = 76.27, rounded down to 76°. The side length of the garment = 60 – 2 – 20.4 = 37.6.

Once the arm hole angle is obtained it is important to know the arm angle or angle of ACE. This angle will provide calculations for the crown as well as the sleeve width at the point of the joint with the main garment body. For this we need to ascertain the value of the angle ACE.

Fig 2 shows the triangle ACE as well as triangle ABC. To understand the value of the angle between ACE it is necessary to study the rectangle ABCD.

Presuming that the angle CAB is ß, ABCD being a rectangle means the angle DCA will also be angle ß. This is also the angle of the arm hole, calculated earlier as 76°. The angle between DCE is also equal to the angle between GHC (angle of shoulder slope and calculated as 12° in part one, Knitting International August 2010 issue page 32). Angle ACE = angle ACD ß – angle DCE α = 76° – 12° = 64°.

Once the value of the angle between ACE is known it is possible to obtain the crown value, width of sleeve and to

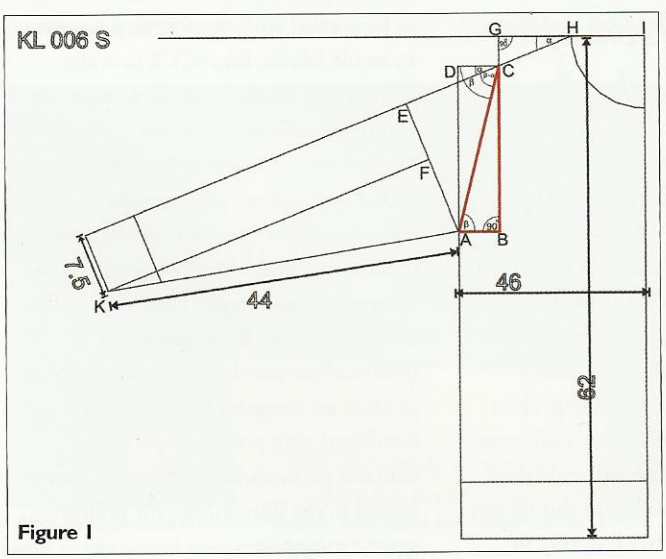

Figure 1

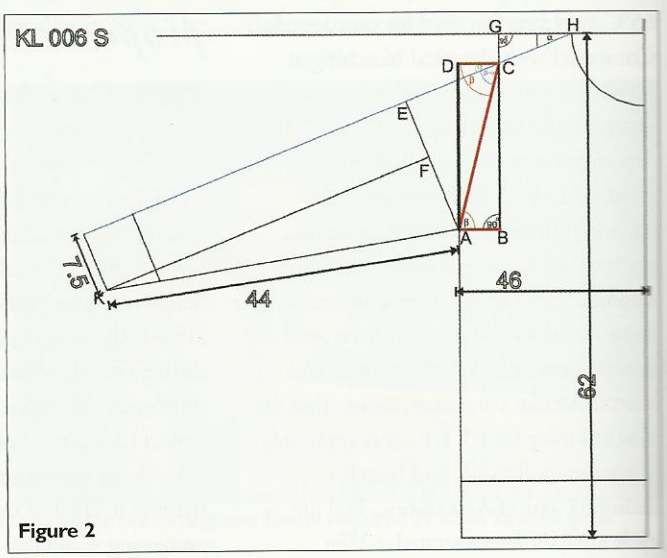

Figure 2

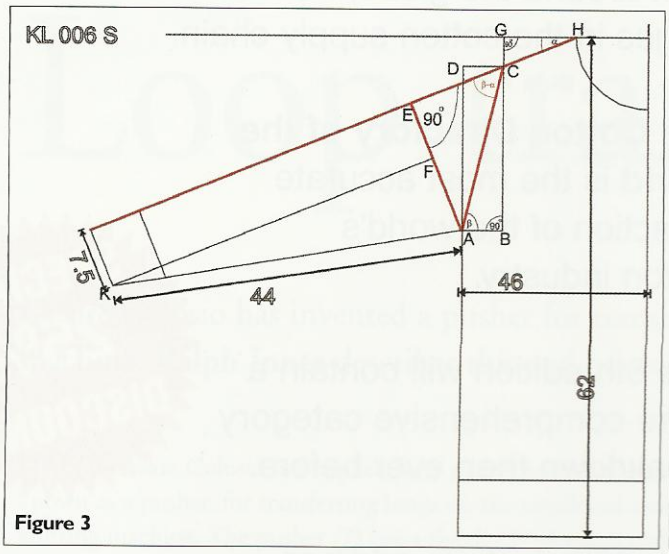

Figure 3

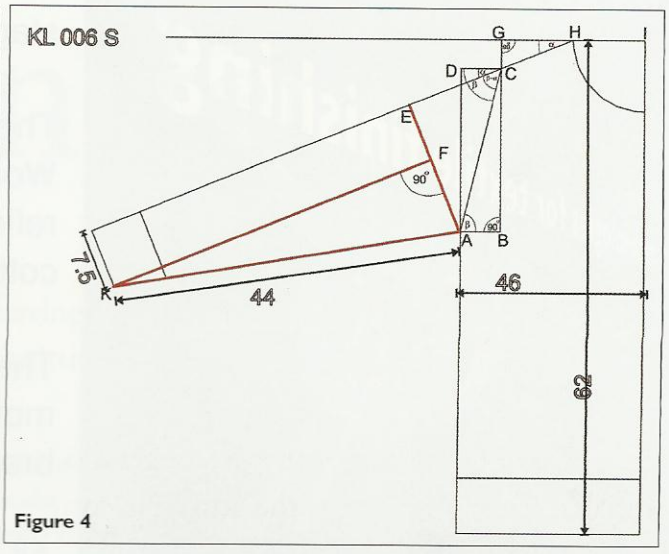

Figure 4

cross check the width of the sleeve as provided by the customer. At times, the latter is a little over or under the exact value which often falls within the tolerance range set by the customer or the industry standards.

The other reason the sweater will still be sewable is that knitted panels adjust to such irregularities to quite an extent because of the nature of the loop structure which can rob and be robbed by the following loops.

It is best to set an accurate target. If the target is hazy, irregularity may play havoc with results and it will be difficult to find the problem's root cause. If calculations are correct and there is still a failure to obtain the desired results, this indicates an alternative cause, but calculation error can be eliminated.

Referring to Fig 3, if we know the angle between ECA and the value of AC i.e. the arm hole, it is possible to reconfirm the sleeve width as well as ascertain the value of CE - the crown or cap of the sleeve.

For calculating the width any of the three equations described in Fig 2 (see part one) can be used. Using opposite/hypotenuse = Sinϕ AE/AC = Sinϕ or AE = AC x Sinϕ. The sleeve width according to mathematical and trigonometric calculations will be: the sine of angle 64° = 0.8987940.

The product of the sine of 64° and arm hole = 18.874 rounded up to 18.9cm.

The width according to the measurements supplied by the customer is, for example, 18cm which may be a little too short and is replaced by, for example, 19cm. The variation may be within the tolerance and thus a supplier may barely get his garment approved even if his measurement is more accurate.

A garment with exact muscle measurement may not look good at all. Therefore understanding of these calculations can save a lot of tense moments during inspections conducted by the customer and especially by the third party. The customer may see the manufacturer's point of view but the third party inspector has to stick to the rules and may reject the perfect shipment.

Sleeve crown

The sleeve crown, also responsible for maintaining the angle of the shoulder slope throughout the sleeve length, can also be calculated as:

adjacent/hypotenuse = Cosϕ

EC/AC = Cosϕ or EC = AC x Cos 64° or EC = 21 x 0.4383 = 9.2.

By calculating the opposite of the arm hole we were able to ascertain the length where the sleeve joins the lower point of the arm hole but the exact sleeve length where it joins the main body has to be ascertained and the total sleeve length is not the answer.

The total sleeve length – the crown of the sleeve which also matches with the width of the sleeve is the measurement of the sleeve length where the sleeve joins the main body. But if the customer has provided the under sleeve length as a standard measurement, the following calculation must be made.

Considering Fig 4, if the value of underarm length is known, the value of maximum width of the sleeve is as calculated earlier and the cuff width is 7.5cm, then the value of AF as AE – cuff width = 18.87 – F 7.5 = 11.37 can be calculated.

The value of the line between K and F can be calculated using Pythagoras Theorem as the square root of (44 x 44 – 11.37 x 11.37) = 42.5. This means it is necessary to knit 42.5cm of sleeve length to knit to the joining point of the sleeve with the body and the increment of the sleeve width will compensate for the balance, 1.5cm. Some margin for the seat of the sleeve as well as the seam margin must be kept in mind.

Using these simple calculations, taking a few minutes if a spreadsheet is prepared for different styles using the necessary formulas, calculating the correct measurements required to knit a perfect garment becomes child's play.

An understanding of these calculations also helps the knitter to point out the corrections needed, if any, in the measurement sheets supplied by the customer.

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