

*Extracted from the plans by Michel Columban for the Cri-Cri/Cricket, found on the web. Used WITHOUT permission. My notes, including English dimension, are THUS - RRY.*

## 7. Metal Folding

### 7.1 Definition

The terms folding or braking are used when it is a question of bending a sheet of metal to a given angle and along a straight line.

If the bending line is not straight, it is not really folding, but forming. This operation will consequently be dealt with separately in the following chapter.

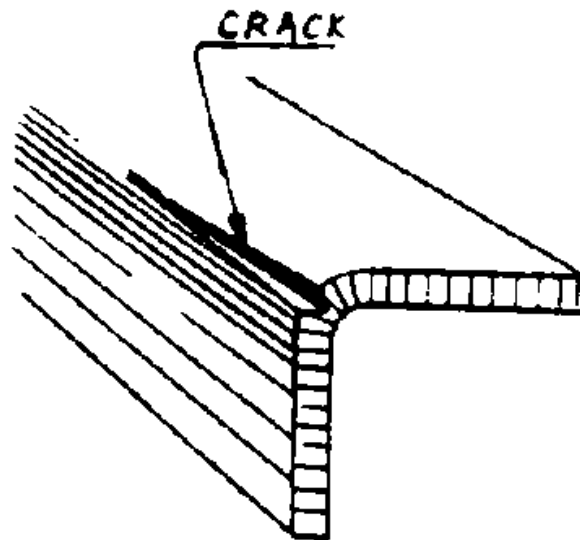
### 7.2 Methods

Folding is done in many ways, depending on the shape, size, and thickness of the part. The necessary machine is the folder or brake; the classic hand brake or bar folder works well, but in the case of the CRICKET it will not be needed except for very long parts: rear sides of the fuselage (1.850 M / 6.07 ft) and the rear drift spar (0.720 m / 2.36 ft). Since it's not likely that you own this machine yourself, you will have to resort to the "neighborhood professional" (light metal shop).

These two parts aside, all the other folds are less than 0.60 m. long and in that case an "Amateur" folder as described farther on is easy to build, and will prove very satisfactory.

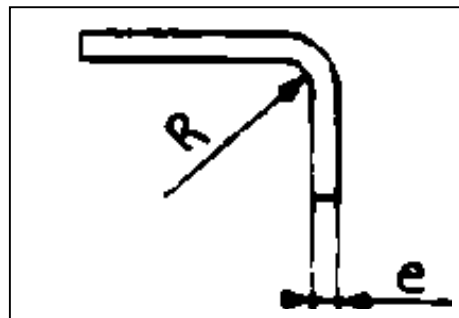
### 7.3 Minimum folding radii

If a sheet of metal is folded without care, and particularly on too small a radius, the outer part of the fold will crack. That is to say, a split forms. According to the thickness of the metal or the direction of the rolling, the radii "R" of the folding must not be less than the values indicated in the following table, as a function of the thickness "a".



Thickness (mm.)	0,5	0,8	1	1,2	1,6	2	3	4	5
A-G5 or A-U4G fresh temper	0	0	0,5e	0,5e	1e	1e	1e	1e	1e
A-U4G temper T3 or T4, folded parallel to direction of grain	1e	2e	2,5e	3e	3,5e	4e	5e	6e	7e
A-U4G, temper T3 or T4, folded perpen- dicular to direction of grain	1e	1,3e	1,5e	1,7e	2e	2,4e	3e	4e	5e
2024 T3 or T4	Multiply the above value by 1,3								

These radii "R", applicable to right-angle folds, can be reduced as the angle of the fold becomes greater.



Note: A-U4G is equivalent to US alloy 2017 and has very slightly lower mechanical properties than 2024.

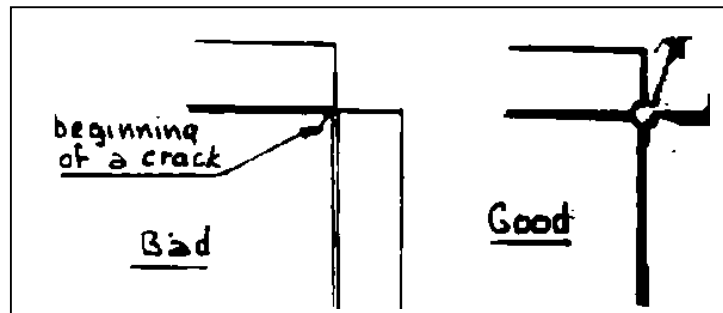
#### 7.4 Precaution

As far as possible make folds perpendicular to the direction of rolling or of the grain of the metal.

Use clean machines and tools, free from irregularities, grooves, filings, etc. If necessary, cover the portion of the part in contact with the tool with Scotch Tape.

The edges located at the extremities of the folds must never be left unfinished after sawing or cutting (beginning of a crack). They must be finished lengthwise (Cf. Ch. 6.1 and 6.6) and worked, with the outer edge filed off and rounded. The recommendation becomes all the more important as the thickness of the metal increases.

Never allow to fold lines to meet in a sharp angle. Eliminate the angle with a hole 4 or 4 mm in diameter, drilled then smoothed.



#### 7.5 Folds on A-U4G parts 0.5 mm (.020") thick

The stability of these parts depends to a great extent on the straightness of the folded edge. Consequently, the use of mallets, as well as certain kinds of corrugations, described elsewhere in discussing forming, are forbidden in the case of folds.

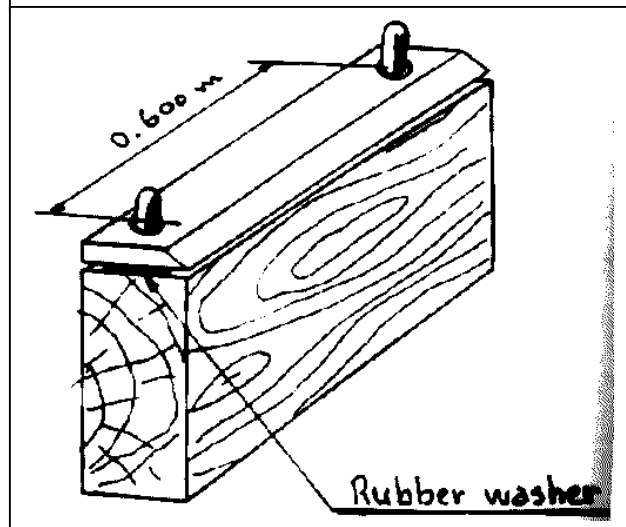
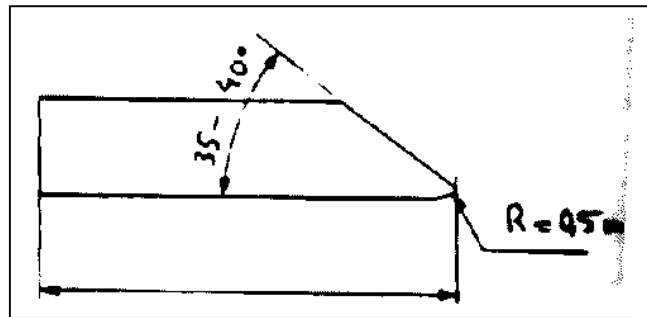
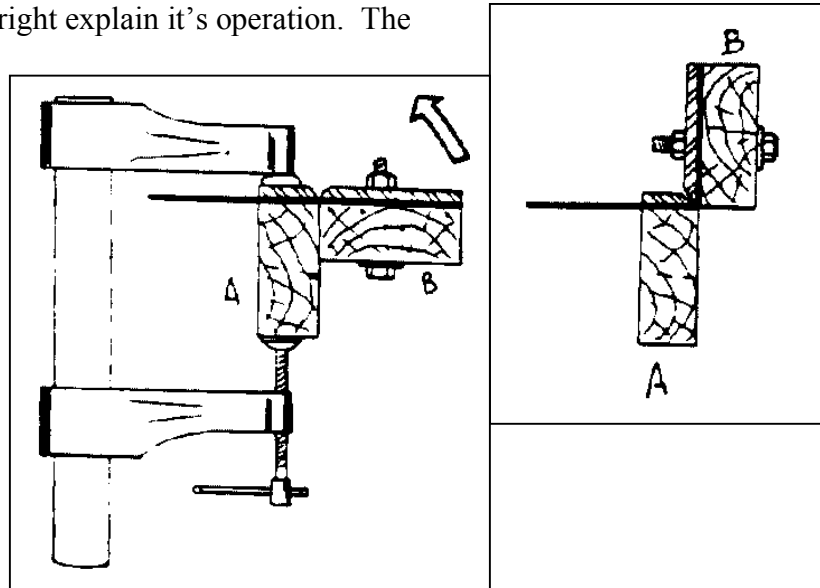
Lacking better means, the Amateur can construct the folder described below, which will save him time, even for a single airplane.

This "Amateur" folder has no hinge. It is made of two crosspieces of hardwood 0.65 m (25.6") long, and two guard plates of A-U4G 5 or 6 mm (about 1/4") thick, of the same length. The cross sections below and to the right explain its operation. The

metal to be folded is sandwiched between the crosspieces and the guard plates of the assemblies A and B, tightened, and folded to the desired angle. That's all.

On assembly A the thickness of the crosspieces and the width of the guard plate must not exceed 24mm (.94") to accommodate narrow parts (especially important for the CRICKET). The guard plate is beveled (and radiused 0.5 mm / .020" - seems pretty small RRY). It is held in place, its edge directly above the edge of the crosspiece, by 2 studs located at each end so that the minimum gap is 0.60 m. Providing that this assembly holds the wide side of the metal sheet, clamping can be done with small clamps spaced at 10 to 15 times the thickness of the guard plate. (In this example, every 10 to 15 inches - RRY)

Assembly B is intended to hold the narrow side (10 to 12 mm and 2-1/2 mm in one case <0.4" to 0.47" and .090" in one case >) Consequently its clamping can be handled with bolts 5 mm in diameter (#10-24) which are 24 mm (about 1 inch) from the edge of the guard plate and alternating with the clamps of Assembly A. Put a shim 10 mm wide on the side of the bolt opposite the edge of the metal the thickness of this shim should be equal to that of the part being folded, that is 0.5mm (.020").



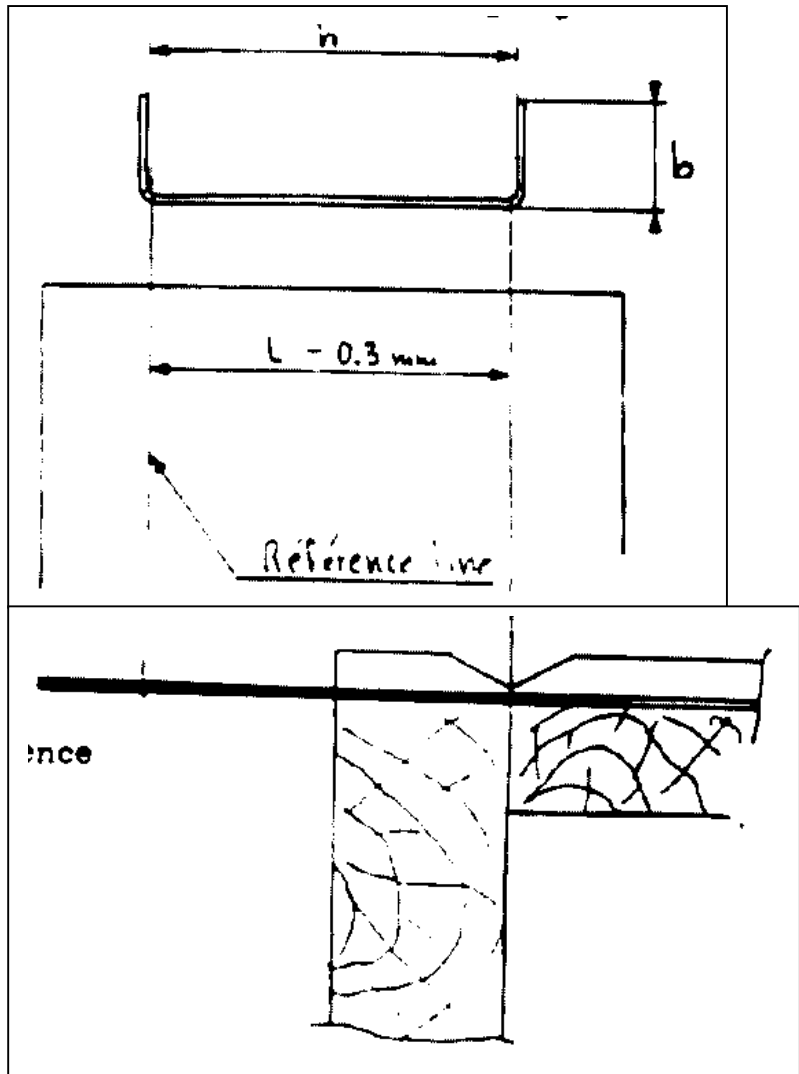
When you make the fold, the edges of the guard plates being in contact with each other, there will be a slight slippage of the piece with respect to either Assembly A or Assembly B. In order to eliminate any uncertainty, proceed so that any slippage takes place in assembly B by

parafinining both surfaces (Of B) and by scouring both surfaces of assembly A with a little cleaner in order to make them hold more securely. Adjust the tightening also: tighten the clamps of A securely, slightly less for the bolts of B.

Following these slight precautions, it is possible to master with precision and fidelity the width of the folded piece. If it's inside measurement is equal to "L", draw with pencil the two fold lines  $L - 0.2\text{mm}$  or  $L - 0.3\text{mm}$  apart on the inside surface. Sandwich the piece in A so that the reference line in exactly below the edge of the guard plate A. Tighten the clamps. Put B in place, tighten the bolts, then fold the metal to the angle desired, increased by a few degrees ( $3^\circ$  to  $4^\circ$ ) because it is elastic and will spring back a bit. Check and adjust as needed in order to reach the correct angle.

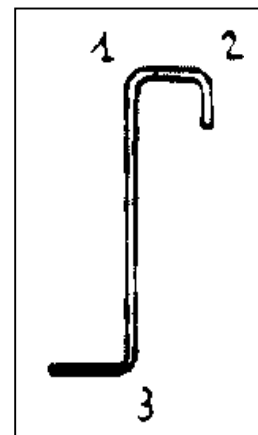
Repeat the operation along the other reference line. You should then find the correct dimension of width in the folded part.

Check the width "b" of the folded edge. It should be slightly greater (about  $0.5\text{ mm}/.020''$ ) than the width as measured from the drawn reference line. Correct if necessary in order to produce dimension "b" so that no adjustment will be necessary after folding.



## 7.6 Special fold in $0.5\text{mm}$ ( $.020''$ )

A few folds in  $0.5\text{mm}$  cannot be done on the "Amateur" folder. Let us consider, for example, the double folds of the C2 and C6 crosspieces. In this case, begin by folding angle 1 on the folder; then clamp the piece between two  $12\text{mm}$  ( $1/2$  inch) pieces of wood or plywood. This second angle has as it's only purpose increasing the rigidity of the crosspiece and it is not necessary that the angle be perfectly straight or clean, since nothing is attached to it: it is nevertheless indispensable that it's free edge be perfectly straight.

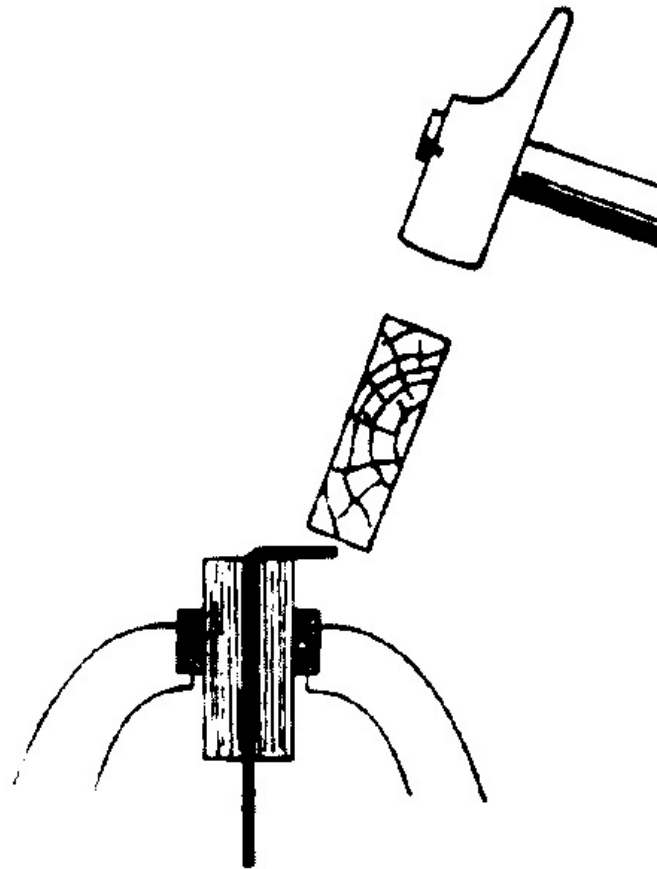


It must be consequently folded down progressively along its whole length using a small board with a straightened edge. You can perfect this fold by clamping it between three boards, and flattening the edge, still using the long straightened block. In any case, avoid waves or undulations in the free edge.

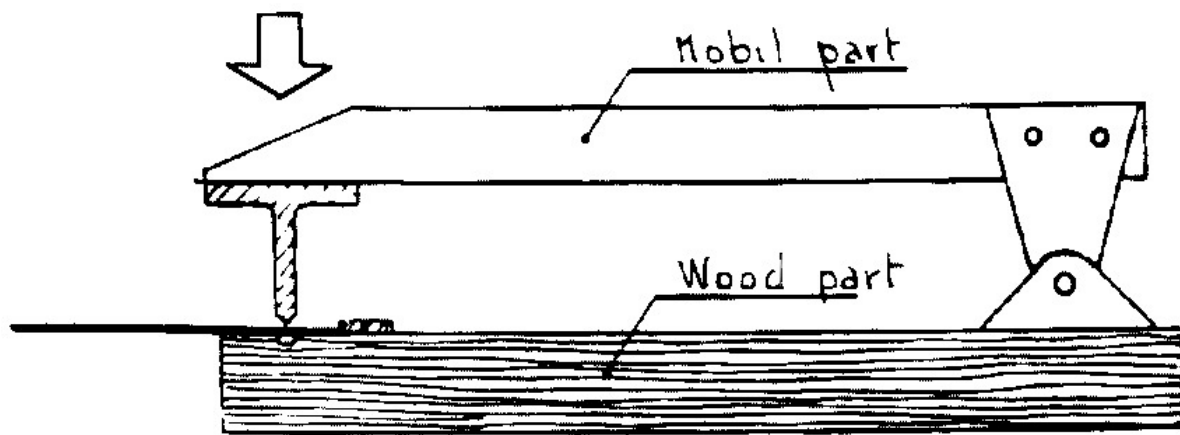
Then make the fold of angle 3 with the folder.

As for the other cases of special folds, we should mention the C11 and C12 frames, small rectangles whose four sides are folded. These folds should be made on the form (Cf. Sh 8.4 I) with the same precautions as above.

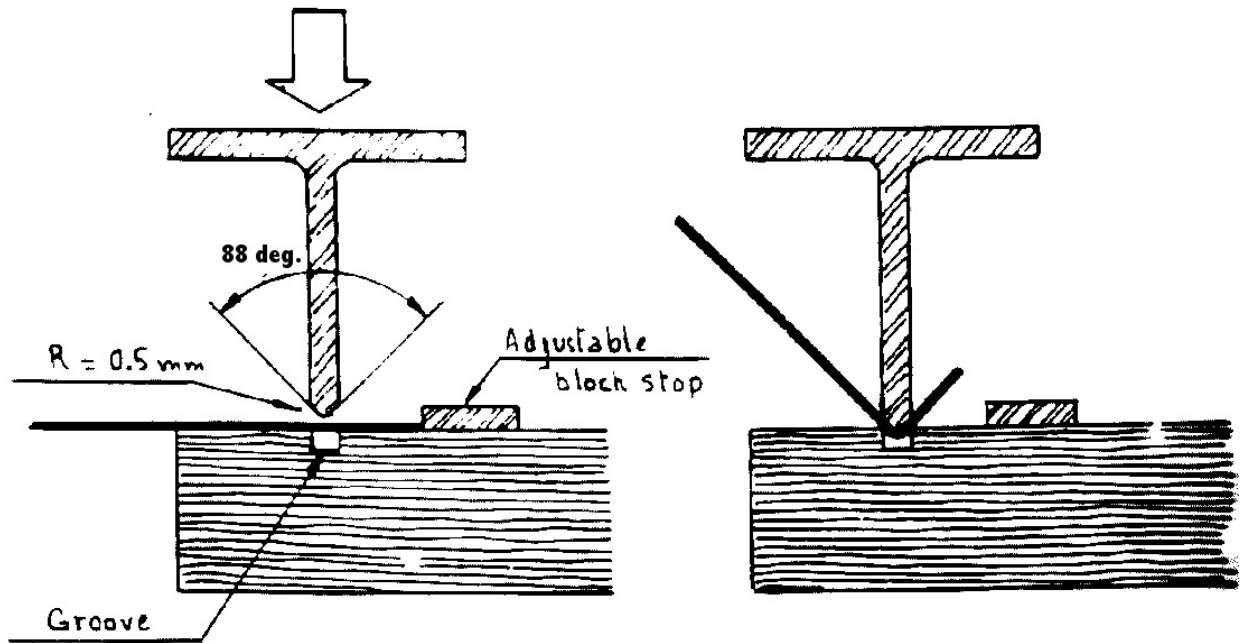
All the folds on the A-U4G .5mm thick should be made on the metal as received.



### 7.7 Alternate possibility for folding 0.5mm (.020") A-U4G

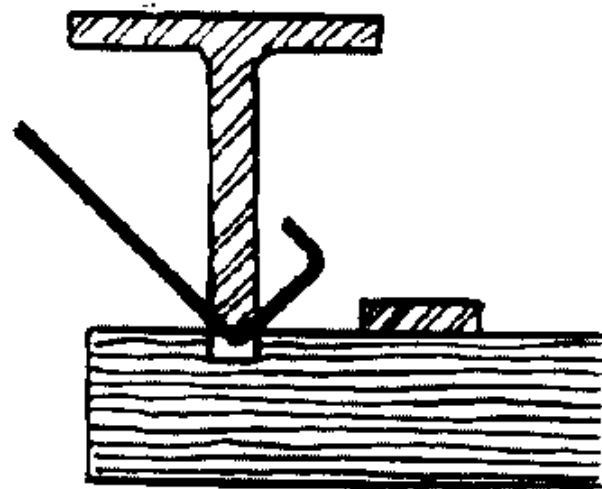


Another variety of folder can be made by the Amateur. Its operation is simpler than that of the folder described above: on the other hand it is difficult to fold other than a predetermined angle. It would be, however, very practical for making right angle folds which are the most common. Its principal elements are shown above and on the next page.



The matrix is composed of a groove 2 X 2 or 3 X 3 mm (0.079" to 0.112" or roughly 3/32") made in a wooden board (hard, if possible) perpendicular to the grain, and the punch is the web of a T-Bar, sharpened to 88° (for right angle folds) and with a radius of 0.5mm (.020").

The metal to be folded is placed under the edge of the punch and positioned either with a guide line or an adjustable guide piece. The T is then lowered and pressed in place with clamps. If everything is correct, the fold should come out perfectly square.



Note that double folds can be made with this folder.

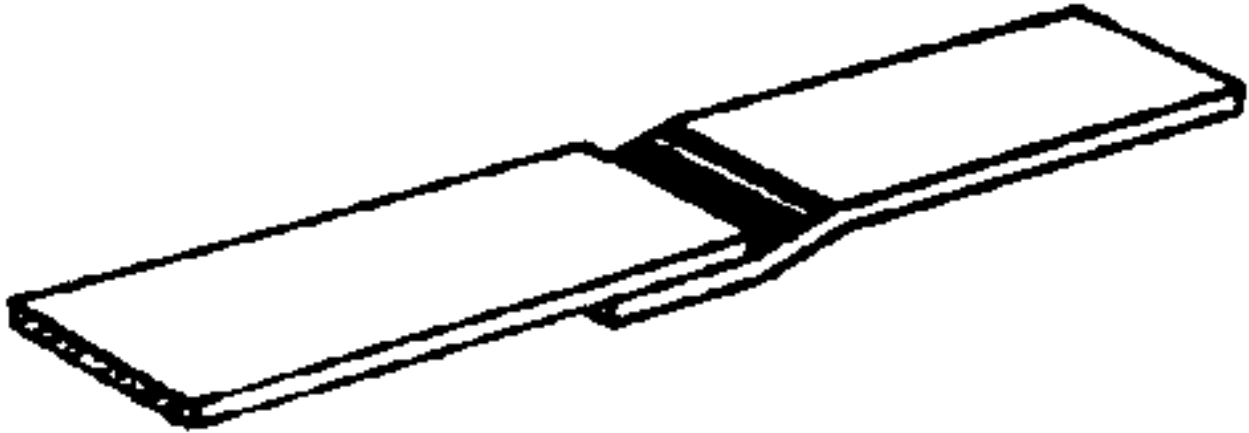
### 7.8 Folding thicker pieces

In the construction of the CRICKET, folded parts from sheet metal 1mm or more are all of small dimension. In this case, folds can be made with a mallet, taking the normal precautions, and on the appropriate forms.

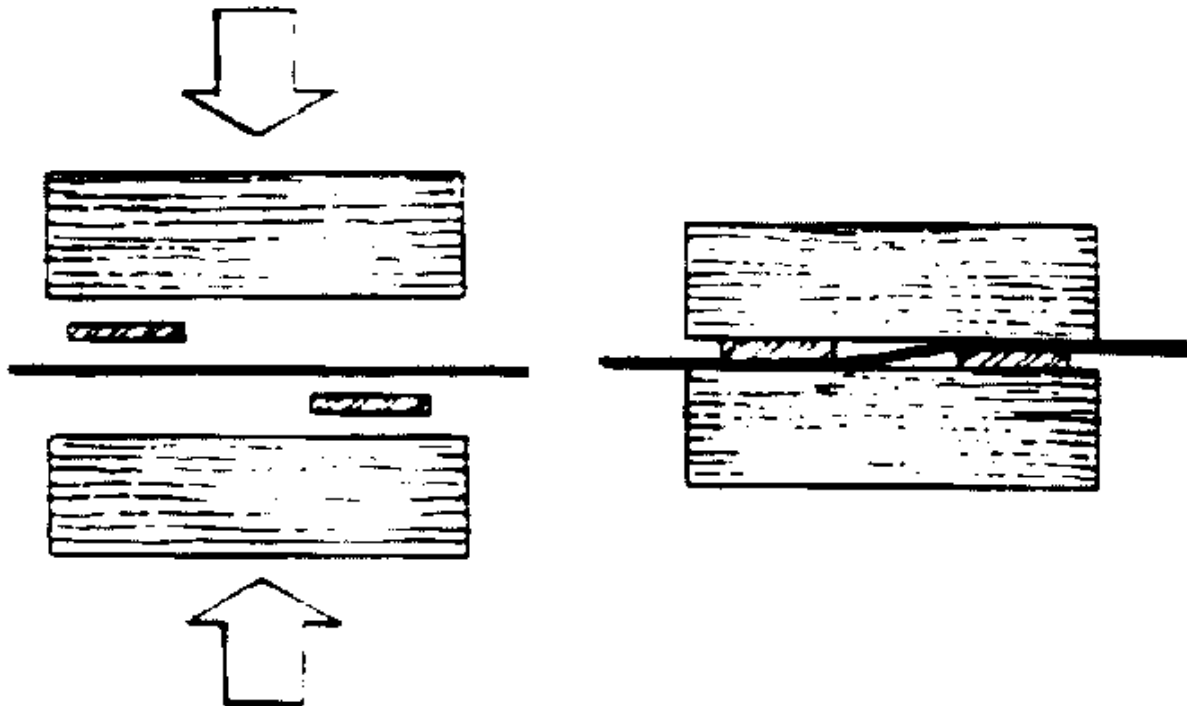
Fresh temper state will be indispensable in this case, only if the fold radius of the piece is less than the minimal value indicated previously (for metal "as received"). <English to English translation: you don't need annealed or dead soft temper unless the desired radius is too tight to bend it in the T3 condition -RRY)

## 7.9 Offset or joggle

This is the name given the slight change of the plane of a part's surface. The frequent type offset, done to accommodate another part flush with the first, is made on sheet metal by a double fold (illustration). When it is located on a flange, the making of the offset has more in common with forming than with folding. In that case it is done on an appropriate form (Cf Ch. 8.4 I).



In the case of a strip of metal or of a relatively narrow part, the offset can be made simply by clamping the part between two staggered shims.



The thickness of the shims should be slightly greater than the depth of the offset (rise).

The staggered shims can be made from a single sheet of the correct thickness and split in the middle (illustration).

