

METAL SHEET SKIN DOOR EDGE PROFILE  
AND METHOD FOR MAKING THE SAME

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TECHNICAL FIELD

This invention relates to a configuration of a door edge, specifically the door edge profile of a door  
10 fabricated from metal sheets. More specifically, it relates to metal sheet doors which are assembled from, and principally comprised of, two metallic sheet face skins.

15 BACKGROUND ART

Conventional metal doors (FIGURES 1-5 - Prior Art) usually are made initially with parts that form the edge of the door and/or channels. Metallic sheet face skins are  
20 then laid over them to form the door panel. Commonly, two face skins are then folded over and joined to the four edges of the door. Often, one of the skins is folded into a deep pan and the other a shallow pan for ease of assembly as taught in, for example, US-5,570,560 (Thompson, et. al.)

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Stiffeners in the form of angle strip (12) as shown in Figure 4, or channels (14) as shown in Figure 2 may be provided along the edges of the door for added structural strength in addition to the folding of the two face skins.  
30 Such stiffeners also ensure that the door edge is not weakened by the holes or breaches along the edge made for the purpose of installing door hinges, flush bolt, lockset and other ironmongery. External channels (18) may also be provided to externally cap the edge of the door as shown in  
35 Figure 2.

The two face skins may be joined in various conventional ways as shown in, for example, Figure 2 (Prior Art) wherein both skins are welded (16) (or secured with other  
5 conventional fastening means) edge-to-edge to provide a flush surface finish. Figure 3 (Prior Art) shows another conventional way of joining the two skins, i.e. by overlap the two skins (20, 21) so as to add to the structural strength.

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Figure 4 shows another conventional way wherein the embossed protrusions (22) made on one skin are inserted into corresponding recesses (23) (either indentation or hollow) of the other skin. This method of mounting one skin onto  
15 the other does not require welding or other conventional fastening means such as rivets or nut-and-bolt.

Another method for mechanically joining one skin to the other without welding or other fastening means is to provide  
20 a groove (24) on one skin by a "double layer" folding (26) and then slotting into the groove an end flange (25) of the other skin as shown in Figure 5.

These conventional methods suffer the disadvantage of having  
25 to weld or fasten the two skins together. Whilst the latter two methods of mounting and slotting in of one skin onto the other eases assembling process and requires less labour, they too suffer the disadvantage of placing undue stress on the edge jointing, particularly at points where hinges are  
30 to be attached. To overcome this structural weakness, an angle strip or channel is secured to the skin by welding or other conventional mechanical fastening means.

### OBJECTS OF THE INVENTION

An object of the present invention is to provide for a  
5 means for mounting or jointing the two skins together to  
form a door edge in a single mechanical step. In  
particular, a slot-in-groove means is provided for jointing  
the two skins together to complete the door edge profile.

10 Another object of the invention is to provide for stiffening  
means which is integral with one of the skins to strengthen  
the door edge. In addition to the stiffening means, the  
edge profile of the invention also achieves the double  
layering of skins at the door edge to strengthen it.

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### SUMMARY OF THE INVENTION

The method of making the door edge profile of a metal sheet  
20 skin door according to the invention comprises, in  
principle, the steps of folding up a stiffening part in the  
form of a channel. In one embodiment, the channel may be a  
separate piece which may be fastened in parallel to the edge  
of a first metal sheet skin at one end of the channel's  
25 flanges with the channel orientated to open inwardly in  
parallel to the first skin.

Fastening may be achieved by conventional methods such as  
welding, riveting, nut-and-bolt, etc. The ends of the  
30 channel's proximal flange may, for example, be welded to the  
first skin, leaving a tight groove opened between the  
channel's proximal flange and the first skin.

The channel being fastened to the first skin are now an

integral piece, ready for the next step of the assembly to form the door profile.

5 The folded edge of the channel proximal to the first skin, i.e. the edge of the bottom and proximal flange, is usually rounded and is thus useful as an alignment guide for slotting the flange into the groove.

10 The next step is to fold a second metal sheet skin into a pan outlining the door edge, with a depth which may marginally accommodate the external depth of the channel, and ending with a free end flange.

15 The subsequent step is to push the second skin with the end flange towards the direction of the groove, which is formed between the channel and the first skin, and to slot it into the groove so that the second skin is securely held therein.

20 In one alternative embodiment, the reinforcing channel part is folded integrally from a metal sheet skin wherein the method of making the door edge profile comprising the steps of, firstly, folding a first metal sheet skin's edge to provide for a groove between the folded edge and said first sheet skin; secondly, folding the remaining edge to form a  
25 channel to reinforce said door edge; thirdly, folding a second metal sheet skin's edge to form (i) a pan skin outline of the door edge to fit over said channel; and (ii) an end flange oriented to fit into said first skin's groove; and then mounting said second skin pan over the reinforcing  
30 channel of said first skin by fitting second skin's end flange into the first skin's groove to completely form the door edge profile.

The reinforcing channel may preferably be formed with an abutment and the second skin pan is formed complementarily to fit over said abutment. The first skin edge may complementarily extend over and encloses the reinforcing  
5 channel.

The first skin edge may preferably further extend outwardly to form a flange fastenable onto said first skin. Preferably still, the first skin edge is hemmed inwardly  
10 along the channel. The second skin edge may also be preferably hemmed inwardly along the pan skin outline of the door edge profile.

Preferably, the respective bottom of the first skin's  
15 folding forming the groove and second skin's end flange are complementarily and intermittently provided with fastening means. Preferably still, the fastening means is any one or combination of key tab-in-hole and hook-in-hole.

20 There are many ways in which the groove may be created as will be described in the following embodiments. In particular, there are many other ways in which the first skin and the channel may be folded to provide for the groove into which the end flange of a second pan skin may be  
25 securely inserted.

#### BRIEF DESCRIPTION OF THE DRAWINGS

30 The aforesaid objects and advantages of the invention may be understood by referring to the following drawings, and its accompanying description of the representative or specific embodiments in which:

- FIGURE 1 (Prior Art) shows a schematic representation of a door wherein a line indicates the typical cross-section of the door edge being viewed in the subsequent cross-sectional drawings;
- 5 FIGURE 2 (Prior Art) is a cross-sectional view of a conventional connection of flush skin surface;
- FIGURE 3 (Prior Art) is a cross-sectional view of a conventional connection of overlapping of skins;
- 10 FIGURE 4 (Prior Art) is a cross-sectional view of a conventional protrusion-in-recess mounting of skins;
- FIGURE 5 (Prior Art) is a cross-sectional view of a conventional slot-in-groove mounting of skins;
- 15 FIGURES 6 show the basic embodiment of the present invention (wherein this and subsequent figures illustrate both the cross-sectional and perspective views of the embodiments);
- FIGURES 7 show one embodiment in which the first skin is hemmed;
- 20 FIGURES 8 show a second embodiment in which the first skin extends to partially cover the channel in parallel with the channel's proximal flange;
- FIGURES 9 show a third embodiment in which the first skin is folded to hem the channel's proximal flange;
- 25 FIGURES 10 show a fourth embodiment in which the first and second skins mutually hem around the end flanges of each other in a latch engagement;
- FIGURES 11 show a fifth embodiment in which the first skin folds back and extend to fully cover the channel;
- 30 and
- FIGURE 12 shows in schematic cross-sectional view two metal sheets skins which opposing edges have been folded according to the invention, arranged to mutually slot into each other to complete the

door in 2-dimensional view;

FIGURE 13 shows in cross-sectional view two metal sheet skins which have been folded on all four edges according to the invention, arranged to mutually and complementarily slot into each other to complete the door with all four edges;

FIGURES 14 show the basic profile of a two-piece skin wherein the channel is folded integrally from the first skin; FIG. 14A shows the perspective view, FIG. 14B shows the cross sectional view; FIG. 14C and FIG. 14D show variations of the edge profile;

FIGURE 15 shows one profile variation with abutment;

FIGURES 16 show another variation wherein the skin edge extends over and encloses the channel; FIG. 16A shows the cross sectional view and FIG. 16B shows the perspective view;

FIGURES 17 show another variation wherein the channel part is hemmed inwardly; FIG. 17A shows the cross sectional view and FIG. 17B shows the perspective view; and

FIGURES 18 show examples of snap-in fastening means for mounting the second pan skin onto the channel part of the first skin to form the door edge.

#### DETAILED DESCRIPTION OF EMBODIMENTS

Shown in FIGURES 6A & B is a basic embodiment of the door profile according to the present invention. The first component to be fabricated is envisaged to be the stiffener part. In this embodiment, the stiffener is provided as a channel (30) which may be formed, for example in Fig. 6A, by folding a metal sheet into a bottom (32) flanked by a pair of flanges (34, 36), wherein the diameter ( $d_1$ ) between the

opposing flanges (34, 36) fits the door edge's diameter ( $d_2$ ).

The next step is to secure the channel (30) to a first metal sheet skin (40) by fastening the channel's bottom (32) to be  
5 flushed with the edge (42) of the first metal sheet skin by, for example, fastening the end of one of said channel's opposing flange (34) which is adjacent to said first skin (40). An example of how the opposing flange (34) may be fastened to the first skin (40) is shown in Fig. 6A where  
10 the tip of the opposing flange (34) is welded (16) to the inner surface of the first skin (40). A groove (50) is thus provided between said first skin (40) and channel's proximal flange (34). It should be understood by one skilled in the art that other means of fastening is possible. Similarly,  
15 the other portion of the opposing flange (34) may be chosen to be the fastening surface with the first skin (40).

The subsequent step is to fold a second metal sheet skin (60) at one edge of the sheet to form a pan, in the shape of the  
20 door edge, with an end flange (62) wherein the internal diameter of the pan ( $d_2$ ) accommodates the channel's diameter ( $d_1$ ).

The door edge assembly may now be completed by mounting the  
25 second skin onto the first skin by pushing the second skin's end flange (62) to slot into the groove (50) that is formed between the first skin (40) and the channel (32).

The corner of the channel's folded edges is relatively round  
30 due to the folding of metal sheet. Due to materials properties, the higher is the sheet gauge, the rounder is the corner when the sheet is folded. The rounded corner assists in aligning and guiding the end flange (62) to be slotted into the groove (50) as it is pushed thereinto.

To provide for a rounding of the edge (42) of the first skin to achieve the same aligning and guiding effect as in the channel's corner, the first skin (40) may be hemmed inwardly. As shown in the next embodiment in FIGURE 7A, the hemmed flange (44) of the first skin (40) may be extended so that its edge is in parallel with, or marginally longer than, the channel's proximal flange (34). The edges of the hem and the proximal flange may be fastened together by, for example, welding (16) so that the channel and the first skin become an integral piece. With the rounding of both edges, the slotting in of the end flange (62) of the second skin becomes easy.

FIGURE 8A & B show another embodiment wherein the channel may be strengthened, that is, with reference to the preceding embodiment of Figs. 7A & B, by extending the hem (46) substantially in parallel with the proximal flange (38) to cover or enclose the channel (30) partially or wholly. The ends of the hem (44) and proximal flange (34) may be secured together by welding or other conventional fastening means as shown in Fig. 8A.

Depending on the angle of approach of the welding means of the assembling machinery during production, it may be advantageous to have the proximal flange (38) extend marginally longer than the extended hem (46) so that the end of the extended hem (46) may be welded onto the marginally extended edge of the proximal flange (38).

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In another embodiment, as shown in FIGURES 9A & B, the proximal flange (38) is not extended; instead the flange (44) of the first skin is now extended (47) to fold over to hem in the channel's proximal flange (38) and then fastened

onto the channel.

In yet another embodiment, as shown in FIGURES 10A & B, the hemmed flange (44) remains unextended; instead the proximal  
5 flange (34) is extended to fold over and hem in (39) the end of the first skin's flange (44); the ends of the proximal flange (39) and the first skin's flange (44) are thus engaged in a mutually hemming latch.

10 Still another embodiment, as shown in FIGURES 11A & B, the end flange (44) of the first skin may be extended to substantially or wholly cover the channel (30) and further extend thereinto (48) along the channel's distal flange (36). This profile completes a rectangular frame cross  
15 section and therefore provides a stronger channel as a stiffener.

To fasten the channel to the first skin, preferably the distal flange (36) is extended so that a marginal end  
20 remains after the first skin's end (48) folds in along the distal flange (36). Welding may then be carried out on the inside of the distal flange (36)'s marginal end to fasten it to the first skin end (48) so that the welded spots are shielded from brushing onto the second skin (60) during the  
25 final slotting-in step.

Each of the above embodiments may be adapted to be folded on a metal sheet so that the channel-stiffened edges are provided on one end and pan-folded edge on the other end.  
30 Two of such folded sheets may be placed atop and opposing each other as shown in FIGURE 12 with the respective edges pushed to have the pan folded flanges slot into the other's groove.

In a more preferred embodiment, the reinforcing or stiffening channel may be formed integrally with the metal skin by folding accordingly as will be described in the following.

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FIGURES 14 show the basic profile of a two-piece skin wherein the stiffening or reinforcing channel (70) may be folded integrally from the first skin (80). The channel (70) may be formed integrally from the first skin (80) by  
10 folding the sheet as shown to firstly form a groove (82) before folding to form the channel (70).

The second skin (90) may be folded as in the preceding embodiments so that a pan outline (94) of the door edge may  
15 be formed to accommodate or mount onto the channel (70). A flange (92) may be provided for insertion into the groove (82) of the first skin as shown in relative arrangement in perspective view in FIG. 14A and in cross sectional view in FIG. 14B.

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The first skin (80) may, firstly, be folded at one edge to provide for a groove (82) between the folded edge (84) and said first sheet skin (80). Secondly, the remaining edge is folded to form a channel (70) to reinforce or stiffen the  
25 door edge. Then, a second metal sheet skin's (90) edge is folded to form a pan skin outline (94) of the door edge. The outline (94) is marginally wider than the channel (70) may be fitted or mounted over said channel (70). The remaining end of the second skin may then be formed into an  
30 end flange (92) oriented to fit into said first skin's groove (82).

Subsequently, the second skin pan (90) may be mounted over the reinforcing channel (70) of said first skin (80) by

fitting the second skin's end flange (92) into the first skin's groove (82) to completely form the door edge profile.

It will be appreciated by a skilled person that the door edge may be folded to different profiles according to aesthetic and/or functional considerations. FIG. 4C shows one example of the profile wherein the door edge's corners are tapered (96, 98) or appear in a partial octagonal shape. FIG. 14D show an example of the edge profile being convex or rounded. In yet another variation of the door edge profile, FIGURE 15 shows an edge wherein an abutment (86) is provided. In this profile, the reinforcing channel may preferably be formed with an abutment (86). The second skin pan (90) may then be formed complementarily to fit over said abutment (86).

A door edge provided with an abutment may, for example, complement a door frame's abutment and lined with intumescent strips for better sealing off of a fire compare to ordinary straight-cut door edge.

The manner in which the channel may be constructed may also have various configurations. FIGURES 16 show one variation in which the first skin's edge extends over and encloses the channel (70). FIG. 16A shows the cross sectional view and FIG. 16B shows the perspective view of this embodiment wherein an end flange (72) completing the enclosure is fastened to the inside surface of the first skin (80). It may be fastened by welding and/or providing punch-out tabs (74) for the edge to be inserted thereinto as shown.

FIGURES 17 show another variation of the channel configuration. FIG. 17A shows the cross sectional view and FIG. 17B shows the perspective view of the hemmed

embodiment. In this configuration, the end flange (76) of the first skin (80), having formed the channel (70), is now hemmed inwardly along the channel's insides. As a further alternative, the second skin's edge (99) may also be hemmed inwardly along the pan skin outlining the door edge. In this embodiment, the hemming in of the pan or second skin results in a rounded and stronger edge flange (92) for insertion into the groove (82) as the second skin (90) is mounted onto the first skin (80).

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There are many ways of fastening one edge of the skin onto the same skin or the other skin, depending on the embodiment. The flange (92) of the second skin is generally required to be inserted into the groove (82) of the first skin (80). In certain embodiments, for example - in FIGURES 16, end flange (72) is required to be fastened onto the same first skin (80).

One method of fastening without the use of welding is shown as an example in FIGURES 18 wherein snap-in fastening means (100) is employed for mounting the second pan skin (90) onto the channel part (70) of the first skin (80) to form the door edge. Preferably, the respective bottom of the first skin's (80) folding forming the groove (82) and second skin's end flange (92) are complementarily and intermittently provided with such fastening means (100). Preferably still, the fastening means (100) may comprise of any one or combination of key tab-in-hole (102, 104) and hook-in-hole (106, 104).

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The key tab (102) may be advantageously stamped out of the skin itself and provided bent so as to enable the snap-in action once the key tab is inserted into the hole so as to prevent the subsequent withdrawal of the flange (92).

Alternatively, a hook (106) with a head diameter, which is substantially equal to the hole's diameter, may be provided in lieu of the key tab. Once the hook's head is pushed through the hole, the hook will be engaged in the hole at the narrower neck portion of the hook thus preventing withdrawal of the hook and retaining the flange (92) within the groove (82).

The channel-stiffened edges may be provided on two adjoining edges of the same sheet, i.e. in an "L" shape, while the pan-folded edges are provided on the opposing two adjoining edges, i.e. in an inverted "L" shape. Gaps in the edges may be provided as shown in FIGURE 13 to enable two similarly folded sheet to be placed against each other in an inverted manner and slotted in, for example, firstly along the vertical edges of the door and then along the horizontal edges.

The variations of the folding forming the stiffening channel and the respective fastening means, and apparatuses which are specially modified or designed to achieve these steps will become apparent to a skilled person instructed with the teachings herein and which are to be considered to fall within the scope and spirit of the following claims.



### CLAIMS

1. A method of making a door edge profile of a metal sheet  
5 skin door comprising the steps of:
  - fastening a channel parallel to a first metal sheet skin's edge to provide for a groove between said channel and said first skin;
  - folding a second metal sheet skin to form a pan skin to  
10 fit over said channel, said pan skin ending with a flange; and
  - mounting the end flange of said pan skin into said groove thus forming the door edge profile.
- 15 2. A method of making a door edge profile of a metal sheet skin door comprising the steps of:
  - forming a channel having a bottom which is flanked by a pair of flanges, wherein the diameter between the flanges fits within the door edge;
  - 20 - securing the channel in parallel to a first metal sheet skin's edge by fastening the channel's flange proximal to said first skin so that a groove is provided between said first skin and said channel, and wherein said channel is orientated to open inwardly to the first skin;
  - 25 - folding a second metal sheet skin at one edge to form the door edge with an end flange, wherein the internal diameter of the door edge so formed fits over said channel; and
  - mounting said second skin over said channel and first  
30 skin by slotting said second skin's end flange into said groove.
3. A method according to any one of Claims 1 and 2 wherein the first skin is hemmed by folding inwardly in parallel



with the channel's proximal flange and the ends of said proximal flange and hem are fastened together.

4. A method according to any one of Claims 1 and 2 wherein
  - 5 - the opposing flange adjacent to the first skin is extended at least to partially cover the channel;
  - the first skin is hemmed by folding inwardly along said proximal flange and extend in parallel thereto to partially cover said channel; and
  - 10 - fastening the ends of both said flange and extended hem.
5. A method according to Claim 3 wherein the first skin further extends to fold over and hem in the end of said  
15 proximal flange.
6. A method according to Claim 3 wherein the flange further extends to fold over and hem in the end of the first skin edge so that said first skin and said proximal flange  
20 are engaged in mutual hemming latch.
7. A method according to any one of Claims 1 and 2 wherein the first skin further extends over the end of the proximal flange to cover the channel and folds in at the inside of  
25 the channel's distal flange.
8. A method of making a door edge profile of a metal sheet skin door comprising the steps of:
  - 30 - folding a first metal sheet skin's edge
    - to provide for a groove between the folded edge and said first sheet skin; and
    - folding the remaining edge to form a channel to reinforce said door edge;



- folding a second metal sheet skin's edge to form
    - a pan skin outline of the door edge to fit over said channel; and
    - an end flange oriented to fit into said first skin's groove; and
  - mounting said second skin pan over the reinforcing channel of said first skin by fitting second skin's end flange into the first skin's groove
- to completely form the door edge profile.
9. A method according to Claim 8 wherein the reinforcing channel is formed with an abutment and the second skin pan is formed complementarily to fit over said abutment.
10. A method according to Claim 8 wherein the first skin edge complementarily extends over and encloses the reinforcing channel.
11. A method according to Claim 10 wherein the first skin edge further extends outwardly to form a flange fastenable onto said first skin.
12. A method according to Claim 8 wherein the first skin edge is hemmed inwardly along the channel.
13. A method according to Claim 8 wherein the second skin edge is hemmed inwardly along the pan skin outline of the door edge profile.
14. A method according to any one of the preceding Claims wherein the respective bottom of the first skin's folding forming the groove and second skin's end flange are complementarily and intermittently provided with fastening means.



15. A method according to Claim 14 wherein the fastening means is any one or combination of key tab-in-hole and hook-in-hole.

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16. A method for making a metal sheet skin door comprising any one or combination of the preceding claims.

17. An apparatus for carrying out the method according to  
10 any one of the preceding claims.

18. A metal sheet skin door wherein the door edge is made in accordance with any of the preceding claims.