Non-conventional die for a thermal break profile

By **Sutanay Parida***

Thermal Break profile is a combination of two types of profile attached together by heat resistant (Polyamide) strips. Both the profiles are generally extruded from different dies and could be from different Presses. In most of the cases the production of both the profiles at same time with equal numbers, always remain a challenge to extruders. Similarly when these profiles are further process for Anodising or Powder coating, controlling of different baskets carrying different profiles not only make the whole process chain delayed but also create an unbalanced process load. But by studying every step and re-engineering the process flow, a die with two cavities and different profiles developed, ultimately resulted in an on-time delivery and cost effective production of the thermal break profiles.

Conventional Die Process

Case 1:

Let us take a case of crimping Profile 20501 (**Fig 1**) which is a combination of Profiles 15647 and 15648. The flow diagram in **Fig 2** shows the plan quantity of profiles with 100 pieces each. Profiles 15647 and 15648 had been extruded 105 pieces and 101 pieces respectively in different Presses at different times. Both the profiles are stacked in different baskets from different Presses, and then head to the surface treatment process. After completion of the surface treatment, all the baskets are arranged for a combination crimping. Two sets of Manpower are required for these two different profiles from different baskets. After crimping, all the profiles (20501) are arranged in a common basket for packing and dispatch.

Problems faced: Most of the big orders are not completed with equal quantity extrusion in different Presses. Hence,

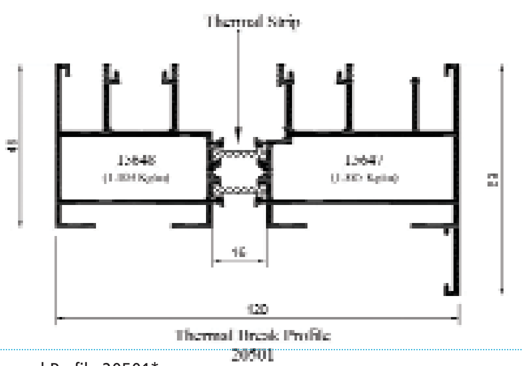


Fig 1. Thermal Profile 20501*

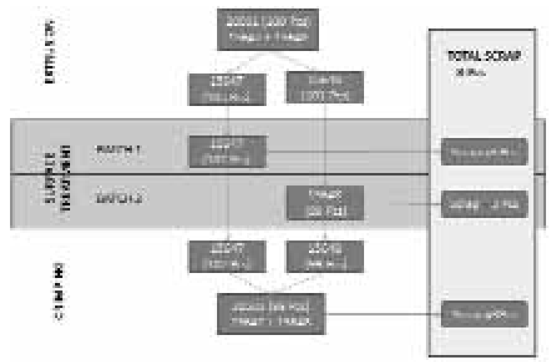


Fig 2. Conventional die Flow

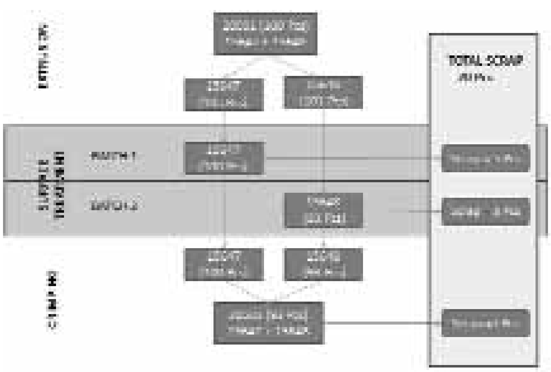


Fig 3. Completed Order Flow

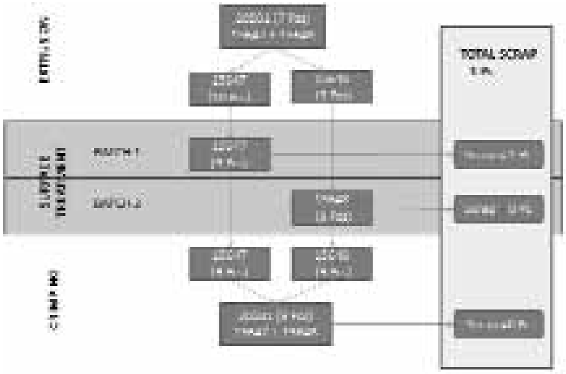


Fig 4. Re-Plan for Scrap Quantity

*This is a complete Thermal Break Profile assembly which consists of two different aluminium profiles 15647 & 15648. These profiles are joined together by means of polyamide strips. Polyamide strips act as a heat barrier which decreases the outside room temperature impact on that of inside room temperature. Fixing of these strips to the profiles done by means of a mechanical process called Crimping. The whole assembled profile is numbered as 20501.

*Gulf Extrusions Co.

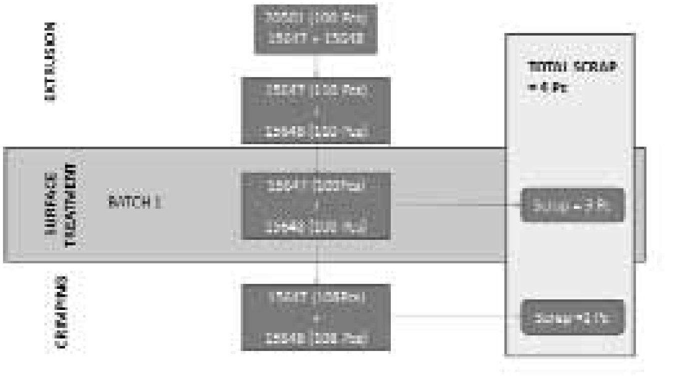


Fig 5. Die-20501 Crimping together

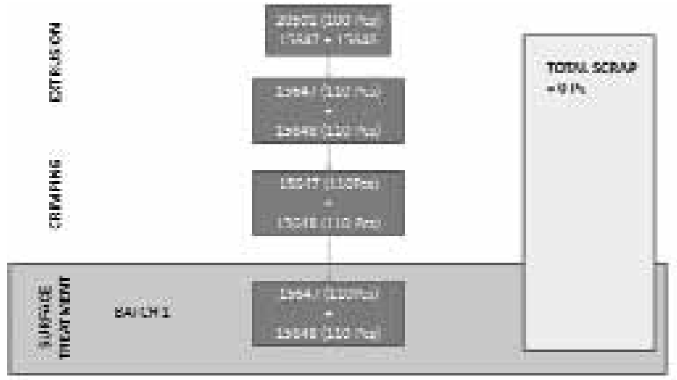


Fig 6. Die 20501 coating after Crimping

profiles get held-up on the floor and this disrupts the process flow/chain. Material handling, especially at the crimping area becomes cumbersome due to non-moving baskets or imbalanced material flow.

Result of Case 1:
Fig 2 shows the 99 good pieces could be ready at the final stage for delivery with a total scrap generation of eight pieces. With a tolerance of 5% on quantity this order could be considered as completed.

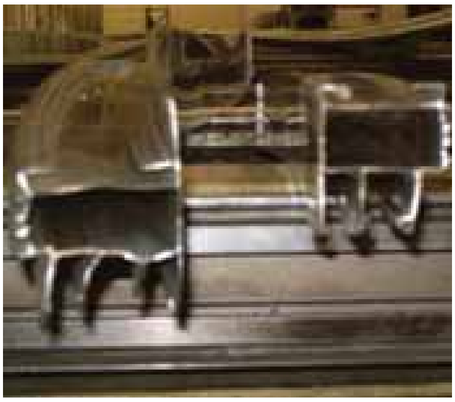
Case 2:
Fig 3 shows a scrap generation at surface treatment of 13 pieces against the extra extrusion of six pieces. This resulted in a further scrap generation of seven pieces at crimping. A total of 20 pieces scrap generated and 93 good pieces could be ready for dispatch. As the order quantity is of 100 pieces, this order is not complete and hence a balance of seven pieces to be again planned for extrusion.

Case 3:
Fig 4 shows the re-plan of balance quantity of seven pieces. A total of nine pieces could be made ready for delivery with an extra scrap generation of one piece. This is acceptable, smooth and the order is completed with little delay due to re-schedule process.

Conclusion of the above case study:
In the above process, the major point to consider is that due to unequal extrusion quantity at different extrusion time intervals, scrap was generated as excess material. A re-plan of this scrap quantity delays the order completion time period. Extra manpower is used to control the basket movement/management at crimping area (**Fig 5** & **Fig 6**).

Non-Conventional die for the same process: A new die designed to produce both the mating profiles from one Press at

Die 20501



Nose piece 20501

Right: Die 20223

Below left: Die 20234

Below right: Two Profiles

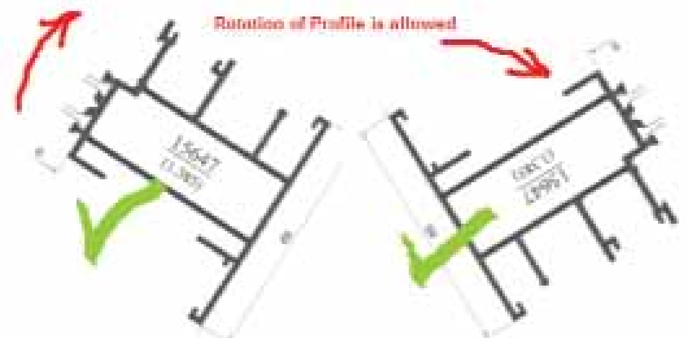


Fig 7. Correct Layout of Die Cavities

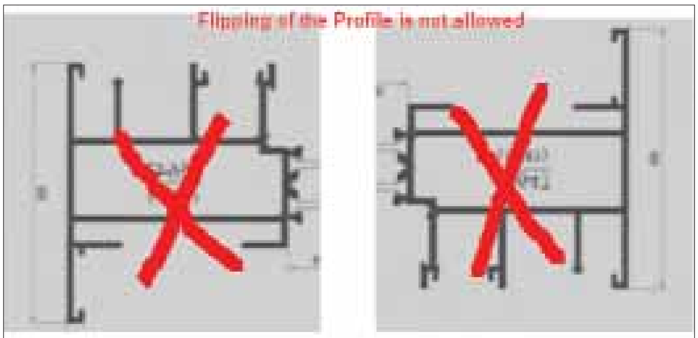


Fig 8. Incorrect layout of Die Cavities

Fig 9 (left and right) Thermal Profile 20234-combination of Profiles 15806 and 15452

the same time. After a few trials the die could be set to produce the material successfully. Production parameters are set by considering both the behaviour profiles. Profiles are stacked in pairs in one basket in the same order as extrusion. This basket will be jigged in pairs in the surface treatment process and ultimately a crimping pair profile will be ready without any waiting for mating profile.

Re-Engineering of the process: For jigging of the profiles in pairs, the surface treatment process was also modified. Even in a few cases, material was powder coating after completion of crimping in mill finish. This made the whole process faster and reduced the value added powder coating scraps.

Can all the thermal profiles be converted in to this non-conventional dies? The answer is 'No'. The selection of the thermal profile is most important. The governing factors are as follows:

1. Top running profiles
2. Geometry of the profiles to suit the Press CCD
3. Degree of similarity in combination Profiles (Dis-similar profiles in R & D)
4. Profile layout

1. Top Running Profiles are selected so the process parameters could be stabilised without affecting the plant production. Many activities required manual data control hence, top running profiles processing built up the confidence and minimise the human error.
2. Geometry of the profiles needs to be balanced with the Extrusion Ratio of the Press.
3. A similar profiles selection reduced the die design issues. But now a few dissimilar profiles are being successfully developed.
4. Profile layout was the most challenging point in the whole project. The layout of the profile must satisfy the required layout at crimping. This made the die designing more complicated and also the correction. But this eases the handling of the material at the crimping operation, which is the ultimate goal.

Fig 7 & **Fig 8** show how a profile can be rotated to any angle to suit the die design layout but cannot be flipped

Details of the die trials:
Flow balance of this unsymmetrical die was a real challenge to the die designer. Small detail-part has a tendency to pull back and at the same time the long leg has a tendency for waviness. As the metal flow volume in the ports was precisely calculated in the design stage, only by fine-tuning the die plate recess, the die could be easily set for the production. Total number of trials was Two. Comparing to die 20501, more challenging was 20234. In the die 20234, one cavity is too small compare to the other (**Fig 9**). Small cavity was initially slow as aimed in the design. By reducing the die plate recess of the cavity, the length difference could be corrected. The total number of trial was three.

Overall gain:
Most valuable gain in this project was the on-time completion of the order. The reliability of the process increased and substantial scrap generation reduced with an improved productivity.

Facts and figures:
Order completion time period (100 pieces) has reduced by 60%. Process scrap reduced by 78%. Most of the scraps were previously generated due to excess quantity at the final stage. The main cause was due to an unequal number of matching profiles. Productivity of the crimping machine has increased by 83%. Even with the profile having crimping in mill finish then surface treatment, productivity has increased by double and scrap generation reduced to zero. So far five types of dies are in process and three are running successfully.

Acknowledgement
All the dies are developed by M/s Extec, New Zealand. The company had understood the requirement of the process and accordingly the die was designed considering a perfect layout. M/s Alutool has also supplied a few dies to prove the stabilisation of Standard Operating Practice. Gulfex Sales department has proactively worked in developing the market in line with the process re-engineering. Now Gulfex IT team is working in developing software to meet the new process requirement. ■

Reference
Gulfex database ALEX.
Die suppliers M/s Extec and M/s Alutool records.