

# Practical application of STAF (Steel Tube Air Forming) process capable of high-strength continuous closed cross-section

**Noboru Itagaki**<sup>1)</sup> **Masayuki Ishizuka**<sup>1)</sup> **Kei Yamauchi**<sup>1)</sup> **Hiroyuki Kan**<sup>1)</sup> **Kimihiro Nogiwa**<sup>1)</sup>  
**Norieida Ueno**<sup>1)</sup>

*1) STAF project, Advanced Technology of Plasticity-SBU, Sumitomo Heavy Industries, Ltd., Sobiraki 5-2, Niihama, Ehime 792-8588, Japan, noboru.itagaki@shi-g.com*

**KEY WORDS: Production Manufacture, Forming process, Machining, Hot metal gas forming (D4)**

So far, we have proposed the STAF (Steel Tube Air Forming) process that can manufacture parts with a continuously closed cross-section structure, which are high strength and high rigidity with flanges for the purpose of reducing the weight of automobile frame parts. We have verified that the performance of parts manufactured with STAF show the better performance, compared with conventional parts and evaluated the benefits of reducing the number of parts with integrating surrounding parts into the STAF part. [1] In the STAF process, Mn-B steel tubes are rapidly heated in the STAF press die by resistance heating, then blow-formed by injecting the high pressure air to the tube inner and finally the cross-section is formed and die-quenched. Compared with ordinary heating in a furnace, the equipment space can be significantly reduced, and the STAF process has features that the flange can be formed to the part by controlling the press die position.

This paper describes about the STAF manufacturing equipment mainly required to have the above features, which are consists of (1) press machine, (2) resistance heating device, (3) high-pressure air compressor, (4) CMS (Compact Multi-function System) , (5) Double acting mold and (6) central control device. Where, CMS refers to an unit for clamping, heating and supplying or sealing high-pressure air to the tube in the press die. The manufactured parts with STAF process can be satisfied the aimed dimensional accuracy and performance. The details about required functions and specifications of 6 units and the evaluation results of the parts obtained by the STAF process are described in this work.

Figure 1 shows the equipment layout. Figure 2 shows the product manufactured by STAF molding. Table 1 shows the specifications of steel pipes that can be formed into automobile parts using the STAF system.

Parts of various shapes can be manufactured by STAF molding.

We can expect to manufacture bumper beams, A-pillars, battery frames, and door impact beams for automobile body parts. Mn-B steel is used for the pipe material, and the target strength after quenching is 1,500 MPa. The conventional hot press manufacturing method requires the installation of a large heating furnace, which requires a large installation area, but the STAF method uses a resistance heating device instead of the furnace heating, which saves space and is highly efficient.

Table 1: Formable product shape for automobile parts

Formable product shape	
Maximum tube diameter	φ120 mm
Minimum tube diameter	φ50 mm
Full length	1,600 - 1,850 mm
Thickness	1.0 - 2.3 mm
Material	Mn-B steel
Target strength	1,500 MPa

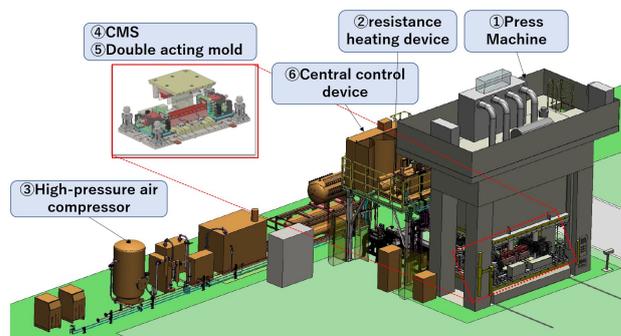


Fig.1 STAF Layout

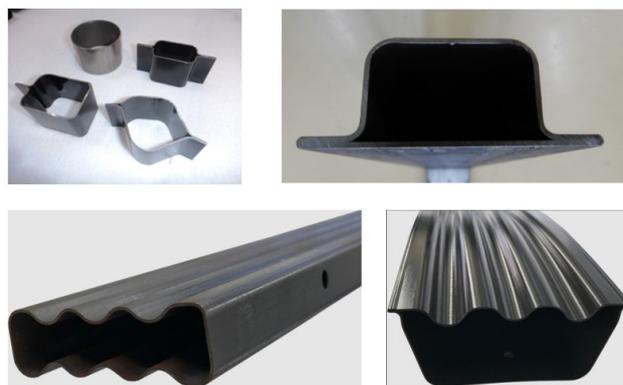


Fig.2 STAF Sample