High Strength Steel Sheets with Excellent Formability Series, JEFORMA™

1. Introduction

In order to improve automobile fuel consumption and safety, application of high strength steel sheets to automotive body structural parts has increased remarkably in recent years. As a top maker of automotive steel sheets, JFE Steel has continued to develop easy-to-use automotive high strength steel sheets over many years up to the present so as to respond to social needs.

Because high strength steel sheets generally have poor formability, such as elongation, stretch-flangeability, etc. in comparison with mild steel sheets, the applicable parts had been limited. Therefore, JFE Steel systematically developed high formability, high strength steel sheets with distinctive features in cold-rolled steel sheets and galvannealed steel sheets (GA) in order to supply the optimum steel sheets matching the forming elements demanded in parts, such as elongation, stretch-flangeability, etc., and commercialized those products in the JEFORMA™ Series.

2. Concept of JEFORMA™

2.1 Concept

To satisfy the needs of diverse parts in which high strength steel sheets are applied, JFE Steel’s JEFORMA Series of high strength steel sheets with excellent formability comprise three types, as shown in Fig. 1. These are a High El type (Type 1) with higher elongation than conventional high strength steel sheets, a High El and high λ type (Type 2) with high elongation and high stretch-flangeability and a Super high El type (Type 3) with even higher elongation. The line-up is based on a uniform concept in the strength grades 590, 780, 980 and 1 180 MPa class for both cold-rolled steel sheets and galvannealed steel sheets (GA). Needless to say, the material design of all of these steel sheets considers the weldability and delayed fracture resistance demanded in automotive body structural parts. In addition, JFE Steel can also supply a wide range of product sheet thickness variations to respond to the need for high strength thin-thickness parts for auto body weight reduction. The origin of the name JEFORMA is JFE Excellent FORMAbility.

2.2 Examples of Applicable Parts

Next, the superiority of JEFORMA in press-forming of an actual part model will be shown. Photo 1(a) is a model of a B-pillar. Because the bottom part is box-shaped, high stretchability is required in the steel sheet material. A crack occurred in the conventional 980 MPa class GA steel sheet shown in Photo 1(c), but in contrast, with the JEFORMA 980GA Type 1 (High El type) in Photo 1(b), satisfactory press-forming with no cracks was possible.

† Originally published in JFE GIHO No. 41 (Feb. 2018), p. 83–84
Photo 2 is an example of a part in which particularly high stretch-flangeability is required. The flange part of the B-pillar upper receives severe stretch-flange forming. With the conventional 590 MPa GA steel sheet shown in Photo 2(b), a stretch-flange crack occurred from the edge, but with the JEFORMA 590GA Type 2 (High El and high $\lambda$ type) shown in Photo 2(a), it can be understood that forming was possible without cracking.

Photo 3 is an example of an A-pillar lower, which has a deep drawing structure. A crack occurred in the vertical wall part of the conventional 1180 MPa class GA steel sheet in Photo 3(b), but satisfactory forming was possible with the JEFORMA 1180GA Type 3 (Super high El type) in Photo 3(a).

Thus, if the optimum steel sheet for the forming method and shape is selected from the JEFORMA Series, it is possible to apply a sheet of a strength level that had been difficult until now, and there is considered to be a possibility achieving a further weight reduction of the part.

3. Features of JEFORMAM™

Table 1 shows examples of the mechanical properties of the high formability, high strength cold-rolled sheet series and high formability galvannealed (GA) steel sheet series (typical values for sheet thickness of 1.4 mm). All three types of JEFORMA are available in strengths from 590 to 1180 MPa. Type 1 (High El type) is a so-called Dual Phase (DP) steel with a ferrite and martensite microstructure, and high elongation is achieved by optimization of the chemical composition and microstructure. In Type 2 (High El and high $\lambda$ type), a combination of not only high elongation but also high stretch-flangeability ($\lambda$) was provided by control of the difference in hardness between the component phases of the microstructure. Type 3 is a so-called TRIP steel that utilizes transformation induced plasticity by retained austenite.

In addition to the above-mentioned high formability JEFORMA Series for automotive body structural parts, JFE Steel also has a line-up of 1320 and 1470 MPa class cold-rolled and GA steel sheets as ultra-high strength steel sheets.
how. As a result, the company has completed a series of high strength steel sheets with excellent formability under the tradename JEFORMA.

JFE Steel not only develops and supplies outstanding steel sheets, but is also grappling with the development of original forming technologies and welding technologies for those products, and supplies the technologies together with steel sheets. By combining these material technologies and application technologies, we believe that we can contribute to more stable manufacture of automotive body structural parts.

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