1c - Common Steel Types and Evolving AHSS Types

Common Steel Types

These definitions are roughly listed by increasing tensile strength.

Interstitial free (IF) steels

Interstitial-free steels have ultra-low carbon levels and primary strengthening due to a combination of elements in solid solution, precipitation of carbides and/or nitrides, and grain refinement. In this steel category, one common element added to increase strength is phosphorous (a solid solution strengthener). This steel type is widely used for both structural and closure applications.

Mild Steels

Mild steels have an essentially ferritic microstructure. The main strengthening is due to a combination of elements in solid solution, precipitation of carbides and/or nitrides, and grain refinement. Drawing Quality (DQ) and Aluminium Killed (AKDQ) steels are examples and often serve as a reference base because of their widespread application and production volume.

Bake hardenable (BH) steels

BH steels have a basic ferritic microstructure and are strengthened primarily by solid solution strengthening. A unique feature of these steels is the chemistry and processing designed to keep carbon in solution during steelmaking and then allowing this carbon to come out of solution during paint baking. This increases the yield strength of the formed part.

Isotropic (IS) steels

Isotropic steels basically have ferritic type of microstructure. The key aspect of these steels is the delta r value equal to zero, resulting in minimized earing tendencies.

Carbon-manganese (CM) steels

High strength carbon-manganese steels are primarily strengthened by solid solution strengthening.

High-strength low-alloy (HSLA) steels

This group of steels are strengthened primarily by micro-alloying elements contributing to fine carbide precipitation and grain-size refining.

Dual phase (DP) steels

Dual phase steels consist of a ferritic matrix containing a hard martensitic second phase in the form of islands. These islands create a higher initial work hardening rate plus excellent elongation. This gives DP steels much higher ultimate tensile strengths than conventional steels of similar yield strength.

Transformation induced plasticity (TRIP) steels

The microstructure of TRIP steels is retained austenite embedded in a primary matrix of ferrite. In addition to a minimum of 5% by volume of retained austenite, hard phases such as martensite and bainite are present in varying amounts. The retained austenite progressively transforms to martensite with increasing strain, thereby increasing the work hardening rate at higher strain levels.

Complex phase (CP) steels

CP steels consist of a very fine microstructure of ferrite and a higher volume fraction of hard phases that are further strengthened by fine precipitates. Complex phase steels typify the transition to steel with very high ultimate tensile strengths.

Martensitic (Mart) steels

To create martensitic steels, the austenite that exists during hot-rolling or annealing is transformed almost entirely to martensite during quenching on the run-out table or in the cooling section of the continuous annealing line. This structure can also be developed with post-forming heat treatment. Martensitic steels provide the highest strengths, up to 1700 MPa ultimate tensile strength.

Evolving AHSS Types

In response to automotive demands for additional AHSS capabilities, steel industry research continues to develop new types of steel. These steels are designed to reduce density, improve strength, and/or increase elongation. Examples of these developing steels are TWIP (twinning induced plasticity) and steels with nano size particles for increasing strength and improving stretch flangeability.