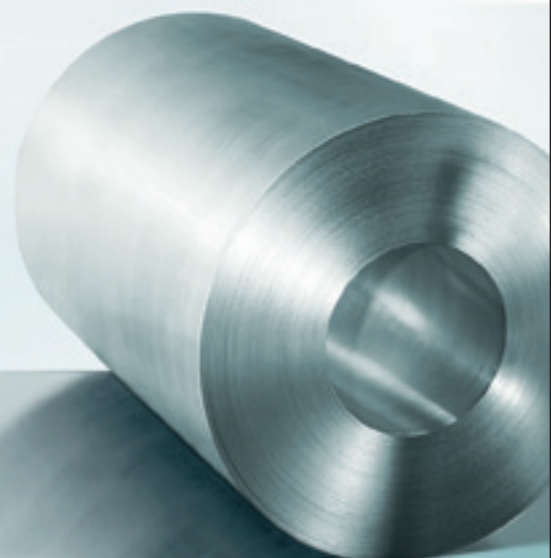


Let your
ideas
fly!



ahss classic
dual-phase steels

ahss classic
complex-phase steels

MATERIAL FACTS

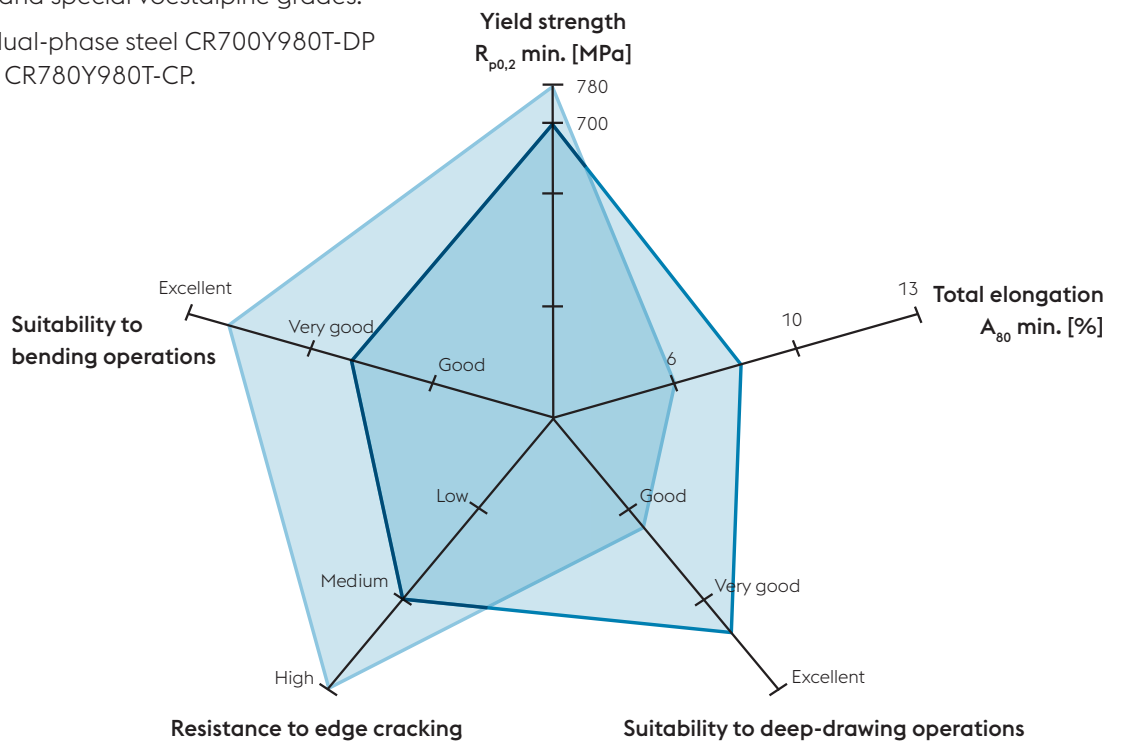
With decades of experience, voestalpine is a reliable partner in the development and manufacturing of advanced high-strength steels (ahss). The ahss classic family made by voestalpine includes dual-phase and complex-phase steels with clearly differentiated property profiles.

The following comparison illustrates which steel grades are recommended for which requirements and applications.

OVERVIEW OF CHARACTERISTICS

A wide range of strength classes are available in dual-phase and complex-phase steels based on EN 10346, EN 10338, VDA 239-100 and special voestalpine grades.

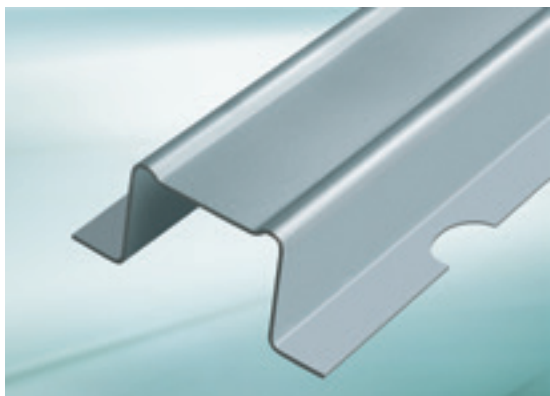
The following compares dual-phase steel CR700Y980T-DP and complex-phase steel CR780Y980T-CP.





DUAL-PHASE STEELS

- » The mechanical properties are characterized by low yield strength, high strain hardening capacity and tensile strength as well as high uniform and total elongation.
- » A balanced ratio between deep-drawing properties and stretch flanging capacity allows excellent cold formability.
- » The balance between the strength and forming properties in dual-phase steels makes them highly suitable for use in complex structural components.

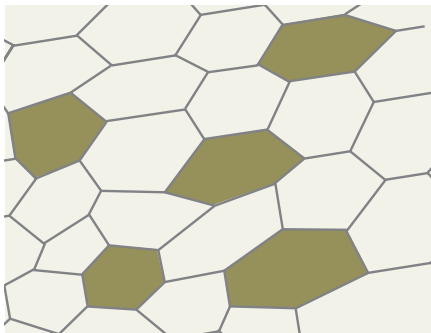


COMPLEX-PHASE STEELS

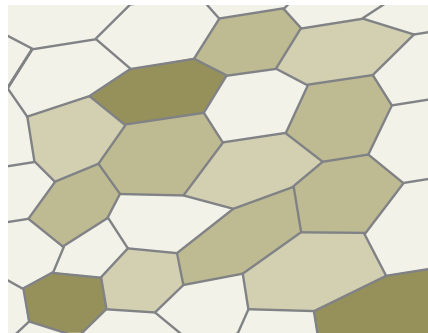
- » In comparison with dual-phase steels, these steels have the same tensile strength but a significantly higher yield strength and thus a higher yield ratio.
- » The forming properties of stamped edges are remarkable because of their high stretch flanging capacity.
- » Their excellent bendability predestines these steels to roll profiling, bending and edging.

DIFFERENT MICROSTRUCTURES – DIFFERENT PROPERTIES

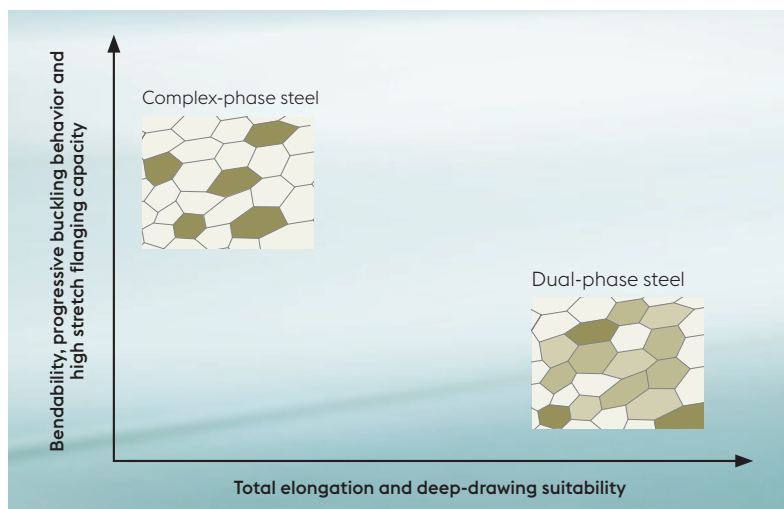
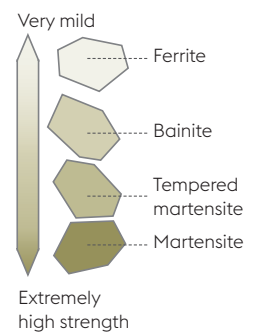
The mechanical and forming properties are determined by the microstructure.



The microstructure of **dual-phase steels** exhibits large differences in strength between the individual constituents in the microstructure.



The differences between the constituents in the microstructure in **complex-phase steels** are much smaller.



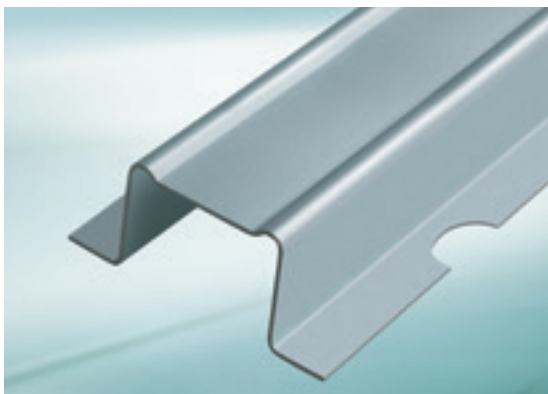
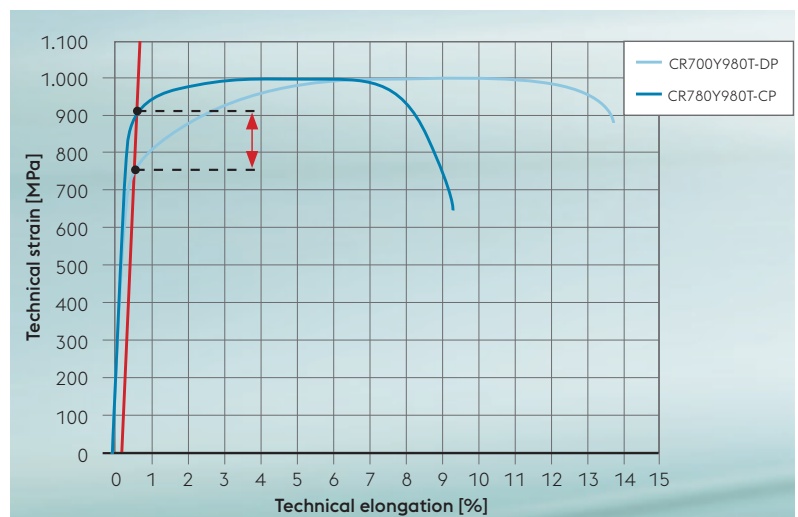
Microstructure influences the following properties:

- » Yield strength
- » Stretch flanging capacity
- » Total elongation
- » Bending behavior
- » Deep-drawing behavior
- » Buckling behavior

YIELD STRENGTH

The strength values of the tensile test results, the yield strength and the tensile strength are of substantial significance to component dimensioning.

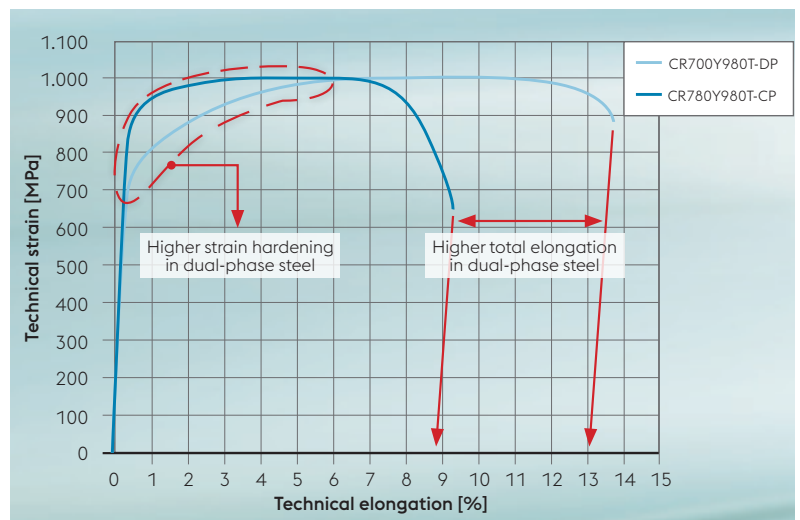
COMPLEX-PHASE STEEL: HIGHER YIELD STRENGTH AT THE SAME LEVEL OF TENSILE STRENGTH



In comparison with dual-phase steels, complex-phase steels have the same tensile strength but a significantly higher yield strength and thus a higher yield ratio. This has the advantage that components made of complex-phase steels have a high yield strength, even in non-formed areas.

TOTAL ELONGATION AND DEEP-DRAWING SUITABILITY

Tensile test results provide information on the strength values as well as the formability of the material. The pertinent standards for dual-phase steels specify both the total elongation and the strain hardening capacity of a material during forming.



DUAL-PHASE STEEL: BETTER DEEP-DRAWING PROPERTIES AT THE SAME LEVEL OF STRENGTH

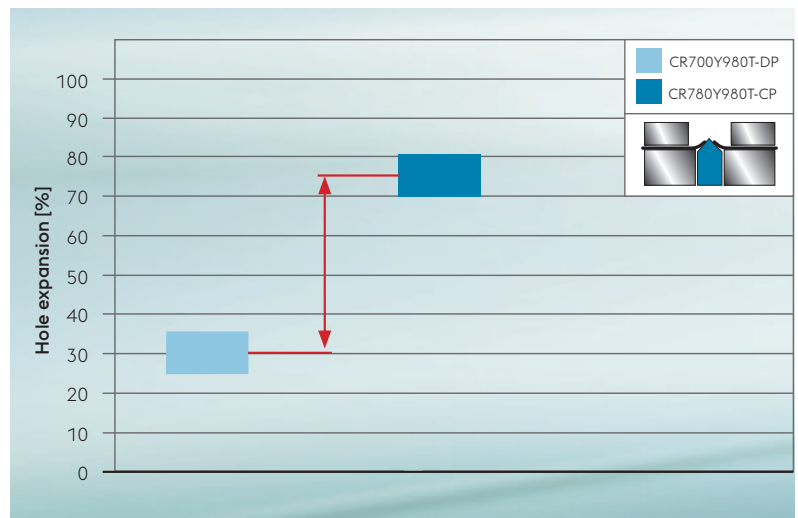


As a result of the large differences in strength between the individual constituents of the microstructure, dual-phase steels feature high strain-hardening capacity and thus high resistance to local necking. They also feature high tensile strength as well as high uniform and total elongation, and they exhibit excellent deep-drawing properties.

STRETCH FLANGING CAPACITY

The formability of stamped edges depends on several factors, an important one of which is the quality of the edge condition after stamping. The differing microstructures of dual-phase and complex-phase steels also have a considerable impact on stretch flanging capacity. The hole expansion test is used to assess the degree of stretch flanging capacity.

**COMPLEX-PHASE STEEL:
HIGH STRETCH FLANGING
CAPACITY**



Hole expansion test pursuant to ISO 16630, typical values

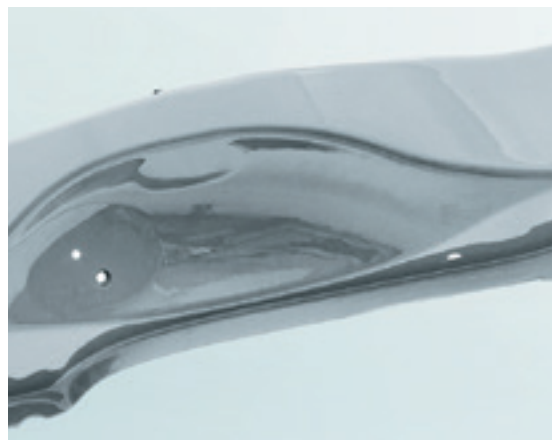
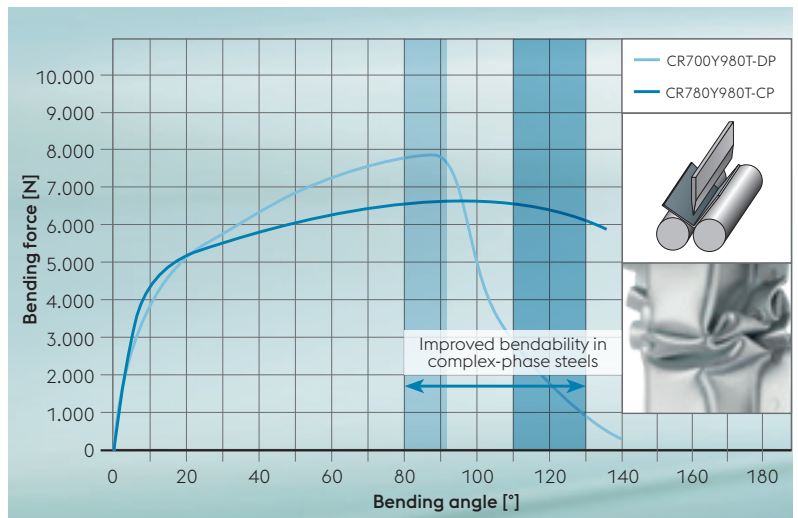


Localized high strain occurs as a result of large differences in strength between the individual microstructural constituents when the stamped edges of dual-phase steels are formed. This localized deformation can lead to damage. The homogeneous distribution of strength in the microstructure of complex-phase steels, however, leads to a uniform distribution of strain. This is the reason that complex-phase steels have a higher stretch flanging capacity and higher hole expansion capacity.

BENDING AND PROGRESSIVE BUCKLING BEHAVIOR

Bending, edging and roll-profiling are common techniques used in the manufacture of crash components and lead to high levels of strain. The bending angle and bending radius are important indicators for material selection. On the other hand, differences in the bendability of complex-phase and dual-phase steels are natural results of the different microstructures.

COMPLEX-PHASE STEEL: GOOD BENDING AND PROGRESSIVE BUCKLING BEHAVIOR



At the same level of tensile strength, complex-phase steels demonstrate better bending and progressive buckling properties than dual-phase steels. This behavior is made clear by the force-displacement curve in the bending test performed pursuant to VDA 238-100. Dual-phase steels do not demonstrate any substantial cracking until a certain bending angle is reached, typically in the range of 80°, followed by rapid failure. In contrast, complex-phase steels demonstrate slight cracking after maximum force is reached at bending angles of 110–130°. When bent further, these steels provide strong resistance to crack growth. For this reason, complex-phase steels are recommended for structural components with narrow bending radii. Their performance in bending also ensures structural integrity in crash events associated with progressive buckling.



Please find further information at:
www.voestalpine.at/ultralights

voestalpine

ONE STEP AHEAD.