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Designing quench and partitioning steels

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Keynote: Industry in general, and the automotive industry in particular, continues to demand steels with improved mechanical properties, to reduce the weight of components, both parts and body-in-white, to lighten the weight of the vehicle, and consequently reduce fuel consumption and CO2 emissions. This has led to the development of the so-called advanced high strength steels (AHSS). Among them, one of the last generation steels are the so-called quenching and partitioning (QP) steels. These steels possess high mechanical properties of strength together with appreciable ductility, which gives them adequate toughness for most automotive applications. These steels make extensive use of the so-called transformed induced plasticity (TRIP) effect whereby the steel has retained austenite at room temperature at the cost of a relatively low alloy grade. In the design of these steels, an interrupted quenching treatment must be carried out together with a subsequent partitioning, somewhat similar to quenching and tempering (QT) steels, but with substantial microstructural variations. The present work offers a methodological guide to design these steels, in order to optimize the chemical composition to achieve an adequate balance between strength and ductility while maintaining high levels of mechanical strength.