

## High-Performance Steel Grades for Special Applications in Ships and Offshore Constructions

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### ABSTRACT

In ships and offshore constructions large amounts of different steel grades are used. Modern steel production techniques make high-performance steel grades available that perfectly fit to the needs of applications in ships and offshore constructions and their demands on the material.

The article gives an overview over two different kinds of these tailor-made steel grades: nickel steels for gas transportation with ships and high-strength steels for the use in ships and offshore wind energy plants. The suitable steel grades used for these applications are described regarding their properties, processing behaviour and production.

### KEY WORDS

High-strength Structural Steels; Heavy Plates; Nickel Steels; LNG Storage; Offshore Constructions; Material Properties.

### INTRODUCTION

Special applications in the manufacturing of ships and offshore constructions require materials which fulfil special demands. Modern steel production techniques make steel grades available that perfectly fit to these demands regarding their mechanical and functional properties. Modern high-performance steel grades are produced by a specific cycle of deformation and heat treatment processes combined with highly sophisticated metallurgical techniques. Production, processing behaviour, properties and fields of application for modern high-performance steel grades are shown exemplarily for nickel steels for low temperature applications and high-strength steels for offshore constructions.

High-strength special structural steel grades are increasingly used in the construction of ships and offshore wind energy plants. The steel grades with higher yield strengths offer further possibilities for the designing engineers in the construction of wind energy plants and enable construction engineers to realise light weight constructions in ships (Kern, Lücke, Niessen, Schriever, 2005; Kern, Niessen, Schriever, Tschersich, 2004). The decrease of energy consumption of ships caused

by a lower dead weight leads to an improvement regarding economical and ecological aspects at a constant performance level.

Nickel steels are mainly used for transportation of liquefied natural gas (LNG) and liquefied ethylene gas (LEG) by ships, on which the gas is stored in tanks. By liquefaction the volume of the gas can be reduced by a factor of up to 600 which obviously simplifies storage and transportation and means significant cost reduction. Due to physical reasons temperatures for liquefying are approx. -162 °C for LNG and approx. -104 °C for LEG. The construction of vessels for liquefied gas transportation leads to a demand for steels with specified low temperature properties. The steels need to remain ductile and crack resistant with a high level of safety even at the mentioned low temperatures. They must also have high strength in order to allow reduction of wall thickness of tanks which permits economic favourably construction. Beyond that, welding without any risk of brittle fracture is of importance.

### PRODUCTION AND PROCESSING OF MODERN HIGH-PERFORMANCE STEEL GRADES

The development of high-strength structural steels, which began at ThyssenKrupp Steel already approximately 40 years ago, is shown in Fig. 1.

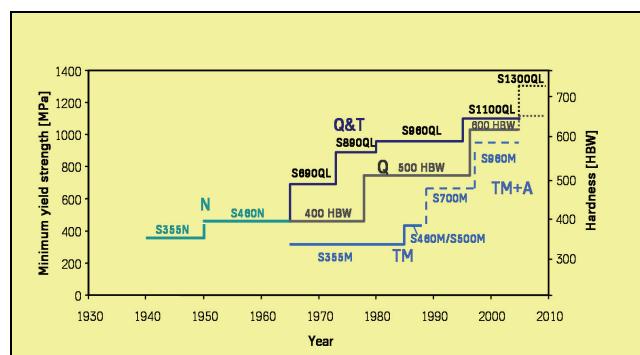


Fig. 1: Development of high-strength steel grades