# Laser-Multi-Pass-Narrow-Gap welding – a new technology for joining thick walled components of power stations

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**Abstract**

In the immediate future thermal power stations will safeguard the basic global energy supply. To achieve the international climate protection goals in combination with renewable energy sources and conventional power stations, these thermal power stations have to operate highly efficiently. One suitable technical solution is to increase the turbine inlet temperatures of thermal power stations to up to 700°C which leads to a thermal efficiency of up to 50 %.

This solution involves the usage of newly developed nickel-based superalloys such as Alloy 617 occ because only these materials can fullfill the requirements with regard to creep, fatigue and corrosion resistance [2]. Due to their difficult machinability, poor forgeability and high material costs compared to previously used steel, an effective welding technology is required to overcome the disadvantages of conventional welding technologies such as low welding velocity, large quantitites of expensive filler wire, high energy input per unit length, high weld distortion and a large heat-affected zone (HAZ) resulting in damaged microstructure.

To overcome these limitations the research scientists of Fraunhofer Institute of Material Beam Technology have developed the Laser-Multi-Pass-Narrow-Gap welding technology (Laser-MPNG) [1]. The usage of the Laser-MPNG welding technology produces crack-free weld seams in Alloy 617occ with wall thickness of up to 72 mm in tubes with an outer diameter of 350 mm. The HAZ width is very small with a thickness of less than 1 mm and shows no loss of elements, e.g. Al or Ti, which would lead to a reduced creep resistance. In comparison to the state-of-the-art TIG-Narrow-Gap welding, the development shows that the filler wire required could be reduced up to 70 %, the used energy per unit length is minimized to 4,2 kJ/cm and welding velocity is highly increased. The welding technology, the developed welding equipment and possible fields of application will be presented. In addition, first results with regard to fatigue and creep properties of the base material in comparison to weld seams will be shown.

**Literature**

[1] Göbel, G. et all: „New Application possibilities for fiber laser welding“, Proc. of 26th ICALEO, 2007, USA
[2] Knezevic, V. et all: Creep Behaviour of Thick-Wall Alloy 617 Seamless Pipes for 700°C Power Plant Technology, In: Procedia Engineering (2013) Nr. 55, p. 240-245