

# KAWASAKI STEEL TECHNICAL REPORT

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Development of the Narrow Gap Submerged Arc Welding Process - NSA Process

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## Synopsis :

With main emphasis on improving slag detachability and preventing weld defects in a narrow gap groove, study was made on the submerged arc welding of heavy steel plate, leading to the development of the NSA process that uses an MgO-BaO-SiO<sub>2</sub> type high-basicity agglomerated flux, KB-120. With thermal contraction behavior of slag found to be the most important factor that determines slag detachability, the maximum contraction was obtained by suppressing transformation expansion occurring around 700 during cooling. It was found that KB-120 can also produce weld metal of low level hydrogen and oxygen. High reliability and productivity of this process has been confirmed by its wide application to the fabrication of pressure vessels, offshore

## Welding Process—NSA Process\*

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a narrow gap SAW process, called the NSA process

maximum thickness of 150 to 200 mm. If the plate

a high-basicity agglomerated flux KB120.

## 2 Outline of NSA Process

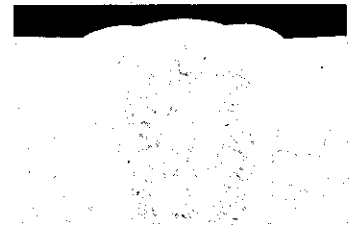
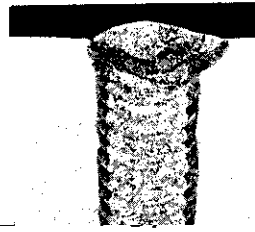
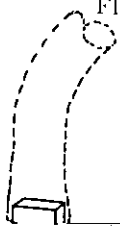
In using the narrow gap SAW process, it is necessary

of 30° to 40° is allowed in the V-shaped groove by employing gas cutting, which is a feature not realized in the narrow gap GMAW process.

**Table 2** is a summary of welding materials for various steels. KB120 is a neutral type flux, and alloy

Welding  
wire

Flux





Silica tube

Furnace

Silica tube

period, and only the changes in length of specimens during heating were measured. The thermal contraction behaviors of slag under the softening temperature

treatment is applied by achieving high resistance to moisture adsorption, the level of hydrogen will be further lowered to that of KR80C which has been

becomes easier than in the case of the U-shaped groove. Table 7 shows the relation of the groove angle to slag detachability and hot cracking tendency.

used without any cracking problems for ASTM A514 steel structures.

pass of a V-shaped groove joint. The effects of arc voltage on slag detachability and undercut generation





600 A, 15 cm/min, Root gap : 12 mm			
25 V	28 V	30 V	32 V

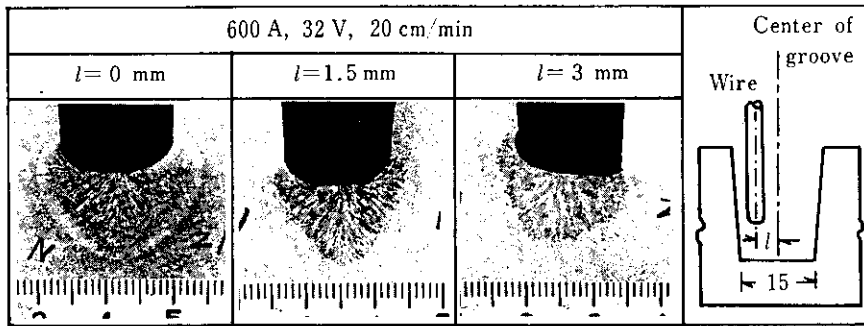
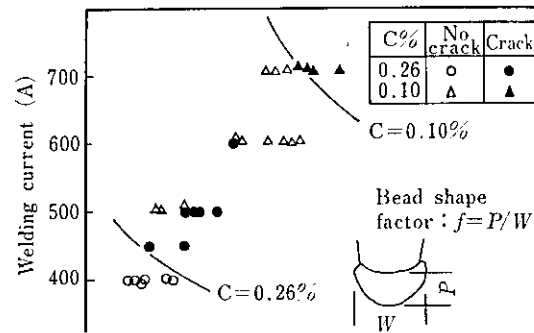


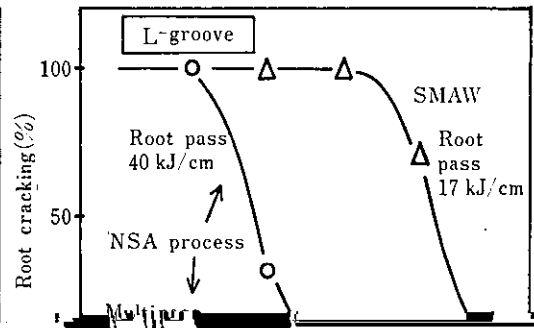
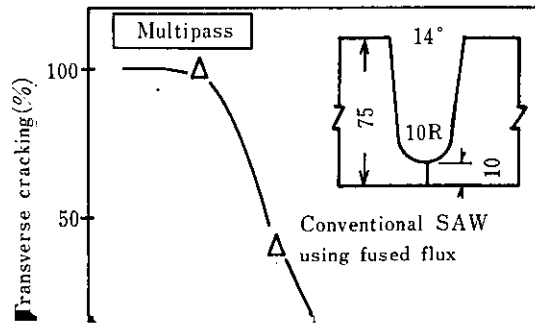
Photo. 4 Tolerance of wire working position in narrow groove

gap GMAW process, the NSA process ensures stabilized welding.

#### 4.4 Measures for Preventing Hot Cracks

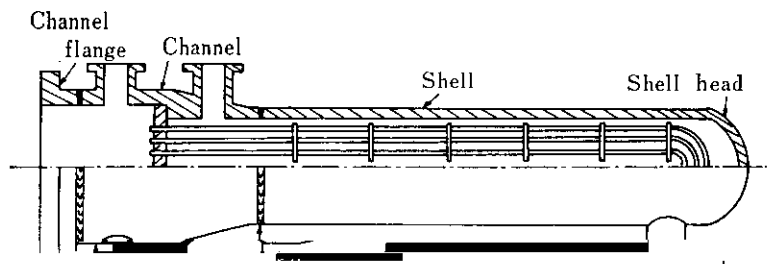
Since "pear-seed" shaped beads are liable to generate in the narrow gap welding, consideration should be given to prevention of hot cracks. Fig. 8 shows a summarized relation between the bead shape factor and the hot cracking tendency, when the welding conditions and root gap are changed. The C content of steel has a great effect on the generation of hot cracks

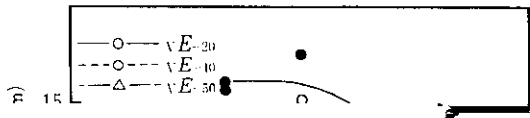




levels of oxygen, nitrogen and grain boundary embrittl-

and one-half, respectively, of the latter. No defects





cooling period is the governing factor of slag detach-ability, the authors have solved one of the greatest problems in the narrow gap submerged arc welding.