



MEMORANDUM

## for LNG Facilities\*



Kiyohiko Nohara  
Dr. Engi., Senior



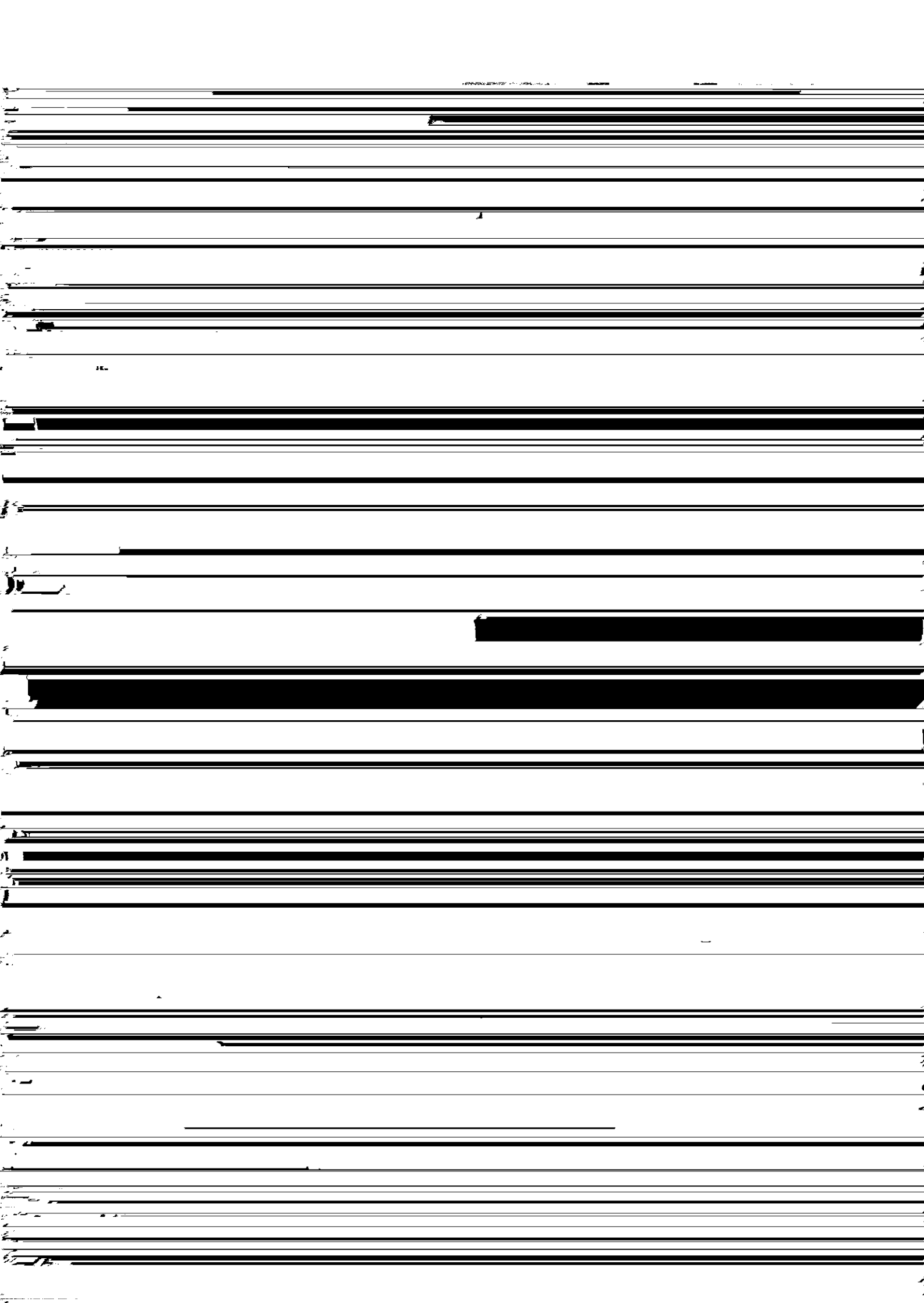
Akio Ejima  
Assistant Director,

### *Synopsis:*

*Since Fe-36%Ni steel (Invar type alloy) exhibits low thermal expansivity, it has been used as the membrane material for LNG facilities. However, there is a drawback of so high susceptibility to hot cracking during welding due to its complete austenitic structure. As a result of study on the influence of chemical compositions of various elements and some conditions in manufacturing processes, it is made clear that both lowering of impurity elements and*

**Table 1** Chemical composition range of specimens (wt%)

Basic elements					Impurity elements				Additional elements			
C	Si	Mn	Ni	Al	P	S	O	N	Ta	Ti, Nb, V, Zr	Cr	Co
0.017	0.16	0.31	34.97	0.001	0.0005	0.0004	0.0012	0.0007	0.001	0.05	0.1	0.1

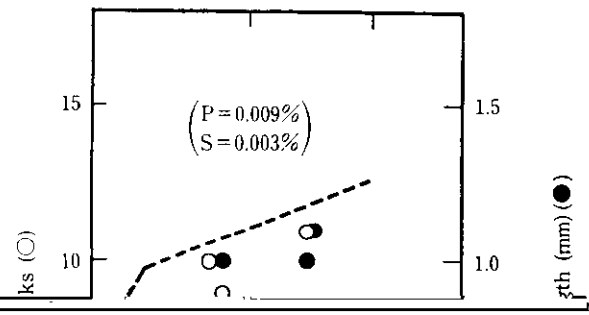
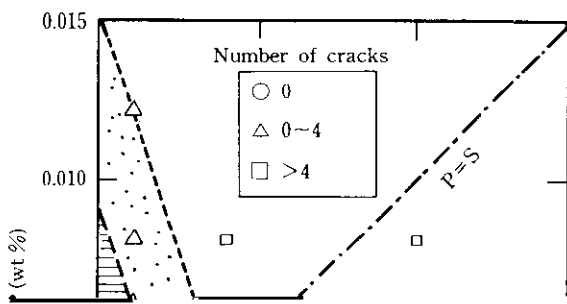


the vicinity of the fusion boundary.

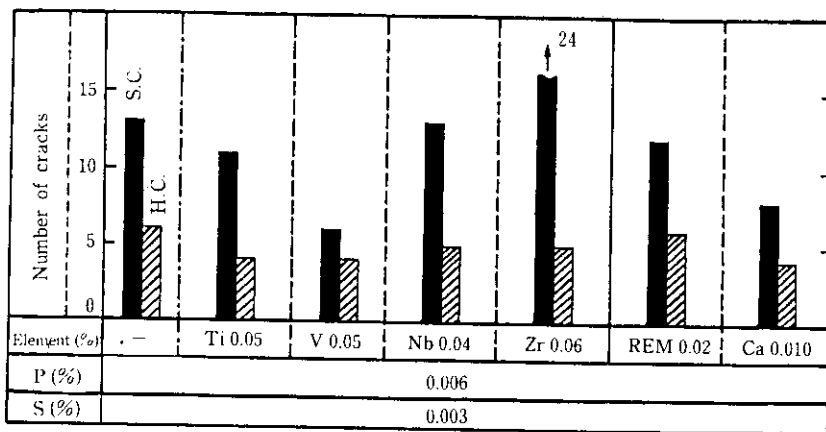
20



3.1.2 Effects of impurity elements basic connec





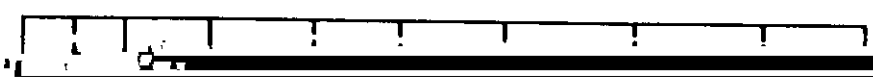


S.C. : Solidification crack on the 2nd bead

H.C.: Reheating crack on the 1st bead

O = 0.0022%

N = 0.0018%





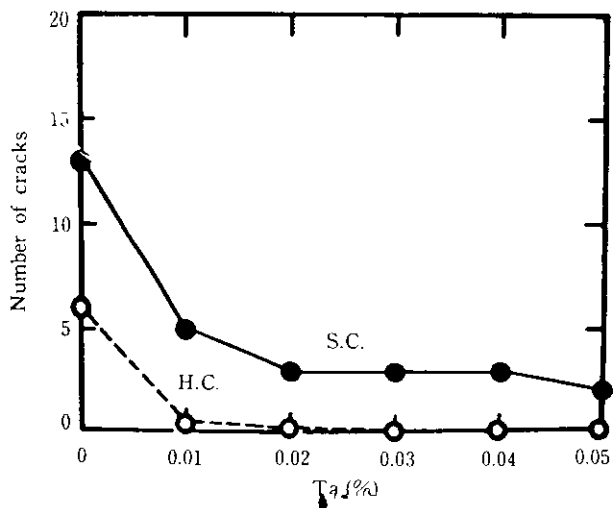


Fig. 9 Relation between number of hot cracks in

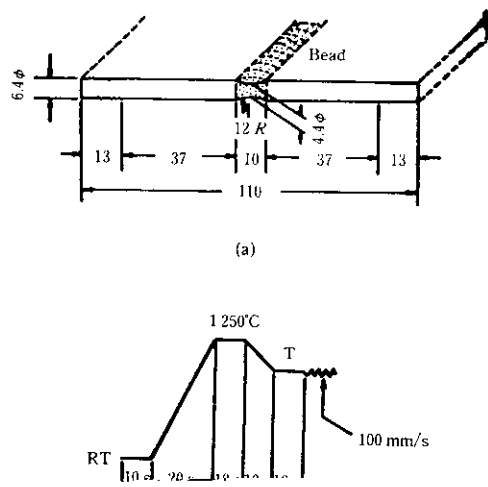
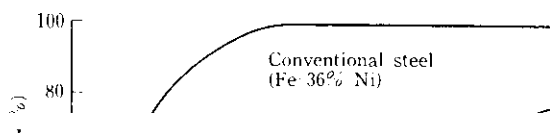


Fig. 10 Shape and size of welded specimen (a) and

tional elements and possessing poor weld cracking resistance, and of the Zr-added specimen decreased within the temperature ranges of 900 to 1100°C, thereby indicating deterioration in high temperature ductility. De-



	C	Si	Mn	P	S	Ni	N	O	Al	
--	---	----	----	---	---	----	---	---	----	--



products were used to construct a model G/T-time

31 H. Matsuda, H. Nakagawa, S. Minahira, N. Sakahara, A.