



[1]. LBB (leak-before-break, )  
 , Type 347 가 가  
 J-R 가  
 가  
 Type 347 -  
 ferrite Cr [2, 3].  
 -ferrite Type 347  
 가 [4 - 6]. 가 가  
 J-R 가 [7].  
 -ferrite J-R

## 2.

(1) 가 GTAW (gas tungsten arc welding) heat Type 347  
 1  
 J-R 316 (elastic unloading compliance method)  
 1 C(T)

(2) (6V, 20s)  
 1000  
 SEM-EDS (energy dispersive spectroscopy)  
 SEM(JEOL 6300, 20kV)-EDX(Oxford)  
 -ferrite Magne-gage (Ferit- scope, Fisher)

(3) ,  
 ASTM E963-95 ,  
 90% methanol-10% HCl ,  
 0.6 A 6~12 ,

### 3.

1 316°C J-R  
 1 가 , SJ SJF 1 dJ/da 175.5  
 223.2 MJ/m<sup>3</sup>  
 Type 347 Nb C 10 가 Cr , Nb  
 J-R ,  
 가 J-R 0.50 wt%  
 Type 347 가 2 ,  
 -ferrite가 , -ferrite  
 가 가  
 -ferrite ,  
 2 DeLong Cr Ni -  
 ferrite 2 Cr<sub>eq</sub> 가 -ferrite  
 3 J-R SJ , SJF  
 SJF SJF  
 가 SJF  
 -ferrite , b  
 5 a SJF 4  
 -ferrite ,  
 SJ SJF , c SJ  
 SJ SJF , SJF  
 -ferrite가 가 acicular lath  
 -ferrite 가 vermicular acicular lath  
 -ferrite 가 vermicular 가  
 vermicular, 10<sup>2</sup> K/s vermicular + lath 가 0.1~10 K/s  
 가 -ferrite 가 J-R

4.

가 Type 347 J-R  
 acicular lath -ferrite가  
 vermicular -ferrite가

1. USNRC, USNRC Report NUREG-800, Standard Review Plan. 3.6.3 (1987).
2. W.T. DeLong, The Welding Journal, July (1974), p. 273s-286s.
3. H. Muesch, Nuclear Engineering and Design, Vol. 85 (1985), p. 155-161.
4. P. Balladon and J. Heritier, ASTM STP 905 (ASTM, USA 1986), p. 661-682.
5. D. Hauser and J.A. Vanecho, The Welding Journal, Feb. (1982), p. 37s-44s.
6. P. Bilmes et al., Revista de Soldadura, Vol. 26, No. 1 (1996), p. 16-30.
7. J. H. Yoon et al., Proceeding of KNSS Fall meeting, Oct. 2002.
8. J. S. Bae et al., J. of Korean Inst. of Met. & Mater., Vol. 36, No. 3 (1998), p. 402-409.

Table 1. The chemical compositions of Type 347 weld metals.

Element Mat.	Fe	Cr	Ni	Mn	Si	Nb	Cu	Mo	C	P	S	N
SJ	Bal.	18.98	10.07	2.28	0.34	0.82	0.25	0.26	0.030	0.020	0.001	0.037
SJF	Bal.	18.99	9.79	2.23	0.36	0.85	0.25	0.25	0.031	0.025	0.001	0.039

Table 2. The  $\delta$ -ferrite contents in Type 347 weld metals.

Heat	$Cr_{eq}/Ni_{eq}$ *	-ferrite **
SJ	1.56	11.29
SJF	1.56	10.11

\*DeLong's equation :  $Cr_{eq} = \%Cr + \%Mo + 1.5 \times \%Si + 0.5 \times \%Nb$

$Ni_{eq} = \%Ni + 30 \times \%C + 30 \times \%N + 0.5 \times \%Mn$

\*\* Magnetic measurement (ferrite-gage)

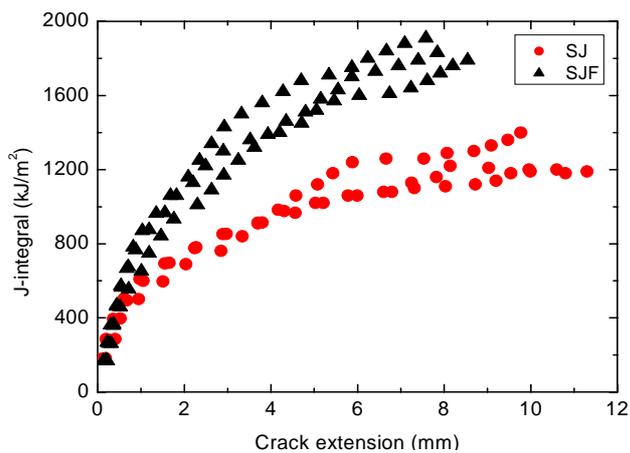


Fig. 1. J-R curves of Type 347 stainless steels welds.

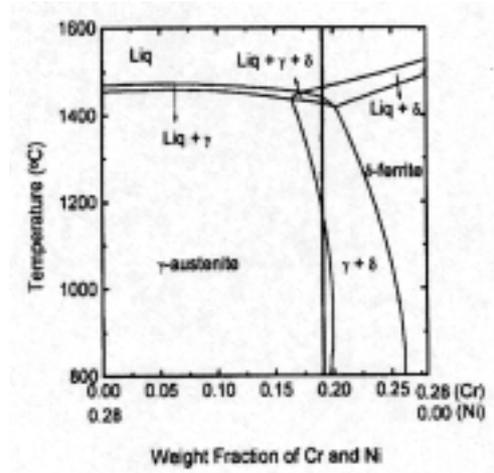


Fig. 2. Phase diagram of the Fe-Cr-Ni -C system at 72 wt% Fe (ref. 8).

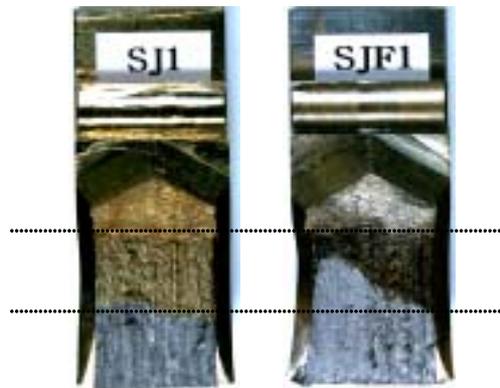


Fig 3. Fracture surfaces of the J-R test specimens

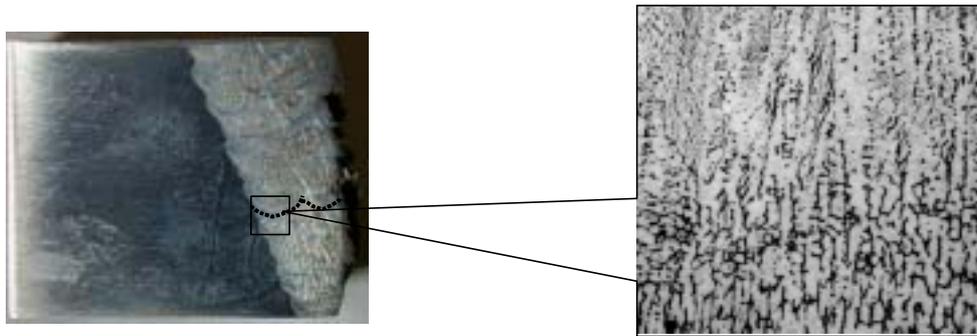


Fig. 4. Microscopy showing solidified weld structure in SJF specimen.

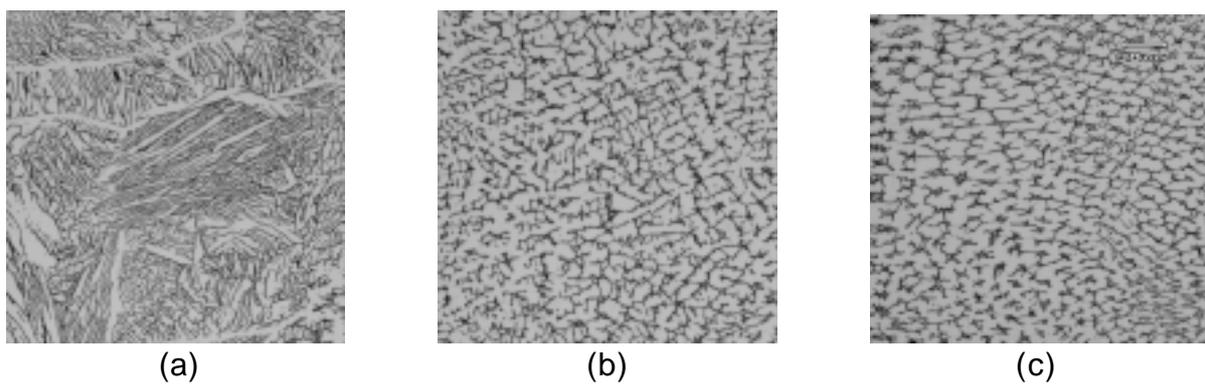


Fig. 5.  $\delta$ -ferrite morphologies in Type 347 welds ; (a) SJF(high fracture toughness region), (b) SJF(low fracture toughness region) and (c) SJ.