Zero-to-Tension Axial Fatigue Strength on Simulated Butt Welded Joint with Backing Strip

by Hironobu Nisitani, Hiroyuki Tanaka and Nobuyuki Bessho

Zero-to-tension axial fatigue tests were made on two types of 0.18C steel specimens. One is a circumferentialty notched specimen and the other is a simulated butt welded specimen with a backing strip machined from the base metal.

First, axial fatigue tests were carried out on the notched specimens, in order to obtain the root radius, ρ_0, of a notch at the branch point (the critical point where a non-propagating crack appears) and the relation between the critical maximum stress for crack initiation and the stress gradient.

By using the results, a method for predicting the fatigue limits of butt welded joints was presented. The fatigue limits of the simulated butt welded specimens wree in good agreement with the calculated valuse based on the proposed method.

<P. 1015>

Effect of N on the Mechanical Properties of the 308 Type Stainless Steel Weld Metals at Elevated Temperatures

by Takashi Zaizen, Shiro Aoki, Katsumi Suzuki and Wataru Kabasawa

The creep and tensile properties of 308 type stainless steel weld metals were studied and following results are obtained.

(1) The amount of scatter in measured value of the creep rupture strength at 550°C, 300hr is about 10 kgf/mm², and that of tensile strnegth at elevated temperature up to 700°C is about 15 kgf/mm² for the standardized 308 type stainless steel weld metals.

(2) As the quantity of N increases the creep rupture strength, the relation between creep rupture strength σ_C and N content C_N can be expressed as follows,

$$\sigma_C = A + B \log C_N$$

where A is the constant varing with composition, welding method, coefficient B indicates the magnitude of the effect of N for the creep rupture strength. The same statement is true on the relation between tensile strength and N content.

(3) The addition of about 0.1% of V strengthens the effect of N on creep rupture strength.

(4) N decreases the creep rupture elongation. The addition of about 0.1% of V controls the effect of N on the creep rupture elongation.

(5) The tensile rupture elongation decreases at temperature range between 20°C and 500°C, and the elongation increases at temperature above 550°C with increasing temperature. The addition of N above 0.078%, controls the decrease of creep rupture elongation at temperature range between 20°C and 500°C, and decrease the elongation above 600°C, for the 308 type stainless steel weld metals.

(6) The quntity of Cr in δ ferrite is 3% more than that of austenite, and the quantity of Ni in the δ ferrite is 3% less than that of austenite for the 308 weld metal containing 0.01%N. In the case of the steel containing 0.253% N, the quantity of Cr in δ ferrite is 9% more than that of austenite, and the quantity of Ni in the δ ferrite is 2% less than that of the austenite. The amount of precipitatae formed in δ ferrite of the latter steel is less than that in the former δ ferrite.

<P. 1020>

Effect of the Roughness of Faying Surface on the Early Process of Diffusion Welding

—Fundamental Study of the Early Bonding Process of Diffusion Welding by Means of Electric Resistance Measurement (Report II)—

by Toshio Enjo, Kenji Ikeuchi and Naofumi Akikawa

The early process of diffusion welding of aluminum, titanium and copper whose faying surfaces have been finished by polishing with emery papers of various grades (600∼1500 grade) have been investigated with the electric resistance measurement. A couple of the base metal was placed in vacuo with their faying surfaces in contact and the electric resistance ρ across the bonding interface was measured while the couple was heated at a constant rate of 15°C/min. The obtained electric resistance in the heating process is anlayzed by using the contact parameter $W(=nS_M/S)$ which is derived on the basis of the constriction resistance theory. Here S_M is the total area of true metal-to-metal contact spots, N their number per a unit area and S the apparent contact area.

For all the bonding interfaces of aluminum, titanium and copper, the value of ρ decreased in its initial value and approached the resistivity of the base metal more rapidly in the heating process, as the faying surface became rougher. According to an analysis based on the constriction resistance theory, the contact parameter in the heating process for all the base mteals was larger when the rough faying surfaces were used.

These results indicate that the disruption of oxide film on the faying surfaces, which prevents true metal-to-metal contact at the bonding interface (as reported in a previous paper), is promoted and so the area and/or number of true