



Fig. 1. Schematic diagram of load carrying transverse fillet welded cruciform joint with LOP (all dimensions in mm).

2.3. Fatigue testing

Two types of cruciform samples with LOP were considered for testing: (i) as-welded condition (non-treated) (ii) after cryogenic treatment (treated). Constant amplitude fatigue experiments with stress ratio, $R=0$ were carried out in air in a 100 kN servo-hydraulic DARTEC universal testing machine with a frequency of 30 Hz. For each condition, 12–16 specimens were tested. The specimens were tested to complete failure or to an endurance of 2 million cycles (in some cases 10^7 cycles, depending on the strain gauge readings), if there was no evidence of fatigue cracking.

An automatic crack monitoring system based on the crack propagation gauges (micro measurements TK-09-CPB02-005/DP series) was used to find the crack initiation and propagation data during the fatigue process with an accuracy of 0.25 mm. The crack propagation gauges consist of a number of resistor strands connected in parallel. This is bonded to a specimen at the tip of the root gap through a connector circuit and progression of a crack through the gauge pattern causes successive open circuiting of the strands, resulting in an increase in total resistance. The output is amplified and a typical step curve of strands broken versus time can be obtained in the computer (Fig. 2).

The chemical composition and mechanical properties of base metal and filler metal are given in Tables 1 and 2. The welding process parameters used to fabricate the joints are presented in Table 3.