COMPUTER CONTROLLED TESTING EQUIPMENTS FOR FRACTURE MECHANICAL PURPOSES

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INTRODUCTION

The main characteristics of the equipments for fracture mechanical purposes are the rigid loading unit, exact measurement of both force and crack opening displacement, computer controlled data acquisition system and automatic evaluation of results. Based on these demands two special-purpose measuring equipments were developed, one for tensile test of 25 CT (1 CT) probes and another for three-point bending test of 75 CT (3 CT) probes. Both equipments are connected with an IBM-compatible professional personal computer which provides not only the control of the loading unit but the data recording and evaluation as well.

MAIN FRAME AND DRIVING SYSTEM

The equipment for three-point bending test is a conventional tensile test machine with two columns as it can be seen on Fig. 1. The ball screws (3) are built in the lower house (1) while the nuts are fixed in the upper travelling beam (2). The driving system rotates simultaneously the ball screws establishing a ram speed of 0.1...10 mm/min. The bending tool (4,5) and specimen (6) can be sunk in a cooling bath. The load and crack opening displacement are measured by electronic transducers (7,8). The load capacity is 160 kN and the main dimensions of the equipment are H=850 mm, L=1250 mm, L1=500 mm and H1=250...600 mm.

The equipment for tensile test of 1 CT probes differs from the conventional solutions. A one-sided loading system has been developed as it can be seen on Fig. 2. The probe (12) is loaded between a fixed tube (10) and a moving bar which is connected to the house (8) of a ball nut (7). The ball screw (6) is driven by the motor (1), gear box (2) and gears (3,4) with 0.05...1 rpm which results in 0.5...10 mm/min speed of bar movement.

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The main purpose of developing this unusual arrangement was that many materials must be tested under different enviromental conditions. In this case the one-sided loading system with 100 kN capacity provides maximum versatility for tests on high and low temperatures. The loading unit is held by a frame and can be turned either in horizontal or vertical positions.

CONTROLLING AND MEASURING SYSTEM

The closed loop control system for both equipments is based on a professional personal computer which has a multi-channel A/D converter, a D/A converter and a 16 bit digital input-output unit. The number of revolutions of the driving motor can be set by the D/A converter while the other functions of the equipment are controlled via the digital output channels. The measured data (force, ram movement, crack opening displacement, temperature) are digitized by the A/D converter and can be stored in the computer memory. For very fast sampling a direct memory access mode can be programmed while low-speed tests can be carried out under computer controll. In this case several possibilities are given for programming the load or ram speed as function of time or other variables.

The most difficult problem of these fracture mechanical tests is the exact measuring of the crack opening displacement. Several solutions are known from the literature for correcting the errors occuring from the fact that the displacement is measured far from the crack, on the outer surface of the probe. Our solution ensures for all kinds of specimens a serie of clip-gages which measure the crack opening displacement in the line of the loading force as it can be seen on Fig. 3. The wedges (3) of the double toucher are placed in the upper and lower notches of the probe (1) and the transducer (2) is held by the touchers.

SUMMARY

In the last few years both equipments were used in laboratory work for different fracture mechanical tests. Experiences gathered so far are very good and have proved that the equipments offer testing possibilities under different enviromental conditions on a wide range.

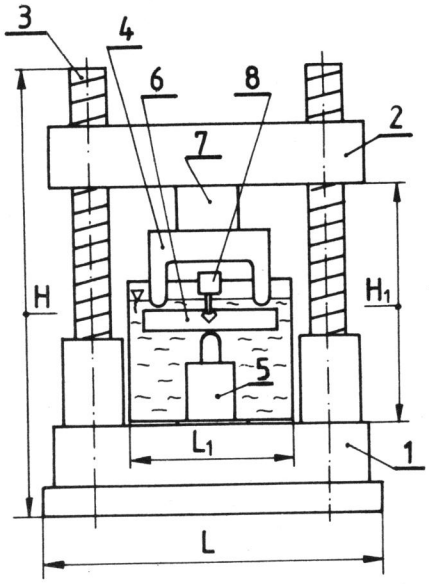

Figure 1 Three-point bending test machine

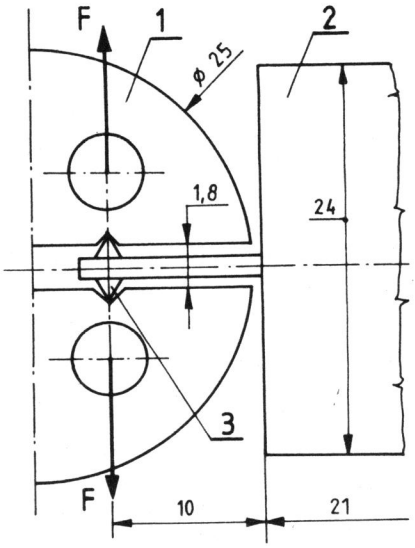

Figure 3 Probe and clip-gage

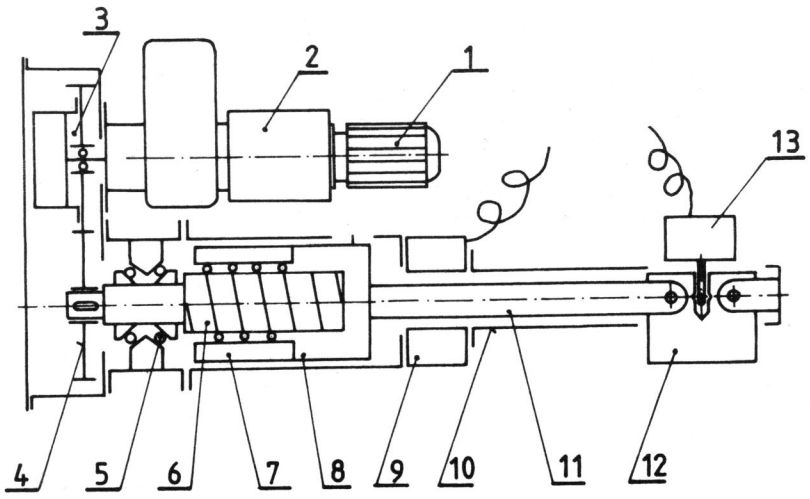

Figure 2 Tensile testing equipment for 25 CT probe