

1. Introduction

The Research Center Jülich participates in the joint european development of a high-performance neutron spallation source: ESS=European Spallation Source.

One of the primary tasks is the development of the target components, their longevity is primarily determined by the proton- and neutron-induced embrittlement.

For the mechanical testing of structure materials, targets irradiated at LAMPF are available. From these components, specimens will be taken for further examinations.

2. Sampling

Due to the dimensions of the proton beam at LAMPF (Los Alamos, USA), the diameter of the irradiation-damaged target segments are approx. 40 - 45 mm Ø, the target themself is a hollow spheres with a diameter of 220 mm fabricated from Inconel 718 (Fig. 1)

The sphere was cut into 2 hemispheres, from which strips with a width of 2 or 3 mm were subsequently fabricated (Fig. 2) using a band saw. The accuracy of the strip width was +_0.1 mm. These strips were further cut into bands having a length of 3 or 15 mm.

3. Sample preparation and examinations.

The following investigations were performed:

- gamma spectrometry
- examination of micro hardness
- 3 point bending tests
- shear punch tests

3.1 Gamma Spectrometry

The material strips were cut with a diamond saw into 15 mm long segments and scanned. These measurements revealed the relative proton distribution during irradiation. (Fig. 3)

3.2 Micro Hardness

The micro hardness was measured on the 15 mm long segments. These measurements give a preliminary indication about the material brittleness. (Fig. 4)

3.3 3 Point Bending Tests

To obtain informations on the ductility of the test material, 3 point bending tests have been carried out. Specimens having the dimension $2 \times 3 \times 15 \text{ mm}^3$ length were tested-to-failure in a bending fixture. The corresponding strain and deflection was measured. (Fig. 5 and 6)

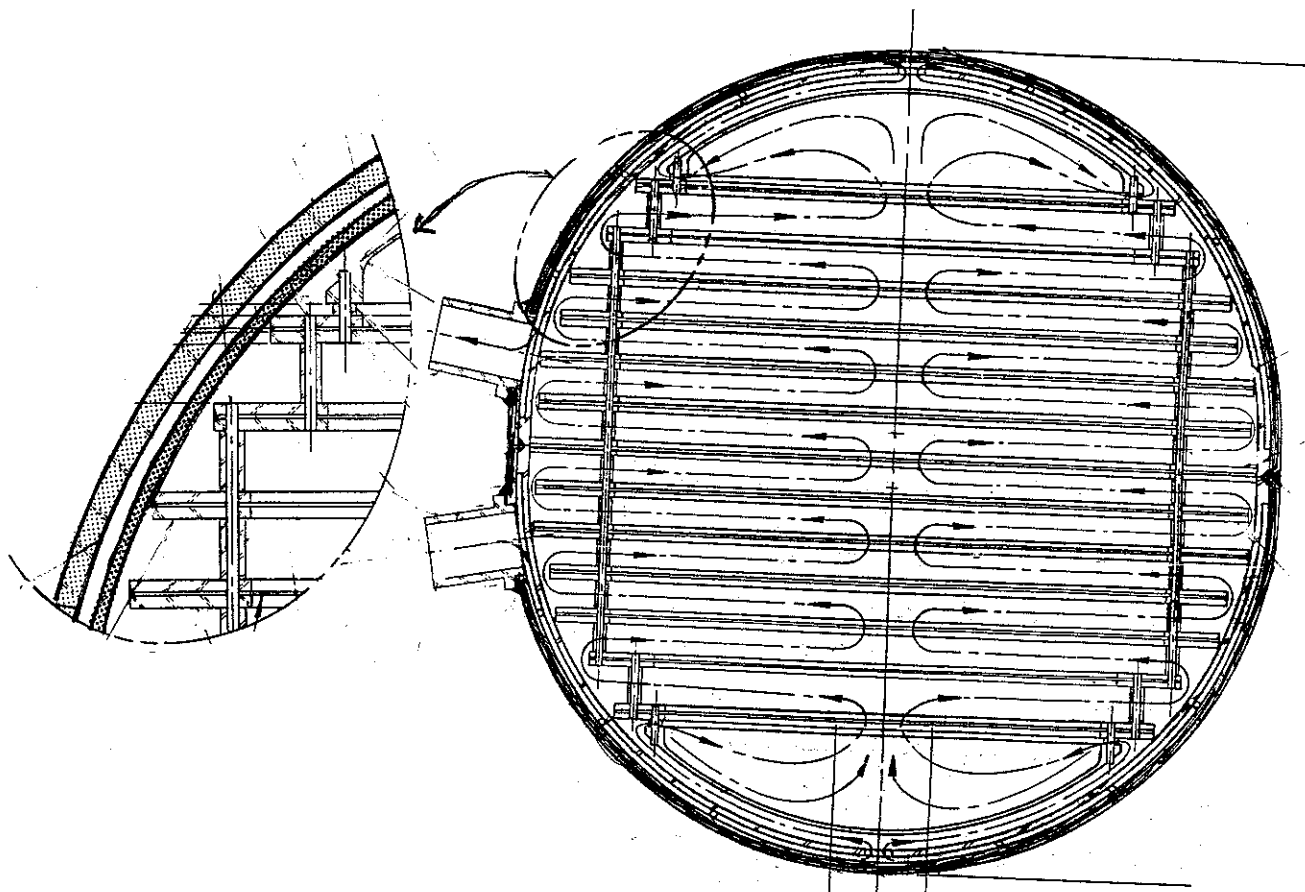
Sample handling was performed with forceps or by a vacuum system.

3.4 Shear Punch Test

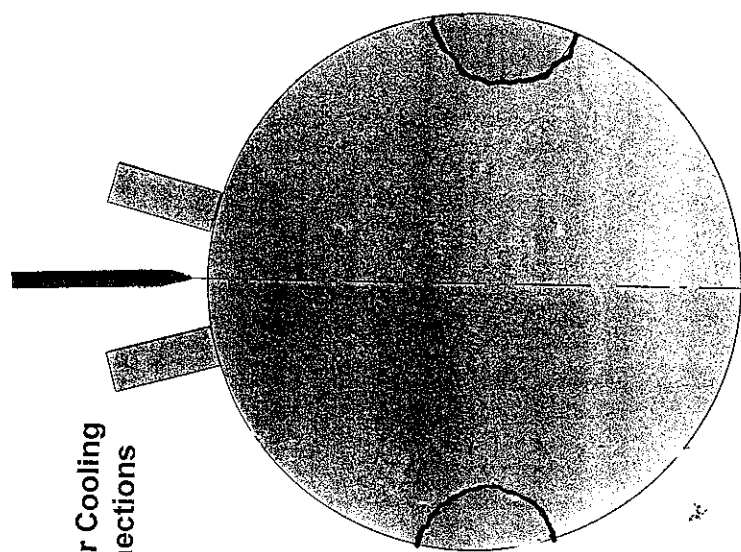
The most difficult sample preparations had to be done for the shear punch tests. Samples with the dimensions of $3 \times 3 \times 0.5 \text{ mm}$ had to be prepared. Strips of $3 \times 3 \text{ mm}^2$ have been manufactured using a band saw. From these strips 1mm thick plates were cut with a diamond blade. These small plates were fixed to a grinding plate, and the thickness was reduced to $0.4 \pm 0.1 \text{ mm}$ (fig.7). The handling was difficult and had to be performed by a vacuum system, leading to a 50% sample loss. These tests are in progress.

Literature:

Post-irradiation testing of target components after service at LAMPF
by F. Carsughi et.al.
TMS Annual Meeting, Orlando 9-13 Febr. 1997



Cut with
a Band Saw



Water Cooling
Connections

Proton
Beam
→

**Water Degrader irradiated in a Proton Beam
(LAMPF)**

Fig. 1

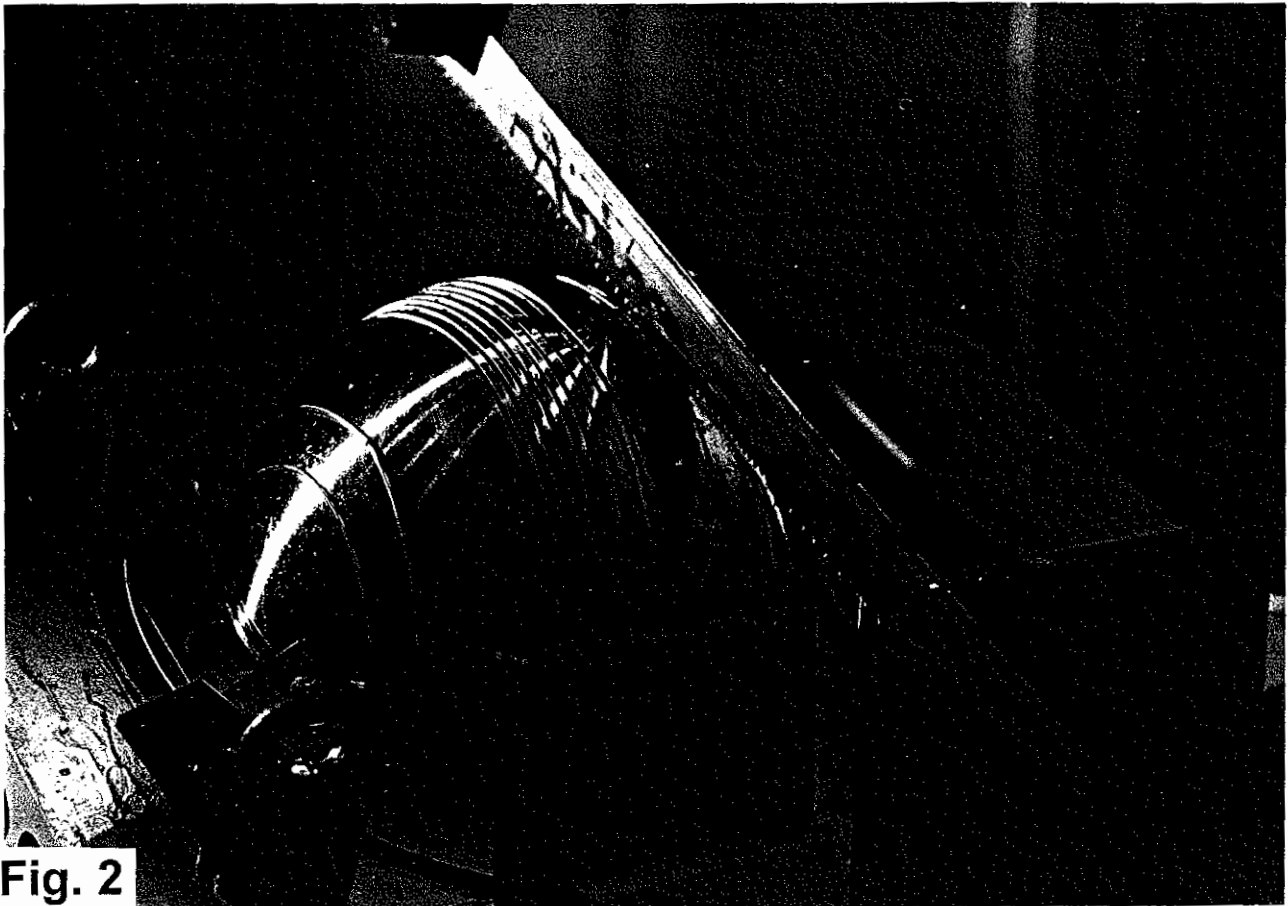


Fig. 2

Sample cutting from a „Water Degradier“ (Strips 2 x 3 mm)

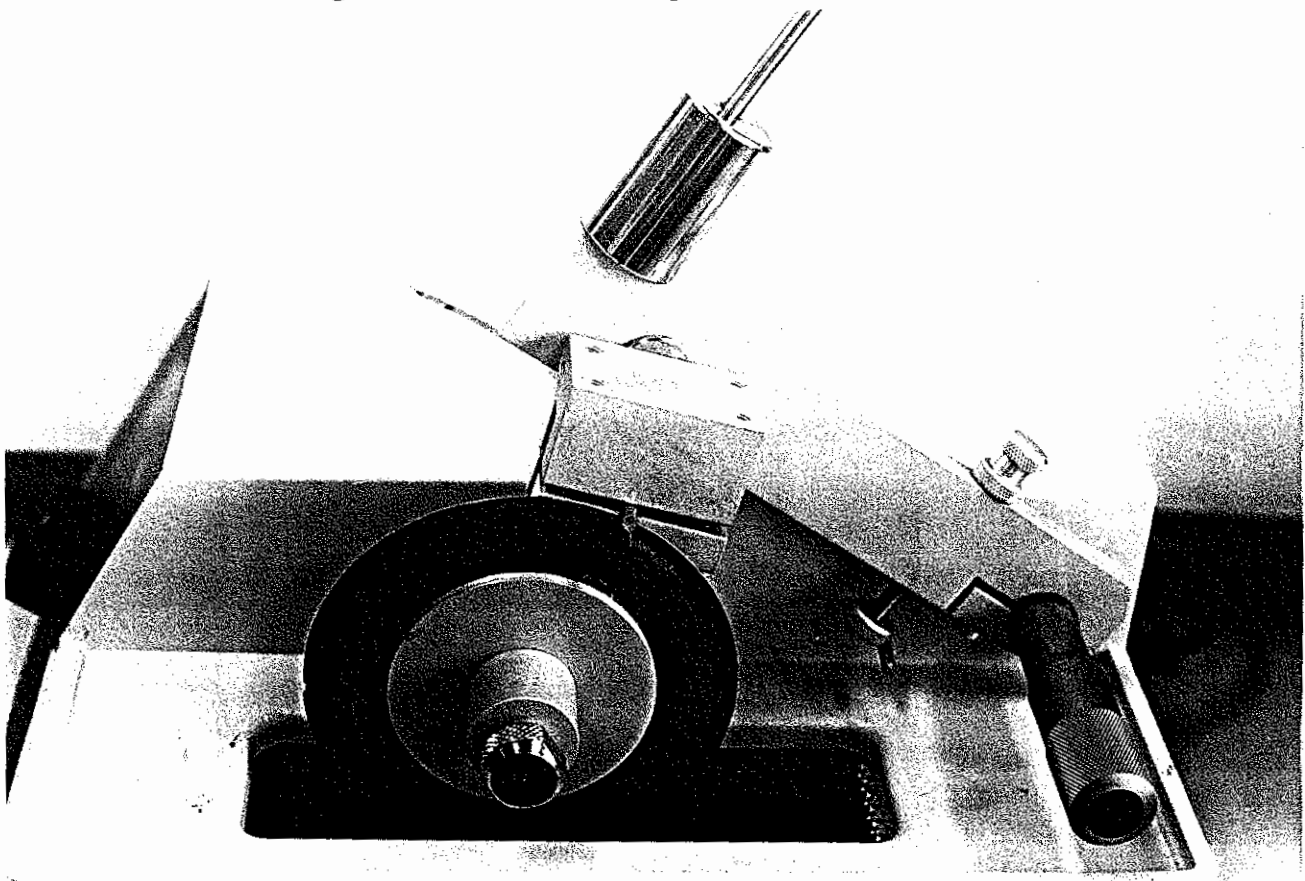


Fig. 3

Diamond coated blade for cutting small Samples



Microhardness HV 0.2 - Activity of stripes #6 and #7

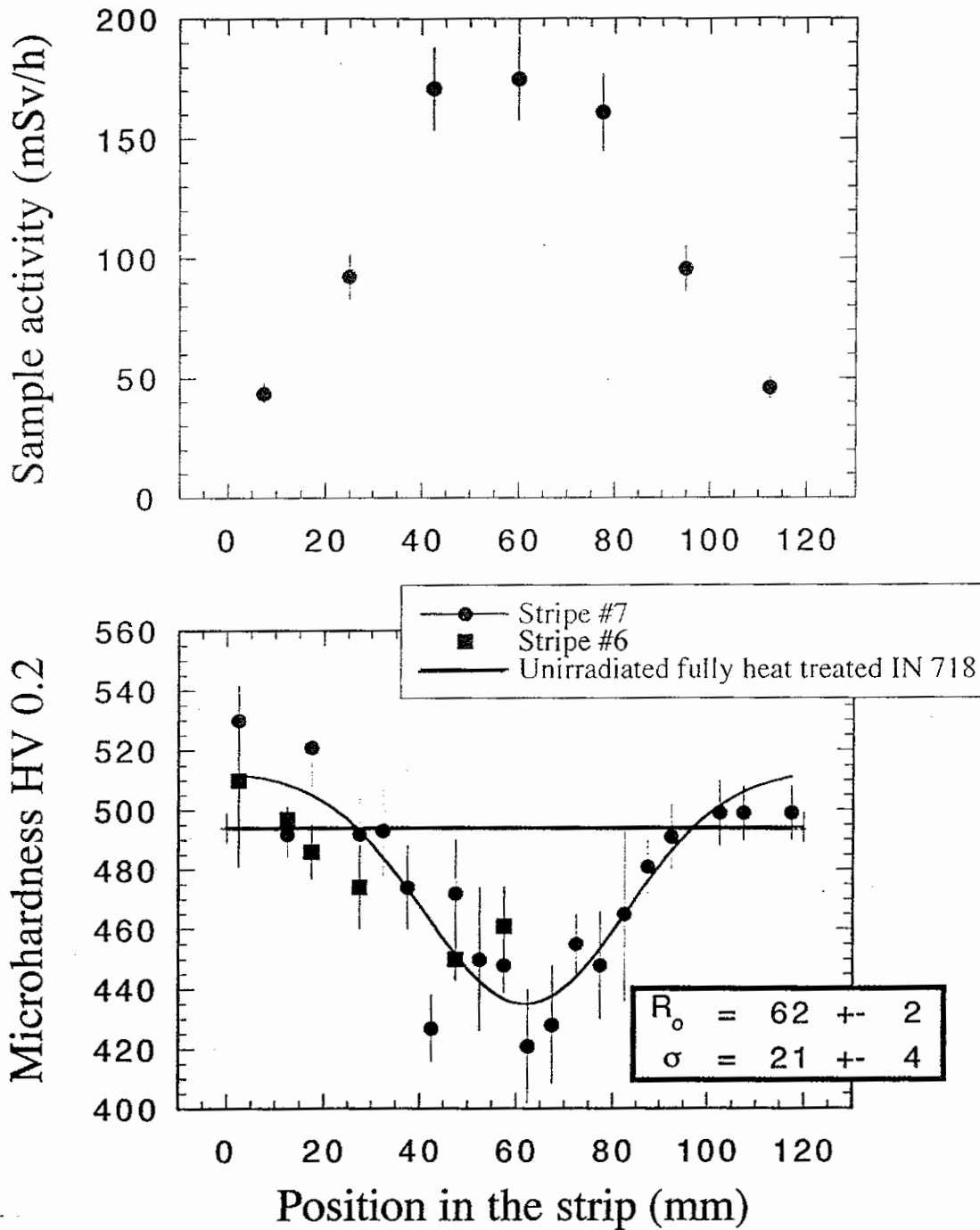
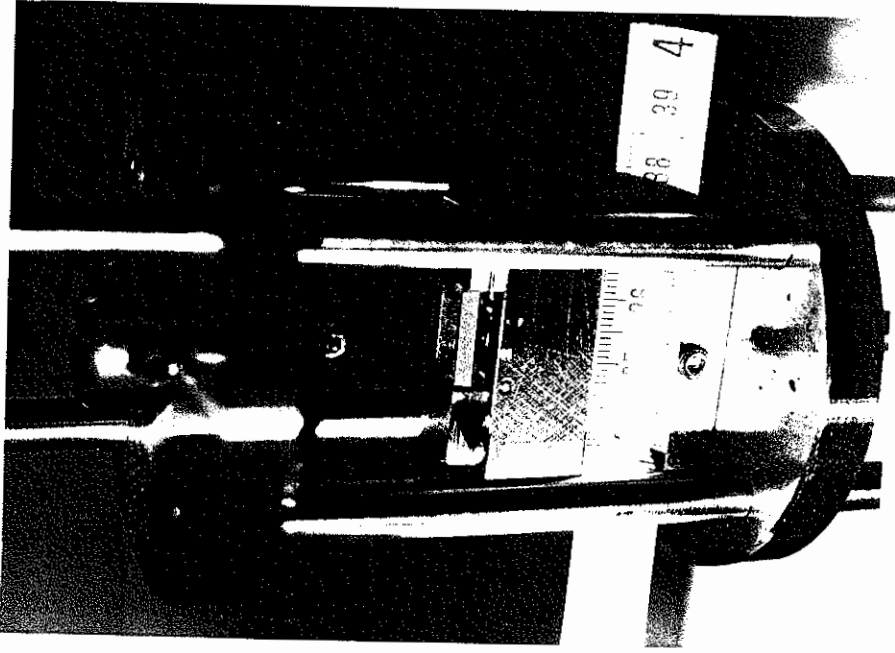
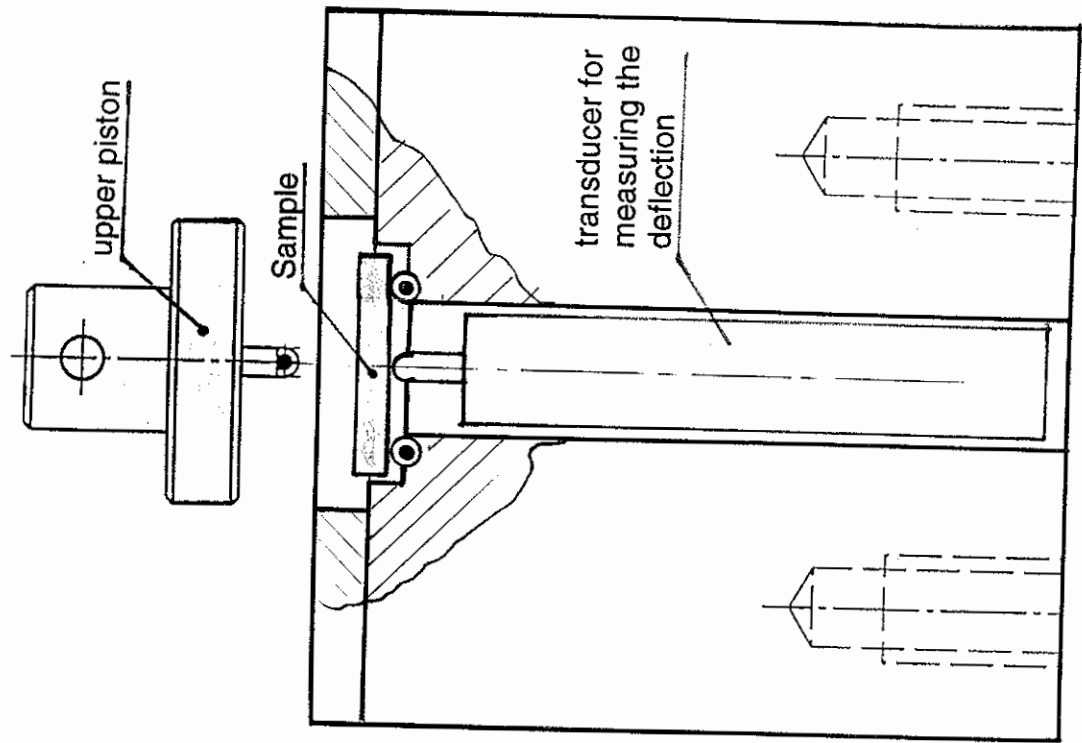


Fig. 4



Device for testing 3 point bending samples
(3 x 2 x 15 mm)



Device for testing 3 point bending samples
(3 x 2 x 15 mm)

Fig. 5



Bending test experimental results

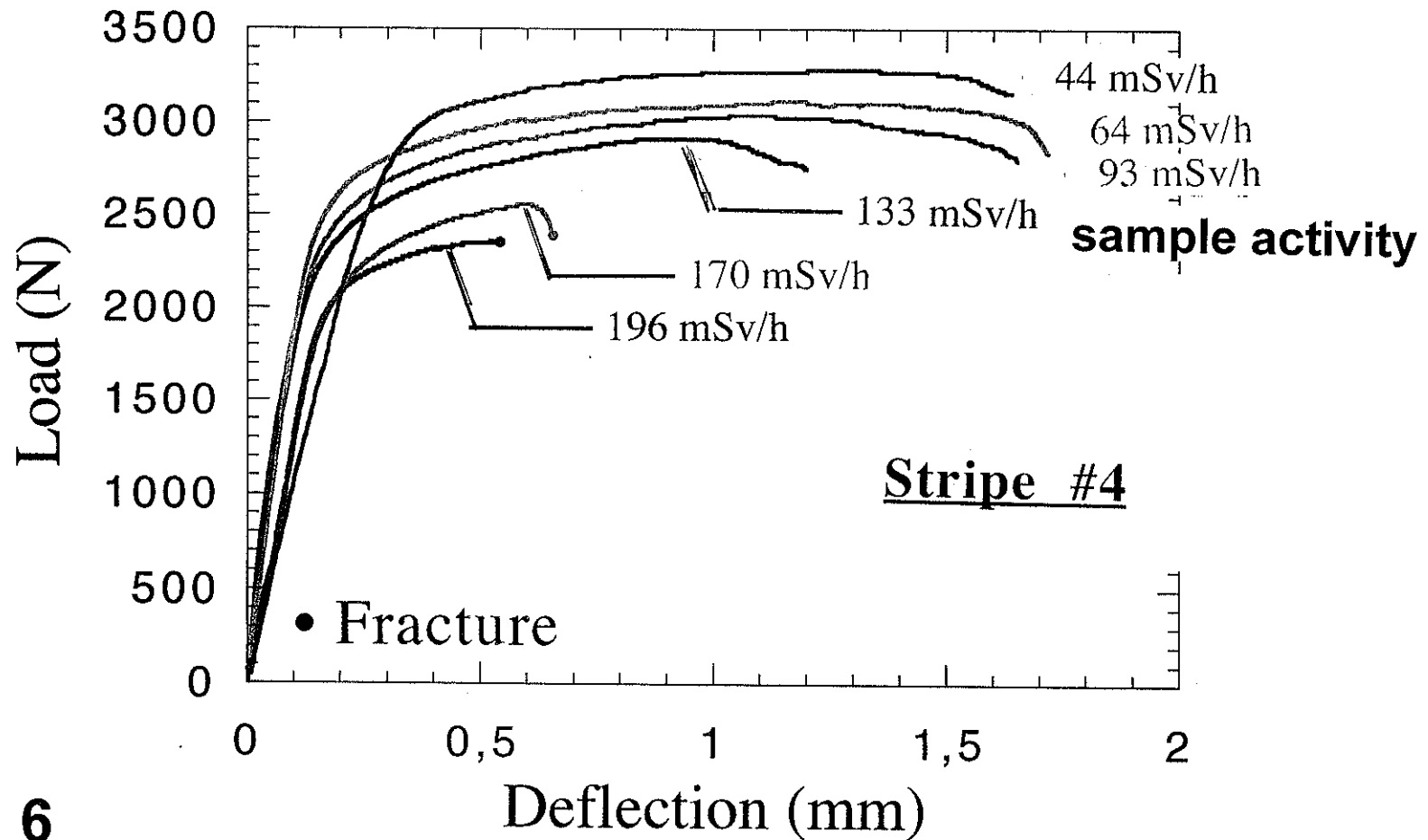
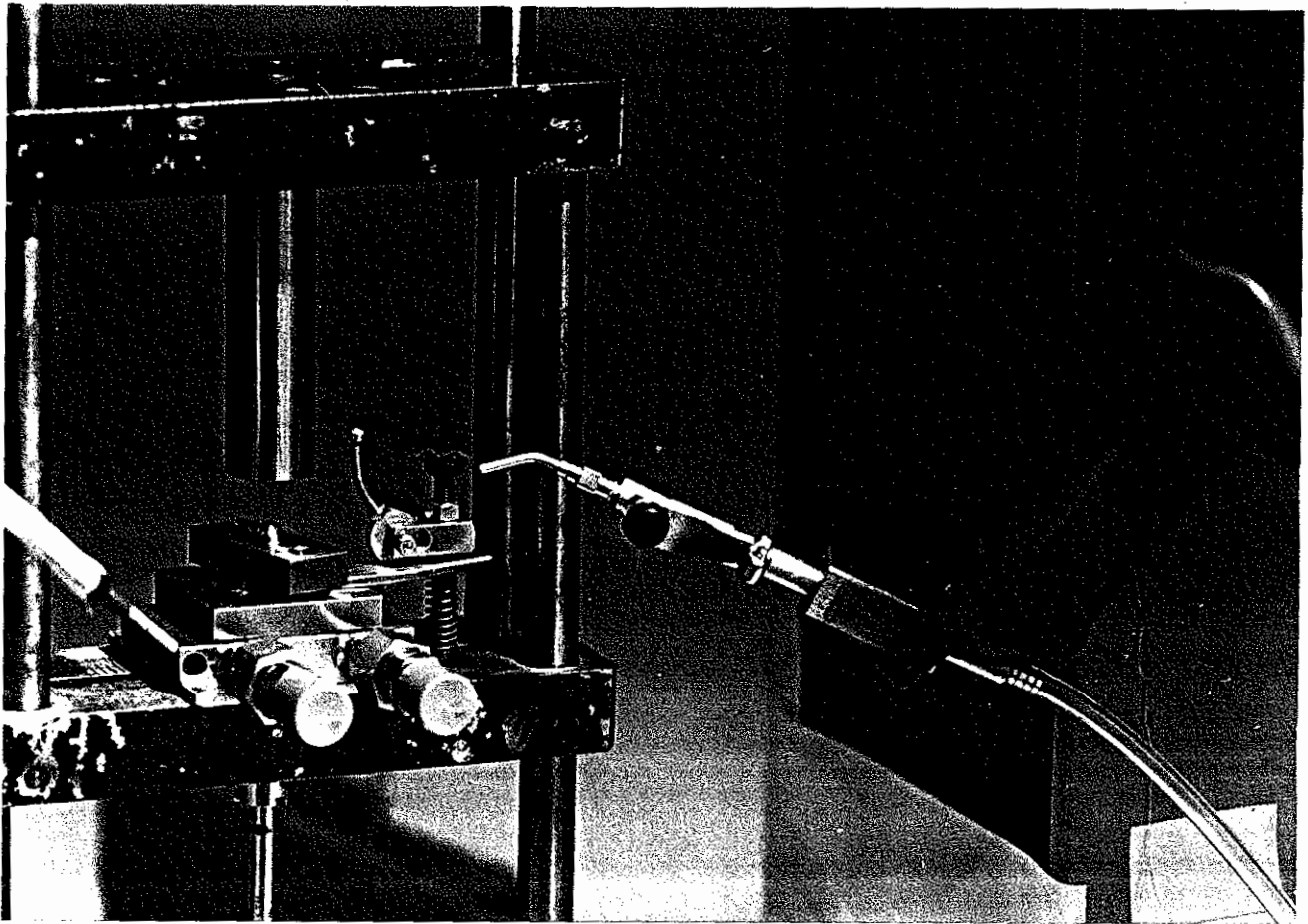


Fig. 6



**Shear Punch Device for Samples 3 x 3 x 0,3 mm
assembled in a Tensile Testing Facility**

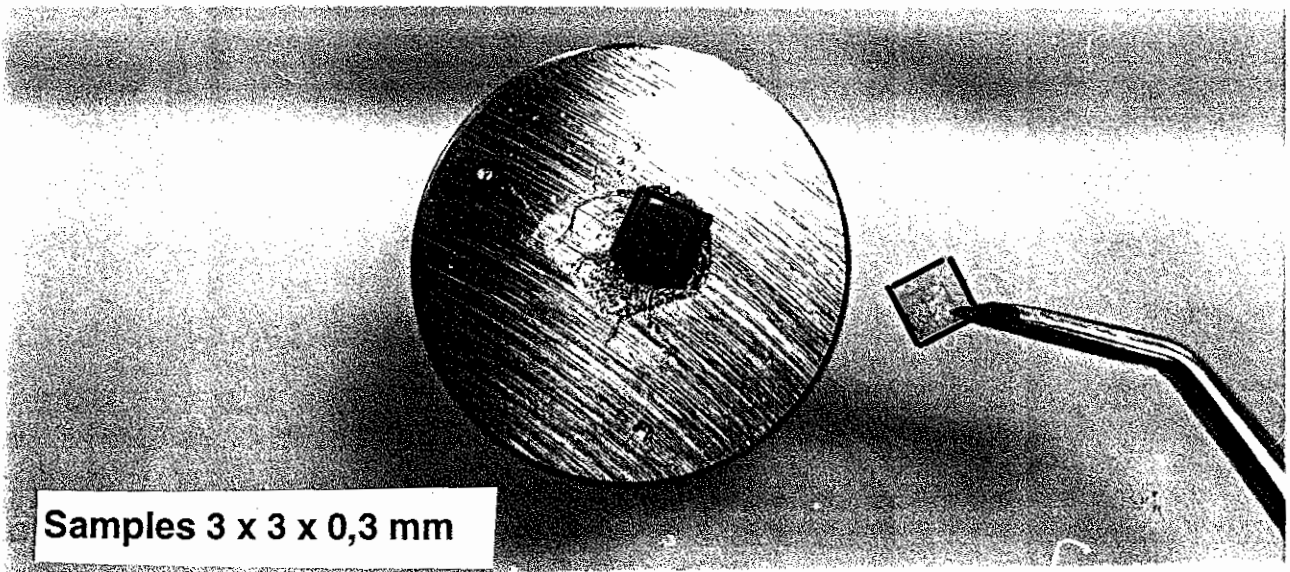


Fig. 7