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COPY

SERVICE PROJECT REPORT

CLIENT: MINISTRY OF LABOUR AND SMALL AND MICRO ENTERPRISE DEVELOPMENT

ADDRESS: Riverside Plaza, Besson Street, Port of Spain

PROJECT: Testing of Scaffolding Material – Custom & Excise Building

PROJECT CODE: EC03828936/06

REPORT NO: 3505/06

DATE: September 20, 2006

Page 1 of 17

Amendment report*
(Supersedes report No 3076/06 dated August 17, 2006)

1. INTRODUCTION

On July 12, 2006, scaffolding erected for the construction of the Customs and Excise Building, Richmond Street, Port of Spain collapsed while in service. On July 14, 2006, CARIRI was requested by the client to meet with representatives of the Ministry of Works and Transport (Mr Richard Fulchan) and the Ministry of Labour (Mr Jeffrey Millington) to determine the testing services which can be provided by CARIRI on the investigation being conducted into the collapse of the scaffolding. Mr Marco Nunes of CARIRI visited the site.

At the site Mr Fulchan (MOWT) selected the tests and the samples required for testing. The tests requested were as follows:

1. Visual inspection
2. Dimensional measurements
3. Hardness test
4. Tensile test

Eight (8) samples were selected. Sampling was facilitated by representatives of NH International (Messrs John Dempsey and Martin Richards) through the provision of

* Changes indicated by sidebars in the column.

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tools and manpower. NH International also facilitated the transport of two large samples. A list of the samples taken from the site was prepared by Mr Richards of NH International and a copy is presented in Appendix I. Samples were delivered to the CARIRI Laboratory at Macoya on the evening of July 16, 2006 and were assigned CARIRI identification numbers and were stored in designated storage areas.

NH International identification, description and assigned CARIRI identification numbers are as follows:

Table 1
Sample identification

Item	CLIENT Identification	Description given	CARIRI Identification
1	#1 C&E – PK-1 (14-07-2006) – Scaffold pipe	24" length, 1½" dia. Scaffold pipe	T065895
2	#2 C&E – PK-1 (14-07-2006)	36" length, 1½" dia. Scaffold pipe	T065896
3	#3 C&E – PK-1 (14-07-2006)	18" length, 1½ " dia. Scaffold pipe	T065897
4	#4 C&E – PK-1 S- pipe (14-07-2006)	24" length, 1½" dia. Scaffold pipe	T065898
5	#5 C&E – PK-1 Horiz. Plank brace (14-07-2006)	6" length, 4" x 2" angle iron brace & pin assembly	T065899
6	#6 C&E – PK-1	2½" length, pin section	T065900
7	#7 C&E – PK-1	8' x 8" x 2" metal scaffold plank	T065901
8	#8 C&E – PK-1	8' x 8" x 2" wooden scaffold plank	T065902

2. APPROACH

The investigation carried out involved the following:

1. *Visual inspection.* The samples were visually inspected and a brief description was made. Photographs were taken to record observations made.
2. *Dimensional measurement of samples.* The samples were measured to determine their dimensions, including, length, width, and thickness among others. Samples T065901 and T065902 (planks) were weighed.

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3. *Hardness test.* A traverse Vickers hardness test profile was performed on the weld of sample T065900. A Zwick Vickers hardness tester type 3202 was used.
4. *Tensile test.* Samples T065897 and T065898 were coupled and tested as a unit to determine the load bearing capacity of the friction joint. A DMG universal testing machine Model Avery No. XT98040 was used.

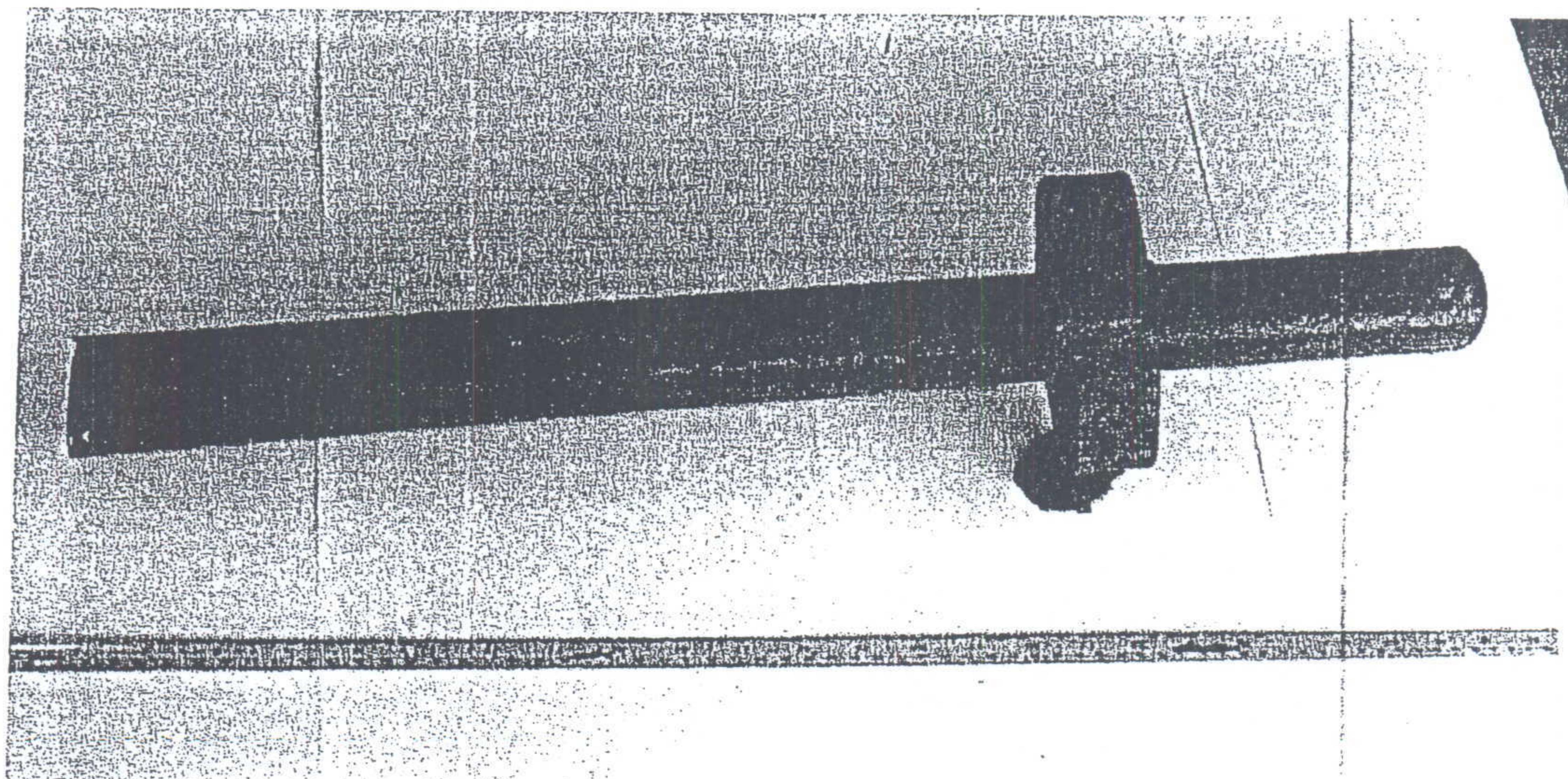
3. RESULTS

3.1 Visual Inspection

A visual inspection was carried on the samples submitted.

The photographic record is presented in Figures 1 to 9.

Figure 1: View of sample T065895 (#1 C&E – PK- 1 (14-07-2006) – Scaffold pipe). No visual defects revealed



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Figure 2: View of sample T065896 (#2 C&E – PK- 1 (14-07-2006). Fractured across length.

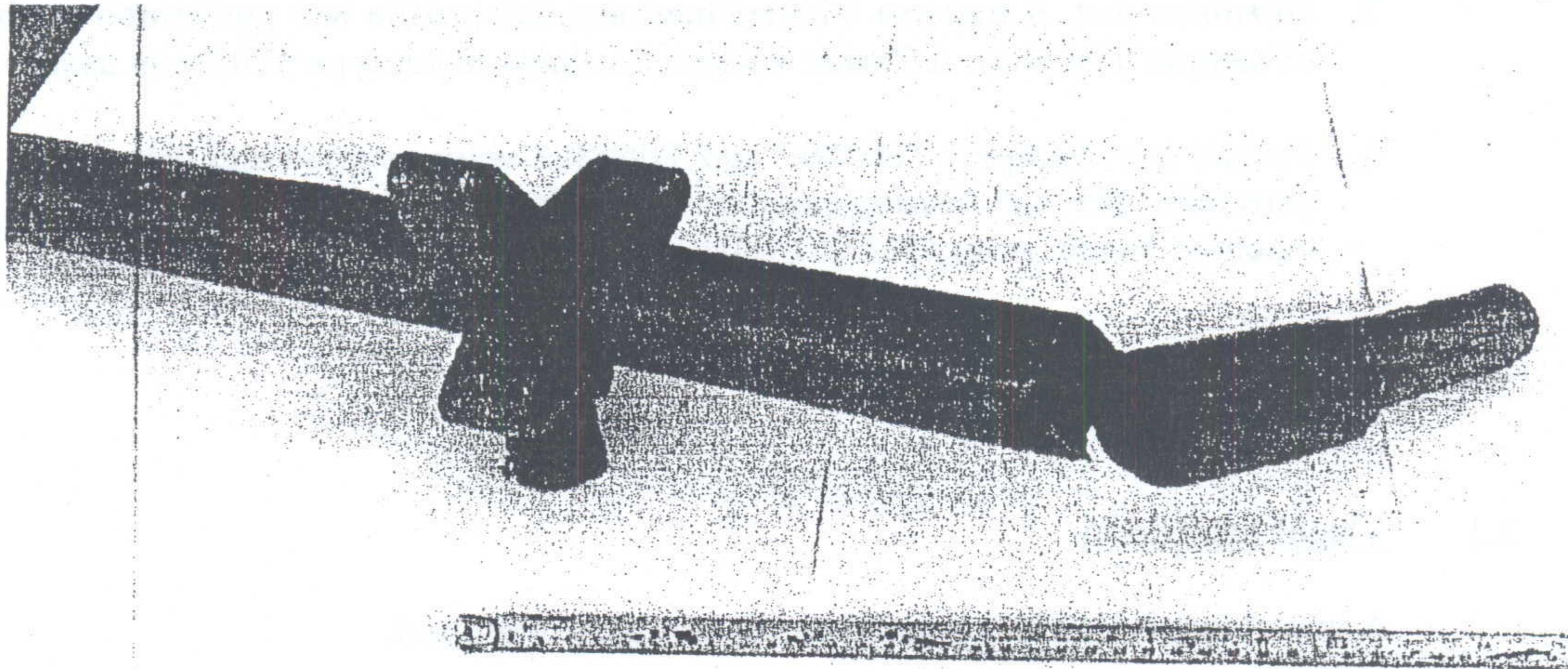
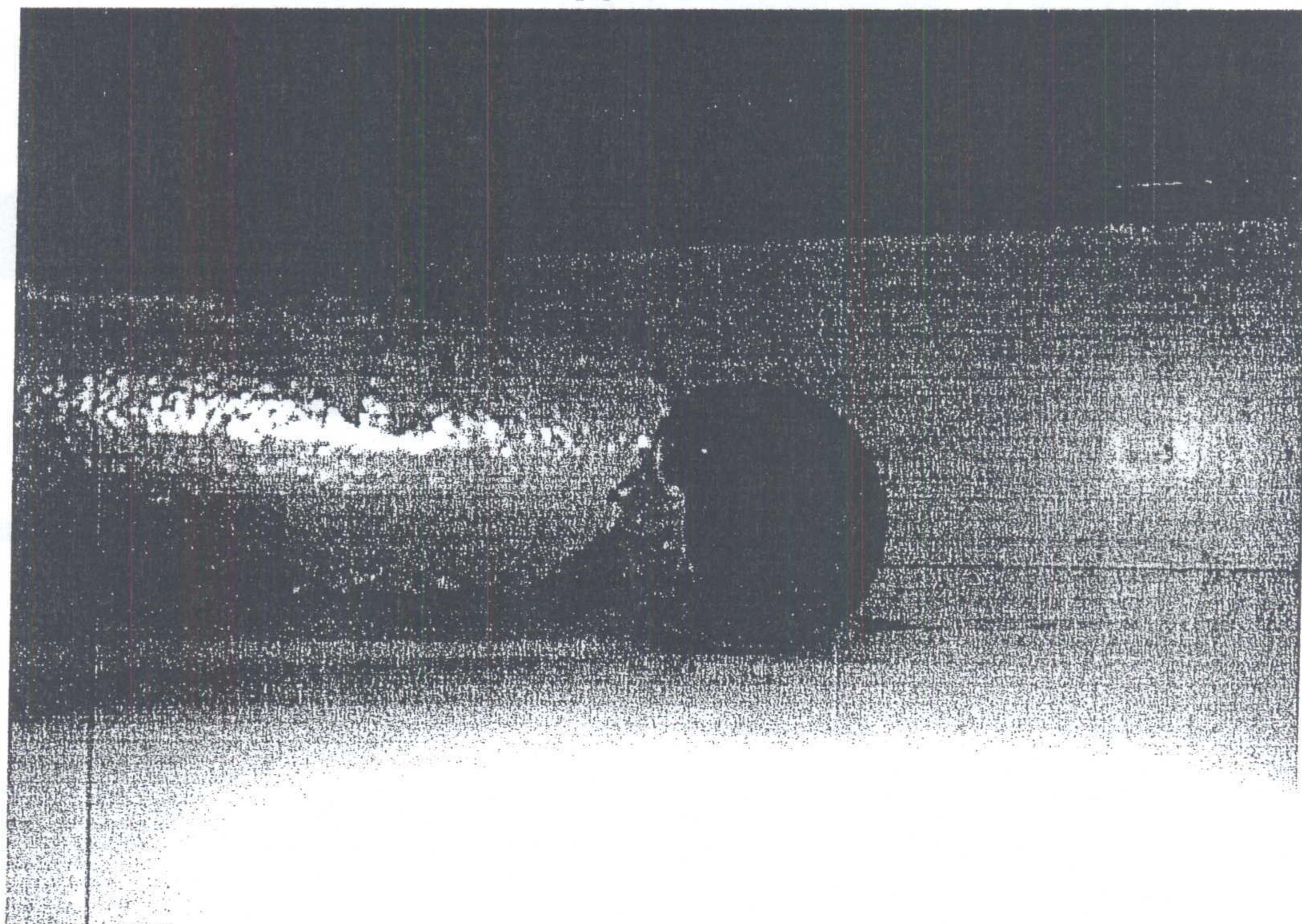


Figure 3: View of sample T065896 (#2 C&E – PK- 1 (14-07-2006), showing the corrosion on the internal surface of the pipe at the fractured section



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Figure 4: View of sample T065896 (#2 C&E – PK- 1 (14-07-2006)), showing (a) a welded and (b) a metallic insert as part of the configuration used during service

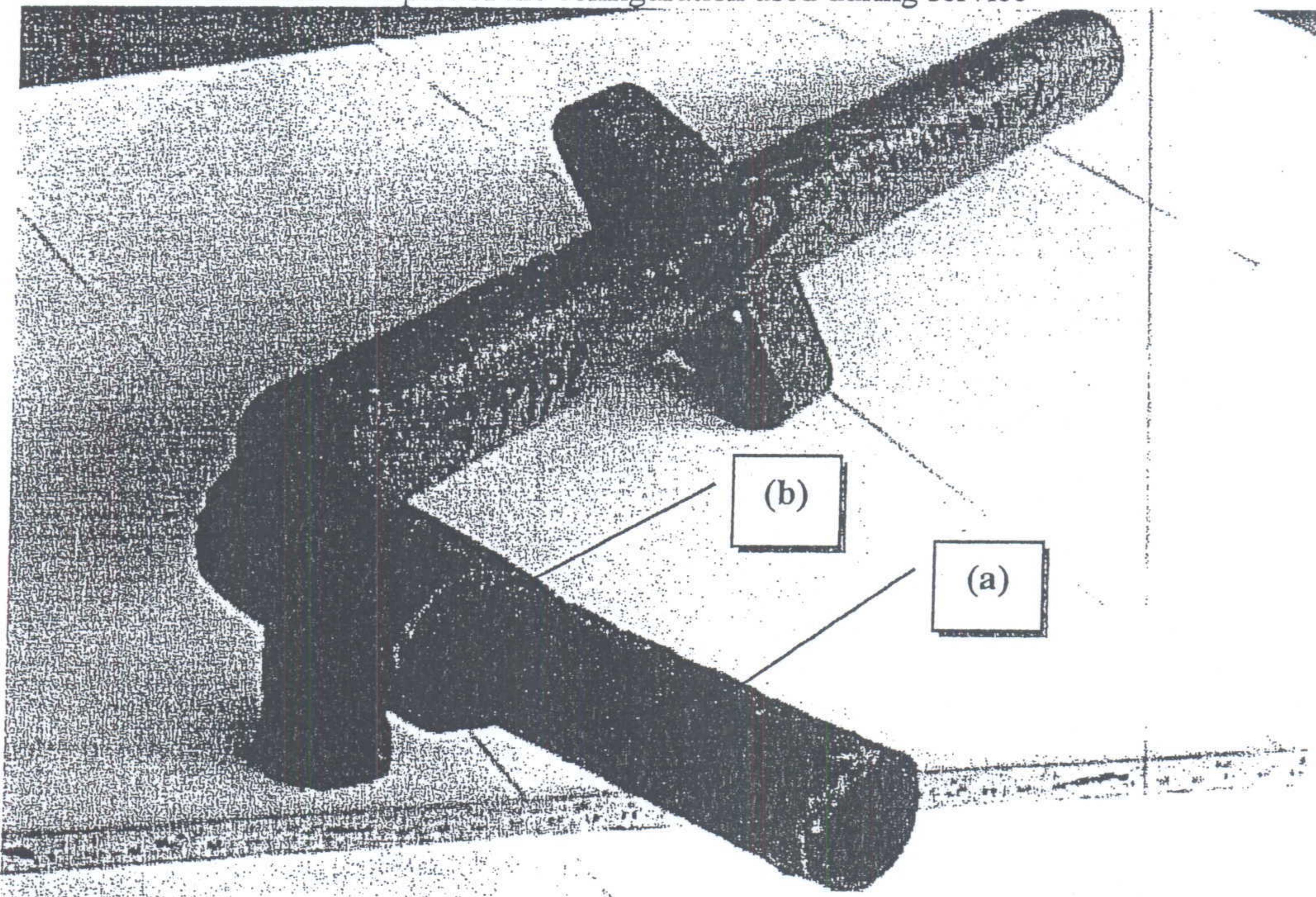
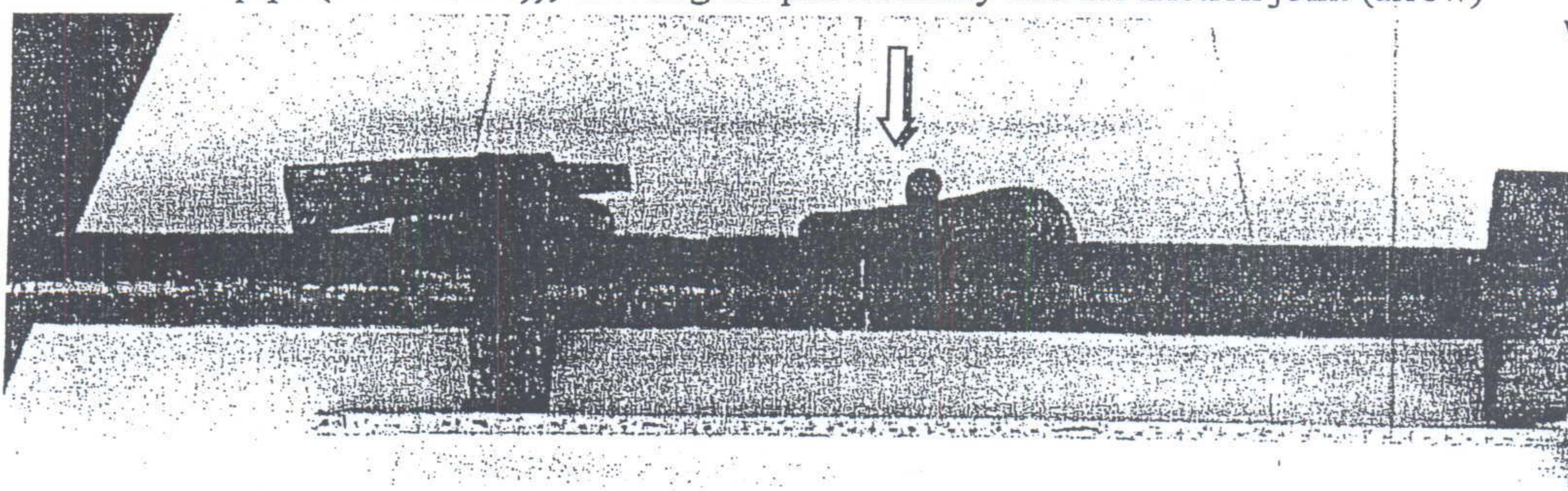


Figure 5: View of samples T065897 (#3 C&E – PK- 1 (14-07-2006)) and T065898 (#4 C&E – PK- 1 S- pipe (14-07-2006)), showing the pin assembly and the friction joint (arrow)



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Figure 6: View of sample T065899 (#5 C&E – PK- 1 Horiz. Plank brace (14-07-2006)), showing the fractured brace.

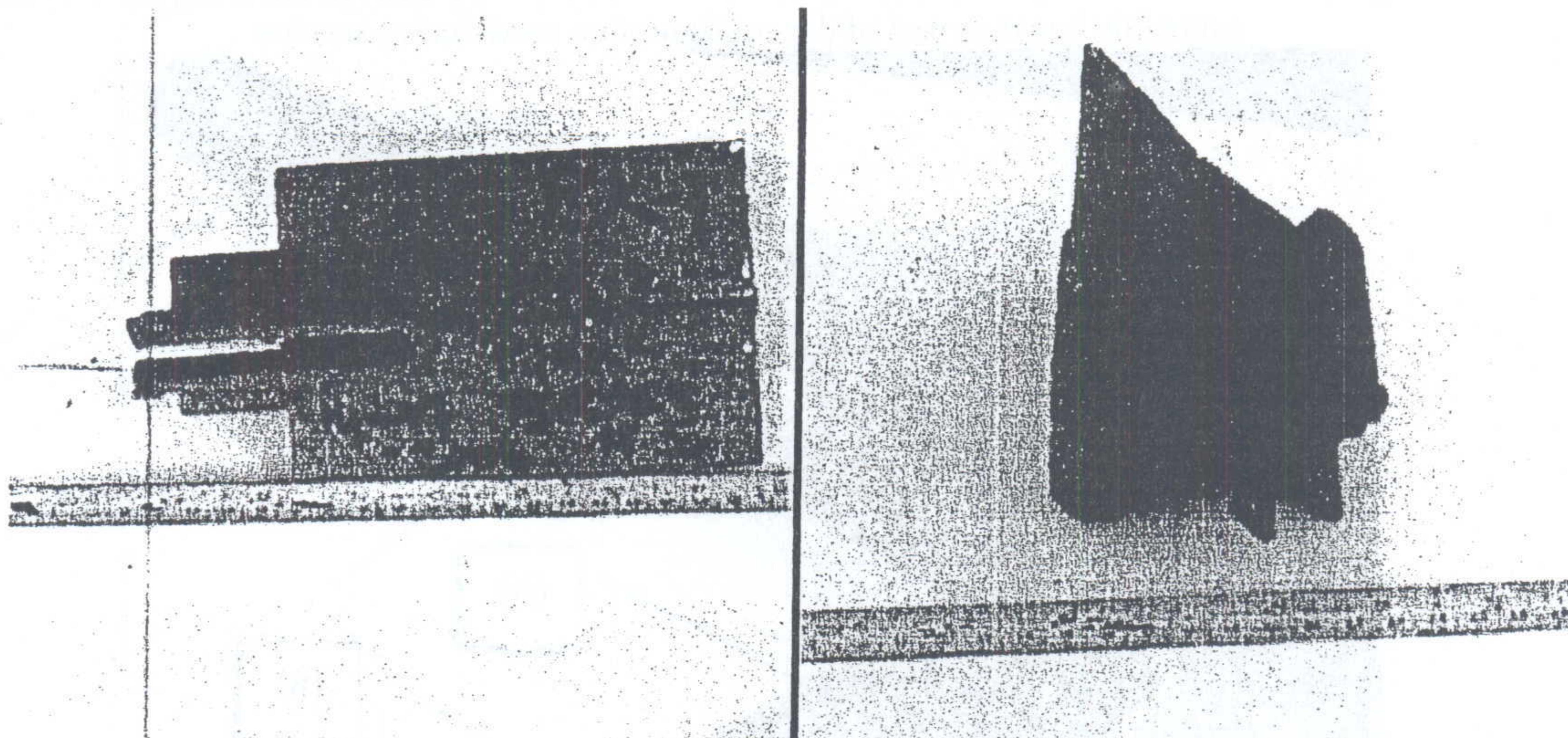
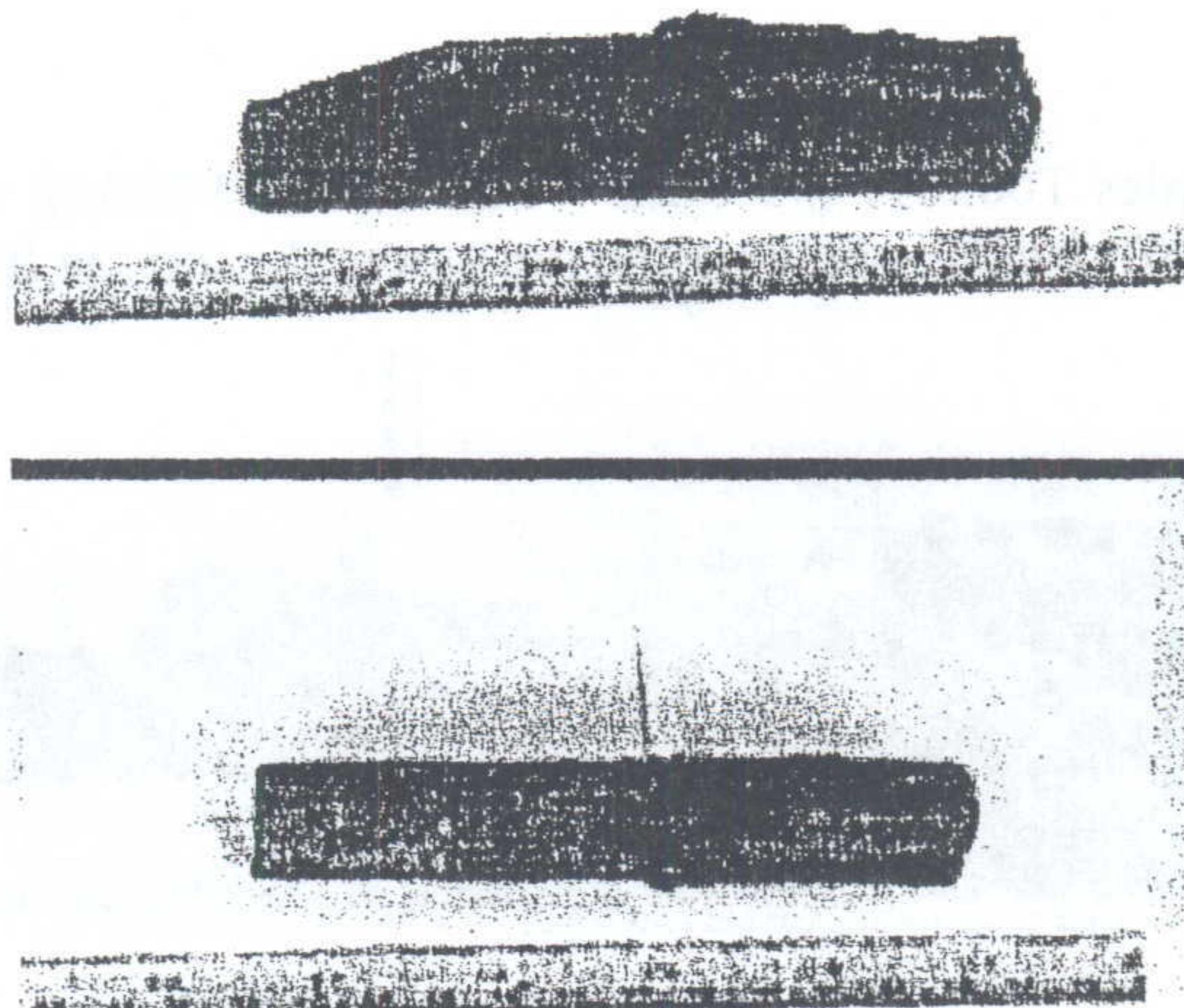
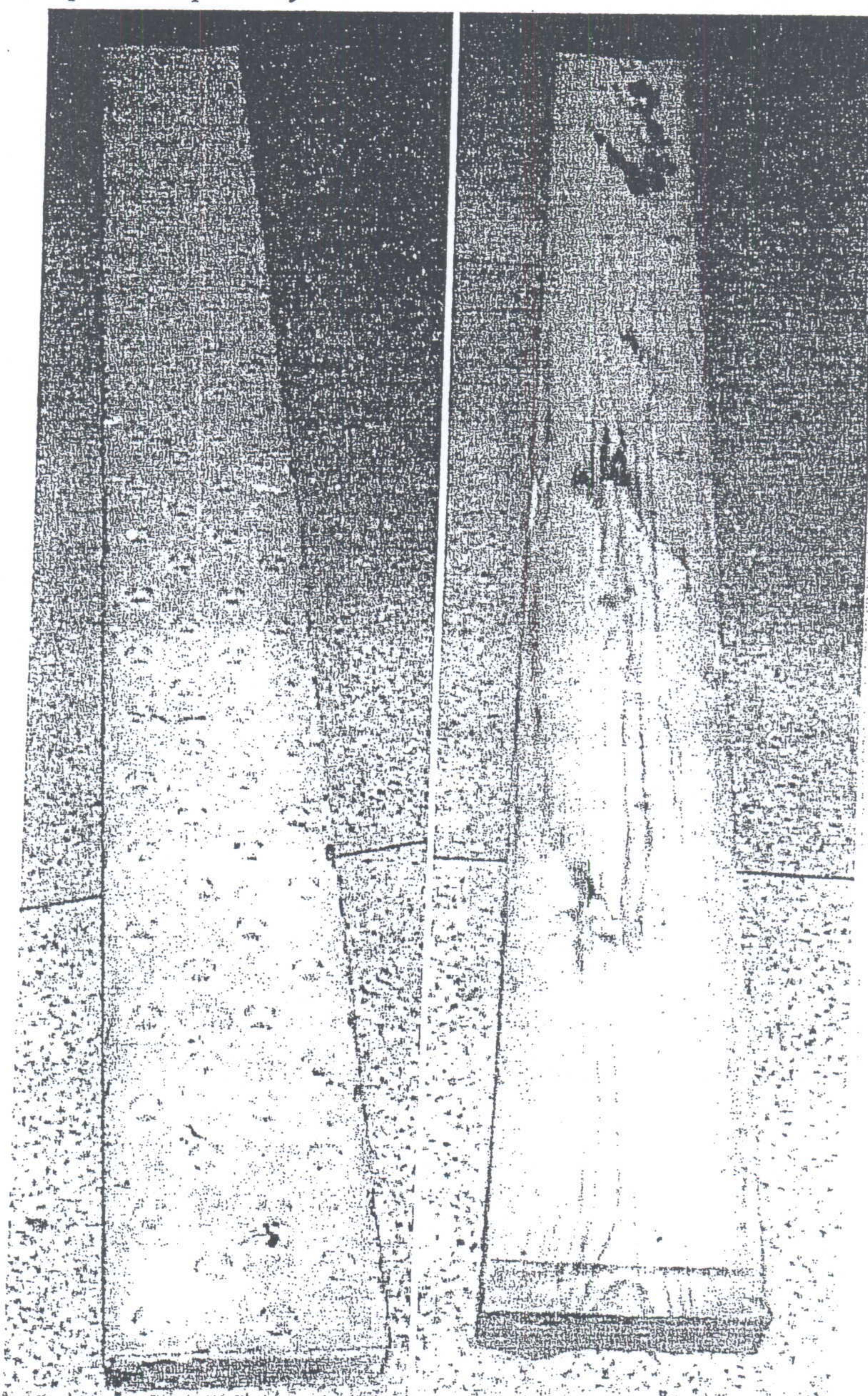


Figure 7: View of sample T065900 (#6 C&E – PK- 1), showing the fractured surface of the matching side of sample T065889.



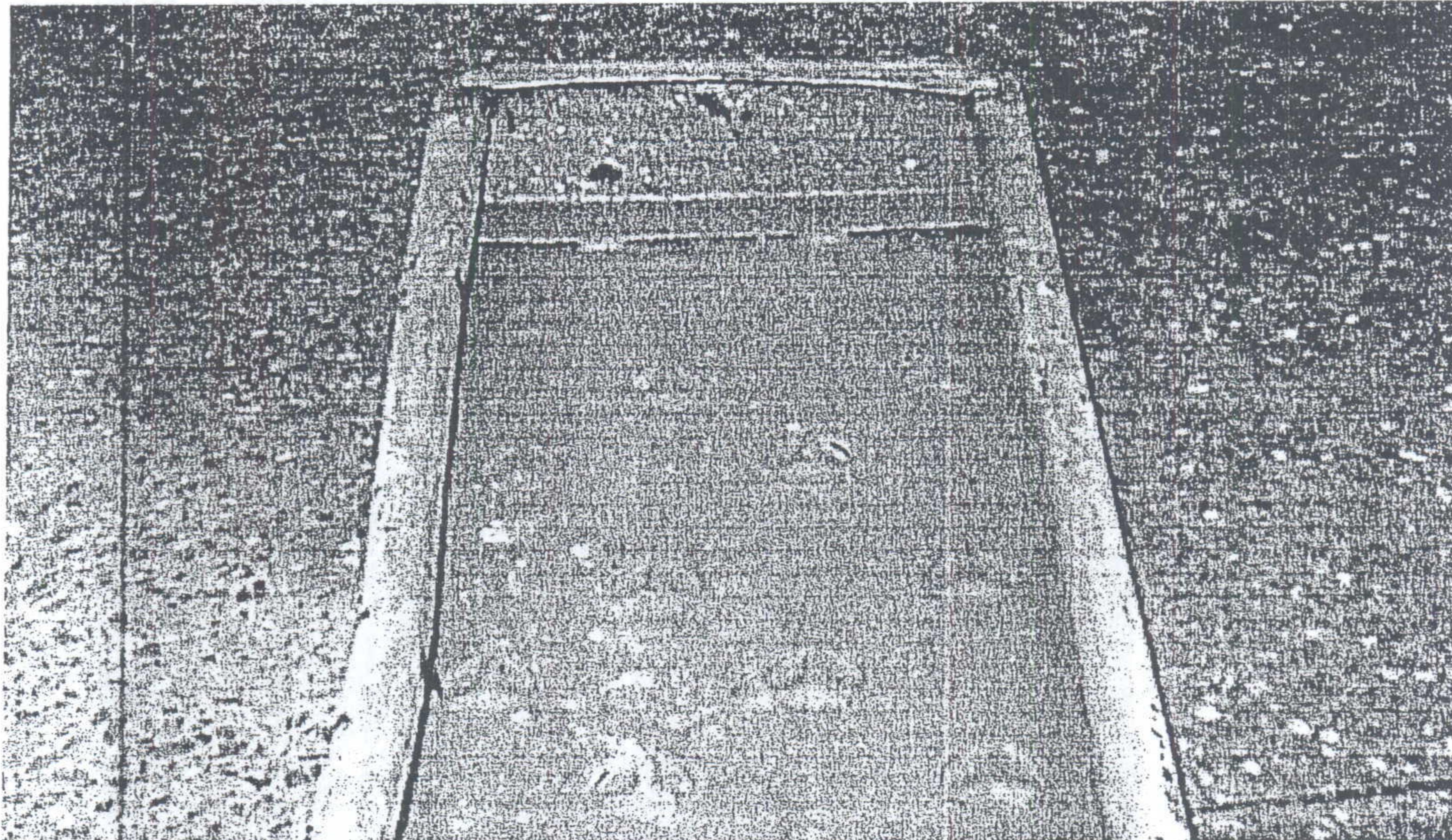
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Figure 8: View of samples T065901 (left) and T065902 (right) – metal and wooden planks respectively.



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Figure 9: View of sample T065901 (metal plank) showing some corrosion and deformation at the internal side.



3.2 Dimension and weight measurement

Wall thickness measurements were carried out on two scaffolding pipe samples, Samples T065895 and T065896. Results are presented in Table 2.

Table 2A
Wall thickness of scaffolding pipe – Sample T065895
(Circumferentially measurements)

Measurement position	Thickness (mm) ± 0.01 mm
	T065895
1	4.17
2	4.04
3	4.06
4	4.09
Average	4.09

For Sample T065895, wall thickness was measured at four (4) points around the circumference of the pipe.

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Table 2B
Wall thickness of scaffolding pipe – Sample T065896
(Longitudinal measurements)

Measurement Position	Thickness (mm) ± 0.01 mm
	T065896
1	1.20
2	3.95
3	3.28
4	3.81
5	3.76
6	3.33
Average	3.22

For Sample T065896, the six (6) points where measurements were taken are shown in Figure 9, Appendix II.

Dimensional and weight measurements were carried on the two plank samples, Samples T065901 and T065902. Results are presented in Table 3.

Table 3
Dimension and weight measurements

Sample ID	Thickness (cm) ± 0.1 cm	
Dimension	T065901	T065902
Length	242.0	241.7
Width	22.8	21.4
Height	6.5	5.7
Weight (kg) ± 0.02 kg	15.86	13.98

Dimensions measured are shown in Figure 10, Appendix II.

3.2 Hardness test

A Vickers hardness test profile was performed across the weld of Sample T065900. The results obtained are presented in Table 4. A macrograph of the sample tested is shown in Figure 11, Appendix II.

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Table 4
Vickers Hardness Test Traverse (HV₁₀) (Sample T065900)

Point	Weld		HAZ	Base metal					HAZ	Weld
	1	2		4	5	6	7	8		
Hardness Vickers	263	271	332	162	153	171	135	201	305	264

HAZ - Heat affected zone

3.3 Tensile test

Samples T065897 and T065898 were coupled as a unit and tested twice to determine the load bearing capacity of the friction joint. The results are presented in Table 5. A photograph showing the arrangement used for the test is presented in Figure 12, Appendix II.

Table 5
Tensile test results
Coupled Samples T065897 and T065898

Test No.	Load (kN)
1	2.98
2	3.12
Average	3.05

4. DISCUSSION

Based on the investigation conducted, the following are noted:

- The scaffolding pipe sample, Sample T065896 (#2 C&E – PK- 1 (14-07-2006)), shows severe corrosion on the internal surface of the pipe at the fractured section. See Figures 2, 3 and 4. The pipe has a welded patch and a metallic insert located between the main pipe and the extension. See Figure 4.
- The average wall thickness obtained in Sample T065895 is 4.09 mm. This sample did not show any signs of corrosion (internal and external) and was taken as a reference for assessing wall thickness. The fractured pipe, Sample T065896 (#2 C&E – PK- 1 (14-07-2006)) has an average thickness of 3.22

The word "not" was inadvertently omitted in report 3076/06. It is included in this report.

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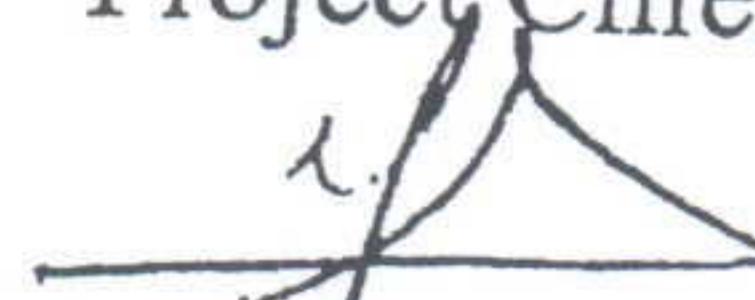
mm. A minimum wall thickness of 1.20 mm was measured at the fractured area, which represents an approximate 70% reduction in wall thickness in reference to sample T065895.

Sample T065899 (#5 C&E – PK- 1 Horiz. Plank brace (14-07-2006)) is a broken brace that contained a welded joint of rolled steel and cast metal. The weld was made by arc welding. Failure occurred at the weld. The hardness test shows a significant difference in hardness between the weld, heat affected zone (HAZ), and base metal, which indicates that a high level of stress was introduced at this location through the welding operation.

Technician(s):

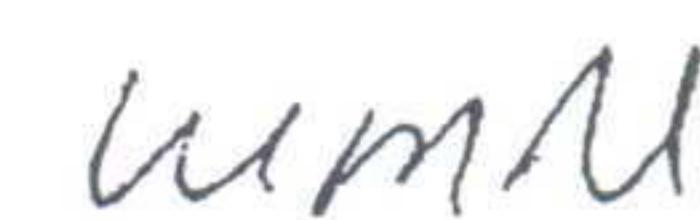
Rishi Deonarine

Project Chief:



Marco Nunes
Materials Engineer

Approved by:



Kamral Mohammed
Laboratory Manager
Industrial Materials Unit

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Appendix I

Copy of list of samples removed from site

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Date: 14 July 2006

Material Removed From Accident Site PK-1
Customs & Excise Building, Ground Floor, Ground Lines 1 & 3 a
S&N.

1 → 24" length, 1 1/2" dia, Scallold pipe

2 → 36" " " "

3 → 18" " "

4 → 24" length, 1 1/2" dia. " "

5 → 6" length; 4" x 2" Angle Iron Brace & Pin Assembly

6 → 2 1/2" length; pin section

7 → 8' x 8" x 2" Metal Scallold Plank

8 → 8' x 8" x 2" Wooden Scallold Plank

Logged by

Martin Richards, TA PM

Yackie

RICHARD FULCHAM MOWT

Bill Sibley

John DEMPSEY NHIC

KY

MARCO NUÑEZ

YD
JUL 14.06

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Figure 10 Overview of samples T065896 showing where the wall thickness was measured (points 1 to 6) in reference to the fractured side.

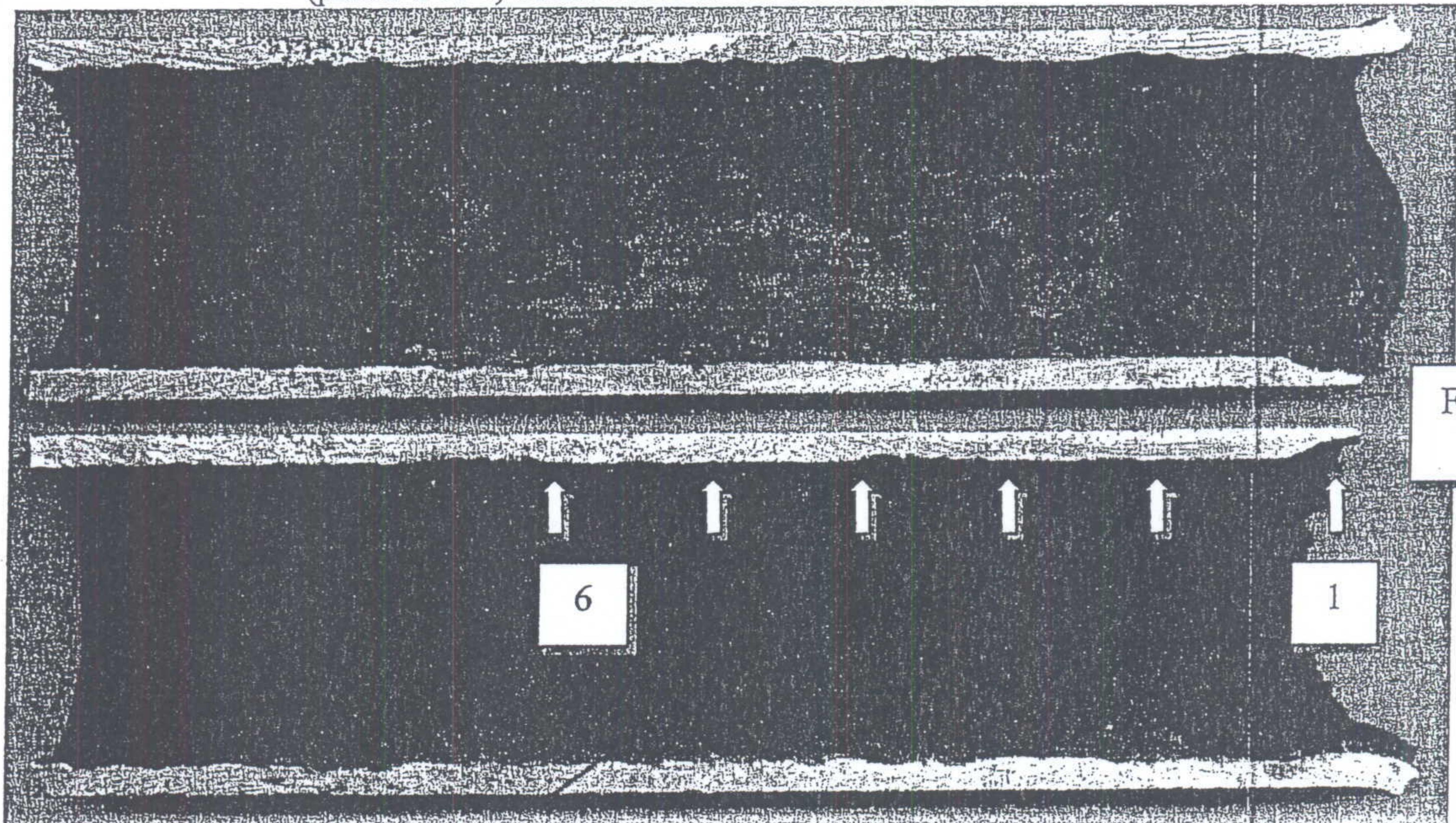
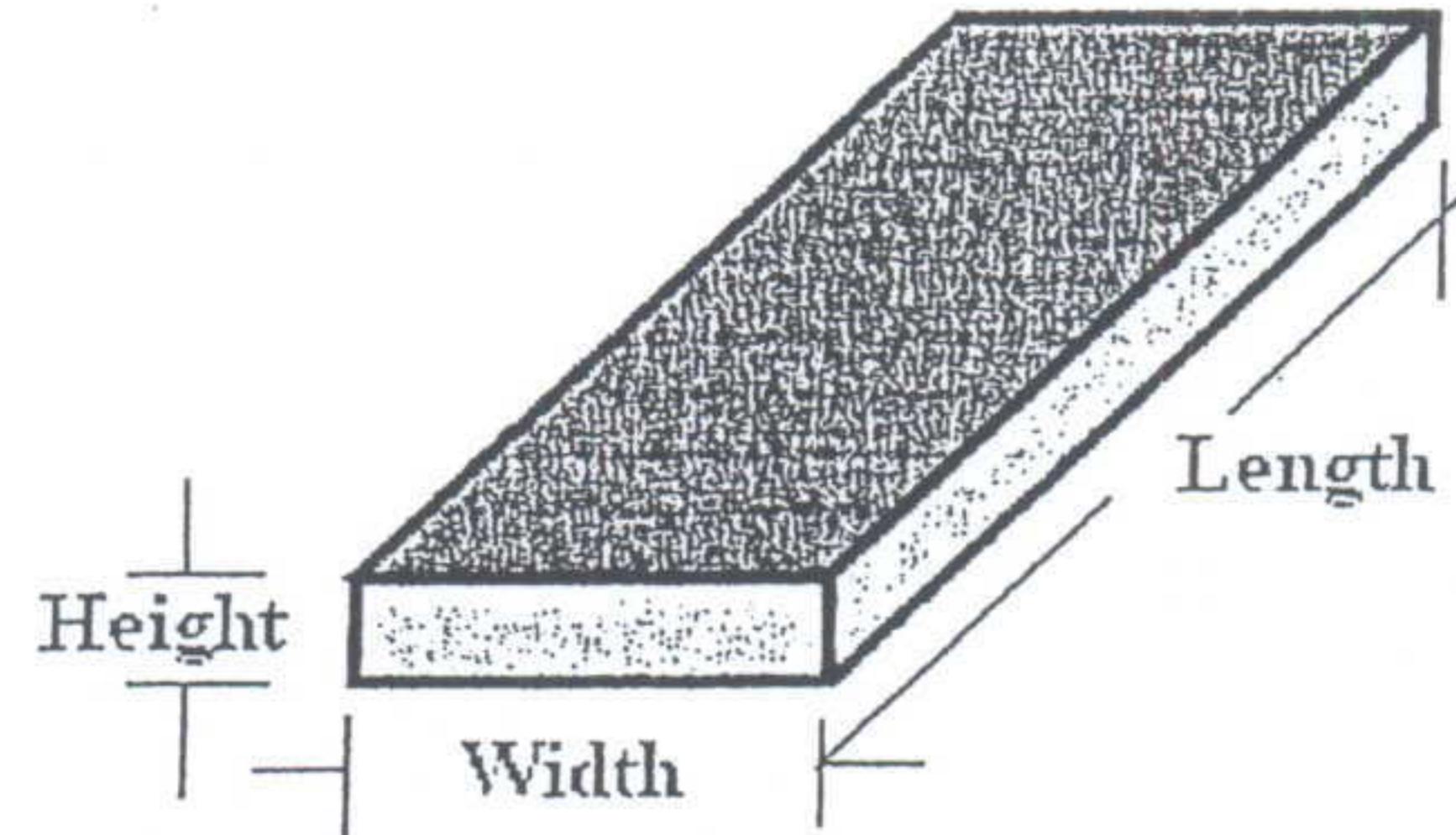
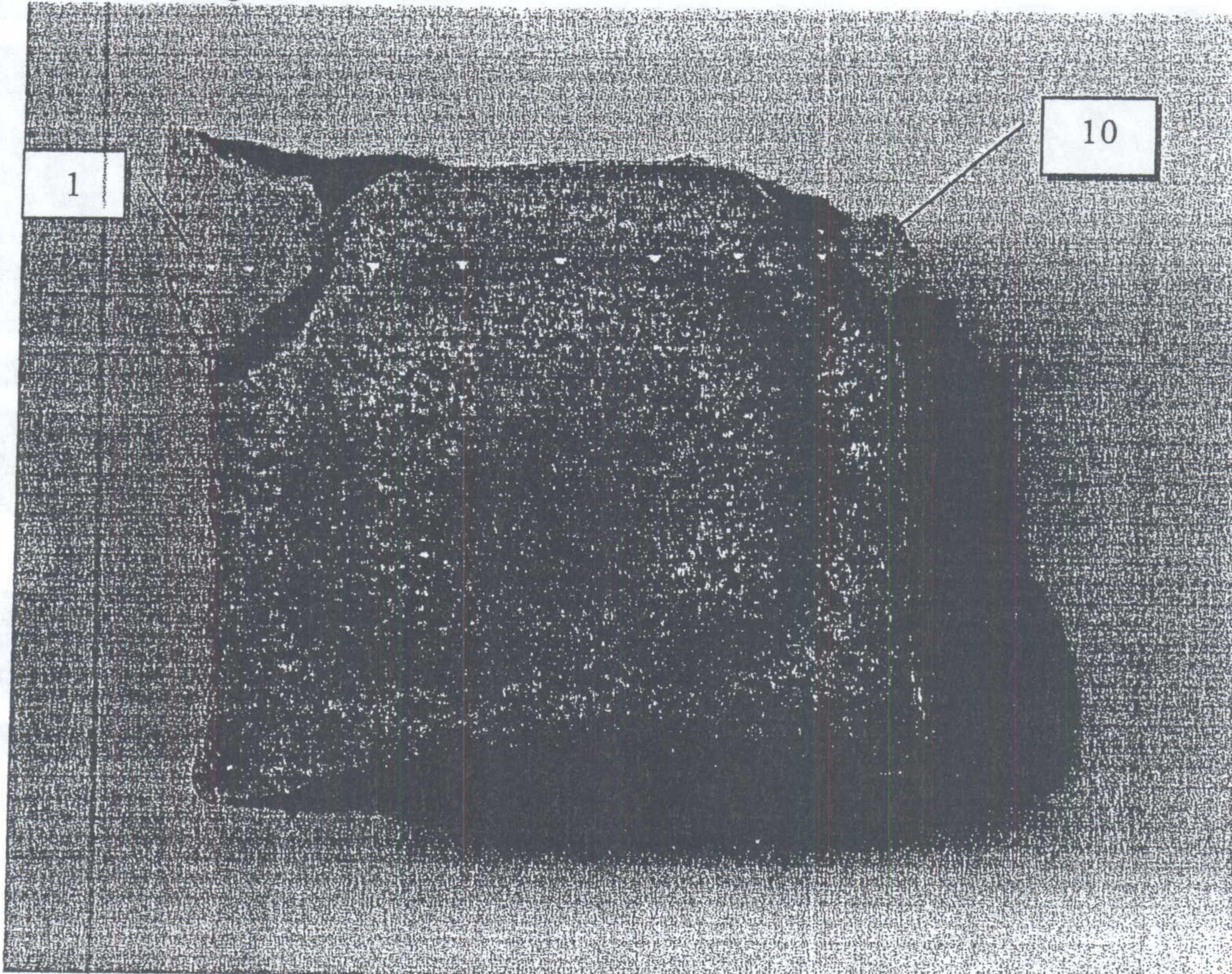


Figure 11 Sketch showing the dimensions measured in both planks



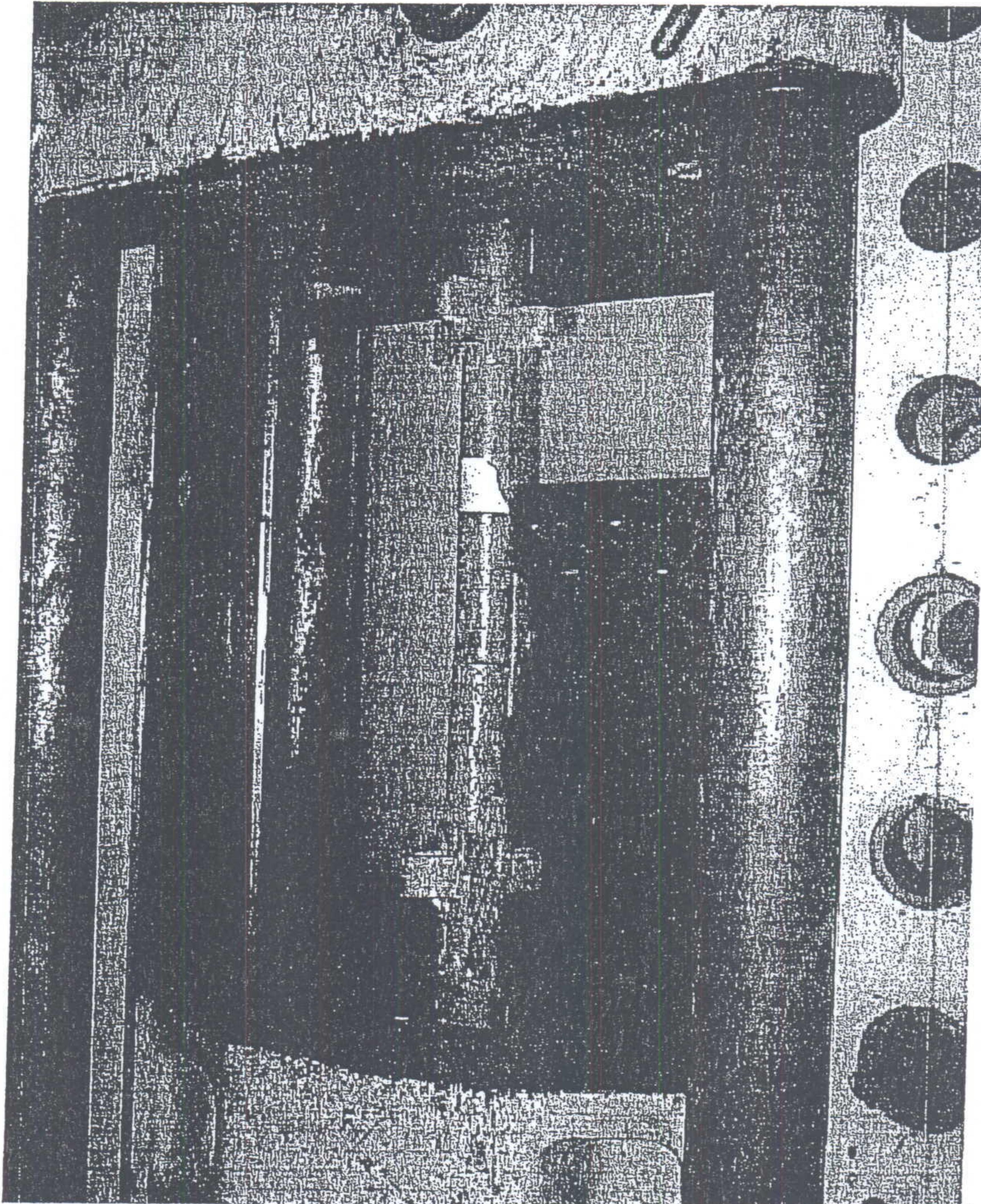
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Figure 12 Macrograph of sample T065900 showing the indentations from the hardness test.
Magnification 4.3X.



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Figure 13 Tensile test of friction joint



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