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NAVY DEPARTMENT

Report of Test

on

Shatterbond Coating

Submitted by

Wilbur and Williams Company
Boston, Massachusetts

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WASHINGTON, D. C.

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Note: See paragraph 18 for explanation of glass sample numbers.

AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and other references pertinent to this problem are listed as references (b) through (g).

Reference:

(a) BuShips Ltr. S62-2(2)(350) of 31 October 1942.
(b) Specification 17E13(INT) of 1 March 1942.
(c) NRL Test Report 311 of 16 September 1942.
(d) Mat'l. Lab. NYNYK Memorandum JJ 12G4(V-18-5-7) of 6 July 1942 to Public Works Officer.
(e) NRL Ltr. S62-2/L5(481) of 7 November 1942 to The Wilbur and Williams Company.
(f) Insl-X Co. Ltr. of 18 January 1943 to NRL.
(g) NRL Report No. P-1934 of 9 September 1942.

OBJECT OF TEST

2. The object of this test was to determine the shatter prevention qualities of the modified Shatterbond coating, when applied to 50 and 100 watt rough service lamps. Additional information was obtained relative to the value of the coating on flat instrument dial window glass to prevent its shattering under high intensity shocks.

ABSTRACT OF TEST

3. Lamps coated at Insl-X Company Laboratories and those coated at the Naval Research Laboratory were set up under suitable conditions and life tests run on them. As the results of these tests were unsatisfactory, HI shock tests were not conducted on any of the sample lamps. Instrument dial window glasses, suitably coated, were subjected to HI shock tests.

CONCLUSIONS

(a) As an emergency measure to protect personnel or reduce the amount of flying particles, the application of Shatterbond to glass not subject to high temperatures will provide a degree of protection, though it is believed better means of protection are available.

(b) In applications where high temperatures will be encountered, this material will be of no value since it will become translucent and brittle.

(c) Extreme care must be taken in the application of the material and, in such applications as instrument dial windows, where the dipping method is used, difficulty will be encountered in obtaining bubble free coatings.

(d) In general, the application of a coating to one side of the material to be shatterproofed will give some protection against the expulsion of glass on the side to which the coat is applied, but no protection will be furnished on the other side due to the low degree of adhesion to the glass.

OMMENDATIONS

(a) That the Shatterbond protective coating be considered UNSATISFACTORY for Naval use as a shatterproofing material for lamp bulbs.

(b) That the Shatterbond protective coating be considered of little value for shatterproofing instrument dial windows.

(c) That, if additional information is desired on this Shatterbond protective coating, or other coatings, arrangements be made to conduct explosion tests on the samples.

DESCRIPTION OF MATERIAL

4. The material tested was a revised formulation of the material tested under reference (c). Only a single grade was used. Some of the lamps and glasses were coated with this material by the Insl-X Company, Inc. and some were coated at the Naval Research Laboratory.

METHOD OF TEST

5. Eighty 100 watt and seventy-five 50 watt rough service lamps were coated at NRL by dipping, each receiving three coats. They were dipped vertically base up and allowed to drain until the bulk of the material had run off. They were then inverted base down and allowed to dry in air. The material as received was used at first, but the thinner as supplied by the company was added at times to keep the material at a nearly constant viscosity.

6. Thirty 100 watt rough service lamps were coated in a similar manner by The Insl-X Co., Inc. as described in reference (f).

7. Life tests were run on the 100 watt lamps mentioned in paragraph 5 as follows:

Seventeen were burnt in a base up position for 300 hours at rated voltage; two were burnt 50 hours base up; two were burnt 20 minutes base up and 300 hours horizontally; one was burnt 20 minutes base up and 50 hours base down.

8. Two of the 50 watt lamps mentioned in paragraph 5 were burnt in a base up position in an enclosed deck fixture for 300 hours.

9. Two of the 100 watt lamps mentioned in paragraph 6 were burnt in a base up position for 300 hours.

10. At this point the tests on the lamps were discontinued due to failure of the material to withstand the temperatures produced by the lamps.

11. The following flat glass instrument dial windows were supplied by The Insl-X Company, Inc. in 10-inch discs:

4 uncoated double strength window glass, 1/8" thick.
5 uncoated plate glass, 3/8" thick.
3 coated on both sides, double strength window glass, 1/8" thick.
3 coated on both sides, plate glass, 3/8" thick.
1 coated on one side, double strength window glass, 1/8" thick.
3 coated on one side, plate glass, 3/8" thick.

12. Of the 4 uncoated double strength windows, two were tested as received and two were coated with three coats on both sides by dipping in the solution and allowing to air dry.

13. Of the five uncoated plate glass windows, two were tested as received, two were coated on two sides, and one was coated on one side.

14. All the other samples were tested as received.

METHOD OF TEST (Cont.)

15. The test on these samples consisted of placing them between 2 Gaskoid gaskets in a specially constructed dummy instrument case mounted on a reinforced subpanel which was mounted on reinforced channels on the HI shock machine and subjecting them to blows as indicated in the Results of Tests. Further details of the mounting can be seen in the plates (5) through (17).

RESULTS OF TEST

16. After the lamps that had been coated with the Shatterbond had been burnt for as little as 20 minutes, the coatings became brittle and on cooling cracked. After longer burning periods, the coatings discolored to a dark brown and at places melted on the glass and formed thick brown ridges. The position of the lamp while burning affected the location of the areas where the coatings melted but not appreciably the extent to which they melted. Some of these lamps can be seen in plates (2) and (4).

17. The coatings on the fifty watt rough service lamps did not deteriorate as much as the coatings on the 100 watt lamps, but these coatings also became very brittle and discolored to a dark brown. However, the coating did not melt or form ridges as in the case of the 100 watt lamps. These lamps can be seen in plate (1).

18. The results of the HI shock test are as follows:

Glass Sample No.	Coated by.	No. of Sides Coated.	Type Glass	Position of Coated Side	Shock in Ft. Lbs. 250	500	750	1000	1500	2000
1	-	0	DSWG	-	*	*	S			
2	-	0	DSWG	-	*	S				
3	-	0	PG	-	*	B	S			
4	-	0	PG	-	B	S				
5	Insl-X	2	DSWG	-	*	*	B	*	FB	
6	Insl-X	2	DSWG	-	B	FB				
7	Insl-X	2	DSWG	-	*	*	B	FB		
8	NRL	2	DSWG	-	*	*	*	B	FB	
9	NRL	2	DSWG	-	*	B	FB			
10	Insl-X	2	PG	-	*	*	*	*	*	FB
11	Insl-X	2	PG	-	*	B	*	*	*	FB
12	Insl-X	2	PG	-	*	B	FB			
13	NRL	2	PG	-	*	*	*	B	FB	
14	NRL	2	PG	-	*	*	B	*	FB	
15	Insl-X	1	DSWG	out	*	*	B	S		
16	Insl-X	1	PG	out	*	*	*	S		
17	Insl-X	1	PG	in	*	*	*	*	*	S
18	Insl-X	1	PG	out	*	*	*	B	FB	
19	NRL	1	PG	out	*	*	*	*	B	S

Notes: All blows were horizontal back blows.

RESULTS OF TEST (Cont'd)

DSWG -- Double Strength Window Glass
PG -- Plate Glass
* -- Indicates that no change occurred at this blow.
B -- Indicates that the glass broke, film intact.
S -- Indicates that the glass shattered, film intact.
FB -- Indicates that the film broke and the glass shattered.

COMMENTS ON RESULTS OF TEST

19. The tests on the lamps were discontinued on two counts:

(1) The Shatterbond coating became brittle and valueless as a shatterproofing material. It was also noted that several weeks after the life tests were stopped, the coating began to flake off.

(2) The material became brown and nearly opaque in some areas, greatly reducing the efficiency of the lamps.

20. Before heating, the lamp coatings appeared to have good transmission qualities.

21. Due to the inconsistency of the tests on the dial windows, the results can be considered as indicative of the value of the coating, but not conclusive.

22. No explosion tests were made, and no attempts were made to correlate the results of shocks as delivered on the HI shock machine, such as reported here, and those delivered by explosion, such as reported in reference (g). Considerable work has been done on protective coatings, both in this country and in England, but generally the tests have been either direct impact or explosion tests. Only in report, reference (g), have shock tests and explosion tests been conducted on the same material, and even here there were not sufficient samples to get any correlation. Therefore, the results reported can only be taken as indicative of effects due to high intensity shocks, and not to explosion. It is believed however that relative merit between two samples as shown on the HI shock machine will also hold true to a considerable degree for explosions.

23. The test setup on the HI shock machine for the instrument dial windows was a steel dummy instrument case especially designed to provide the severest possible shock, i.e. the greatest acceleration, with a minimum of bending or otherwise placing nonuniform stresses on the glass. It does not attempt to simulate actual shipboard mountings for instrument dial windows except in general plan for securing the glass in the case. Therefore, the results of the tests do not indicate the probable performance of glass windows subjected to shock under all shipboard conditions, where in some instances considerable flexing of the cases may be expected. The results are comparative for the types of glass tested and give an index of the protection provided by the coating.

24. The plate glass demonstrated itself to be no stronger than the double strength window glass, though it was considerably thicker.

COMMENTS ON RESULTS OF TEST (Cont'd)

25. In the matter of protecting personnel, the single coat, when placed on the outside, had the advantage over the double coat since the broken glass fell away from the film instead of being retained between the films to cut through on the suceeding blow. This kept the flying glass inside the instrument. However, the flying glass could cause considerable damage to the instrument.

26. Four months after the coatings were applied there appeared to be little deterioration of the film due to aging as long as the samples were not heated, though the samples were not in an exposed position. The bond between the coating and the glass, however, appeared to have been weakened.

27. The addition of the protective coating appears to slightly increase the HI shock resistance of the glass. In the case of the double strength window glass with a coat on each side, the glass broke and on the following blow, the film broke. In the case of the plate glass coated on both sides in several instances the glass broke and then the film did not break until several blows later, indicating that a stronger coat was deposited in preparing the samples.

28. There was very little evidence of the broken glass adhering to the film. Had this bond been greater, the shatterproofing properties of the material would have been greatly increased.

29. While difficulty was experienced at the Laboratory in obtaining a good coat on the glass, i.e. a coat that was reasonably free from air bubbles, there was no evidence that the coats obtained were any weaker than those supplied by the Insl-X laboratories, or that there was less adhesion between the film and the glass.

30. When the glass windows are correctly dipped, the protective coat only very slightly cuts down the transmission of the glass; but some experience is required to obtain satisfactory coatings.

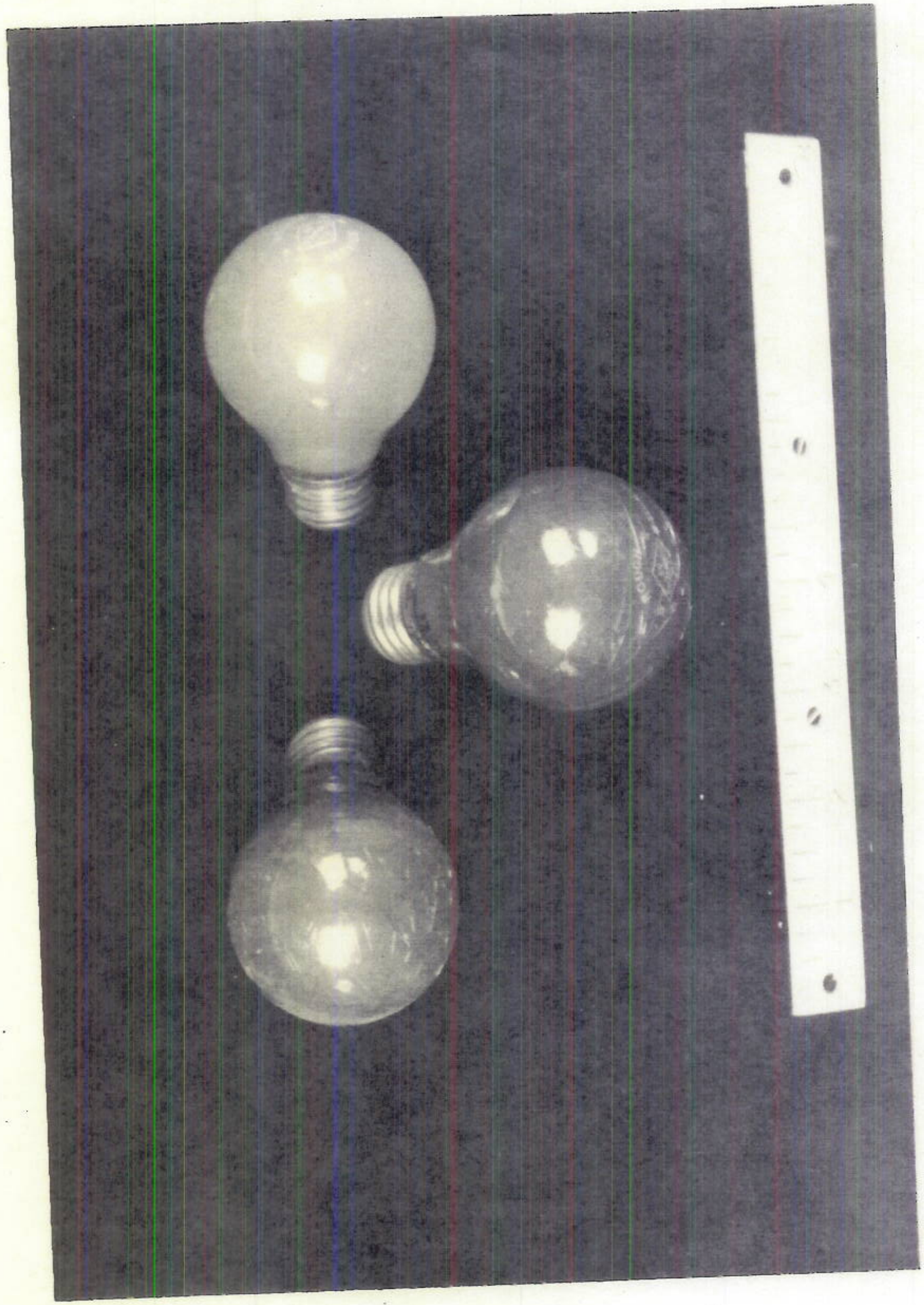
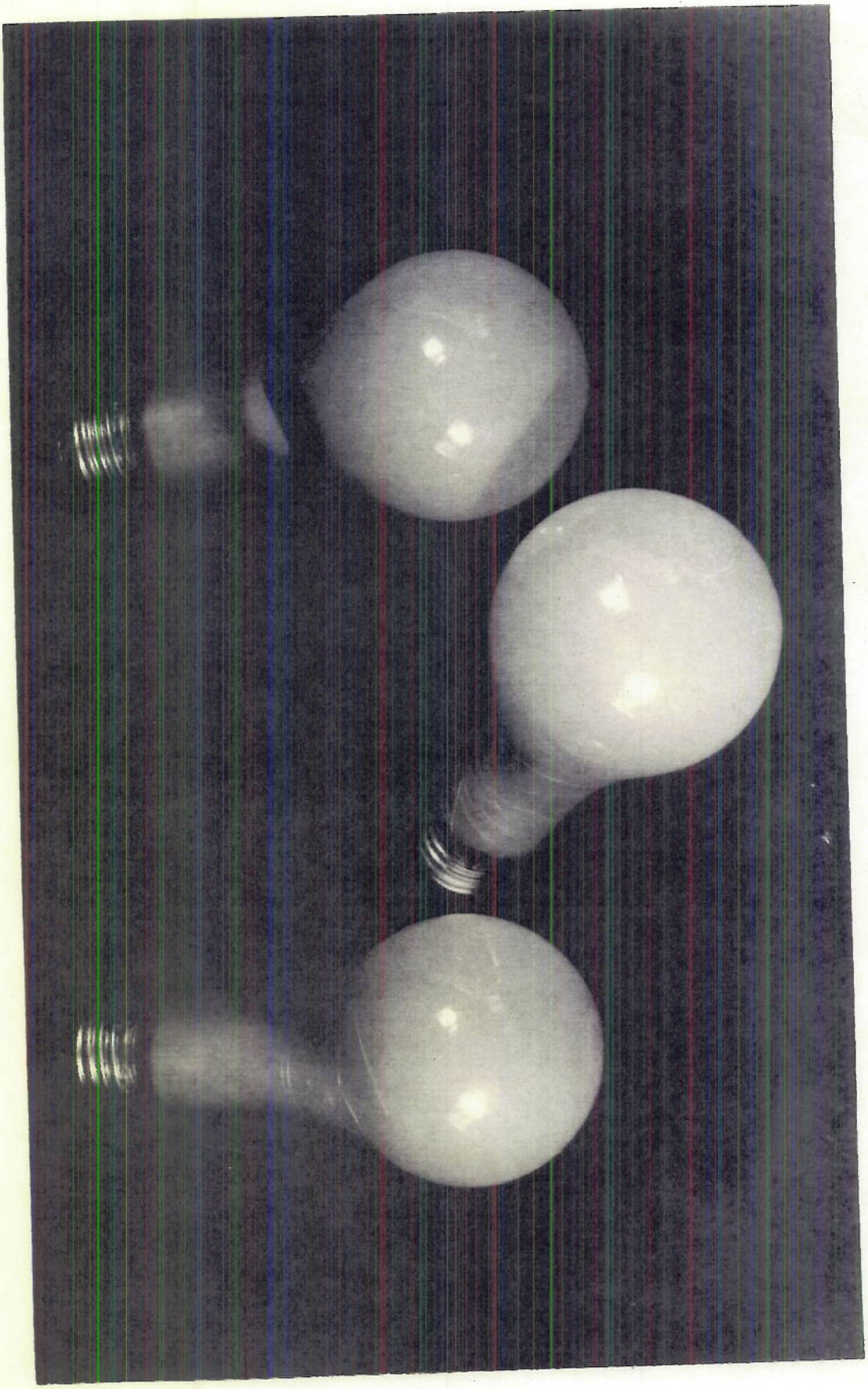


PLATE I



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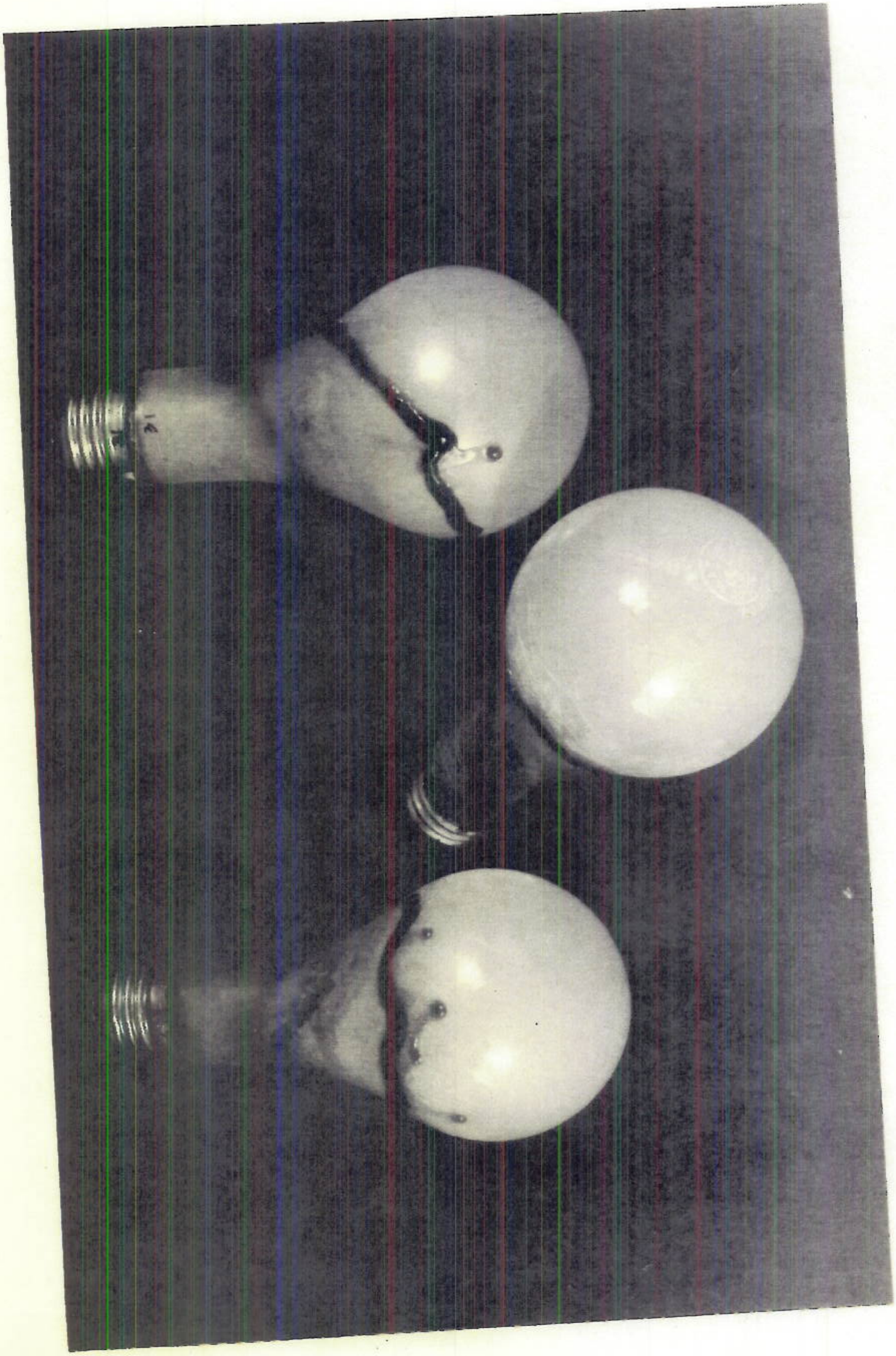

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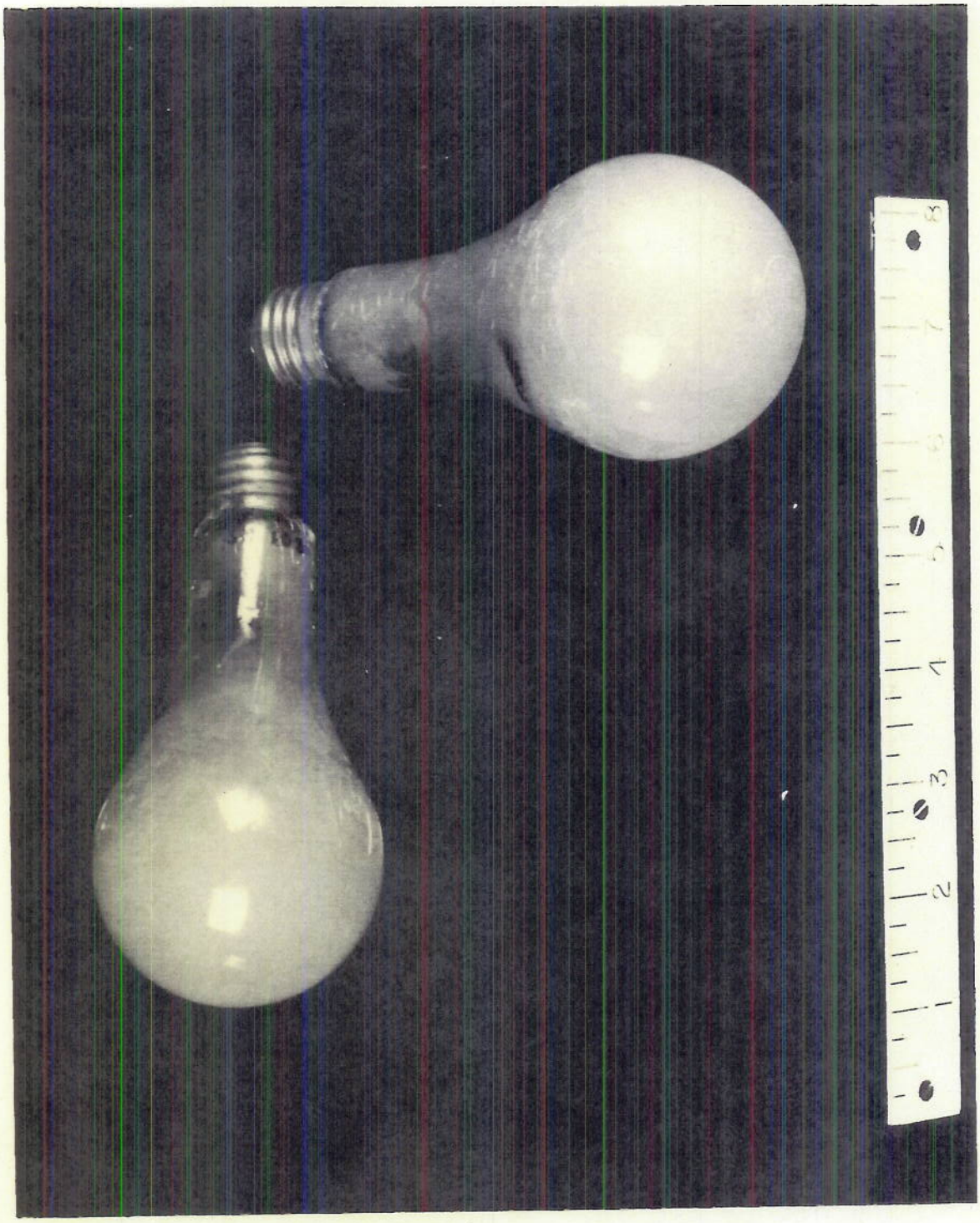

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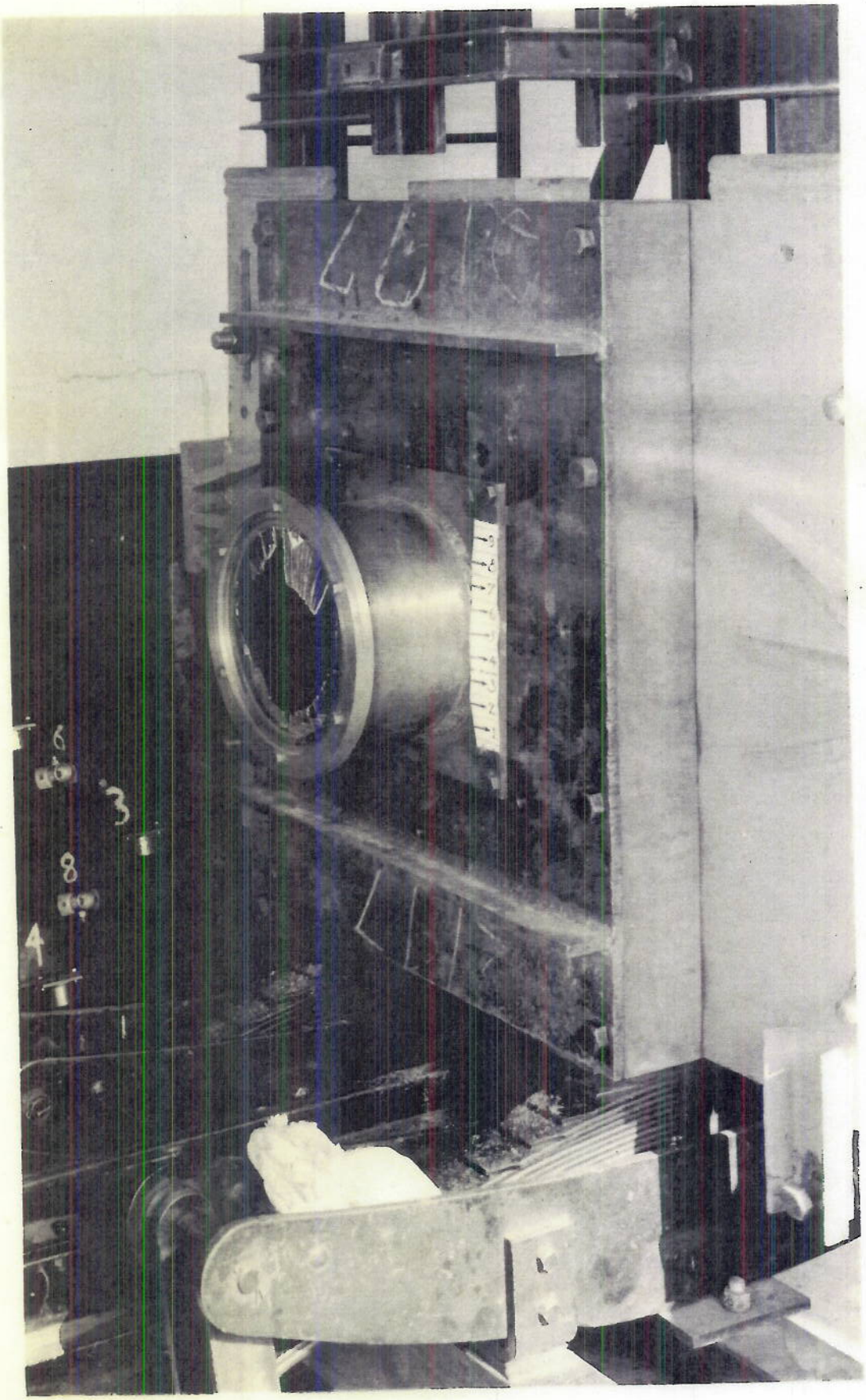
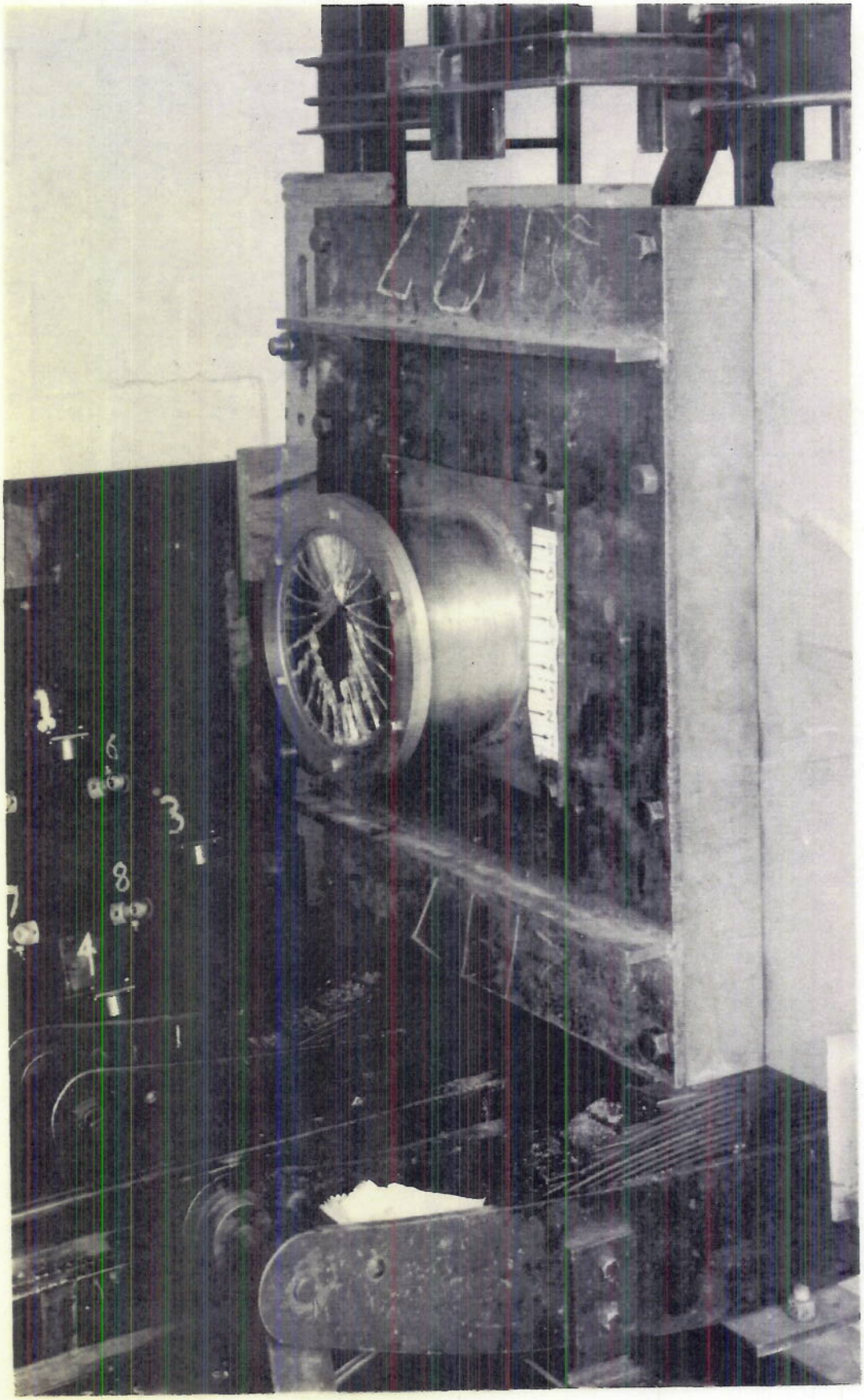


PLATE 5

PLATE 6



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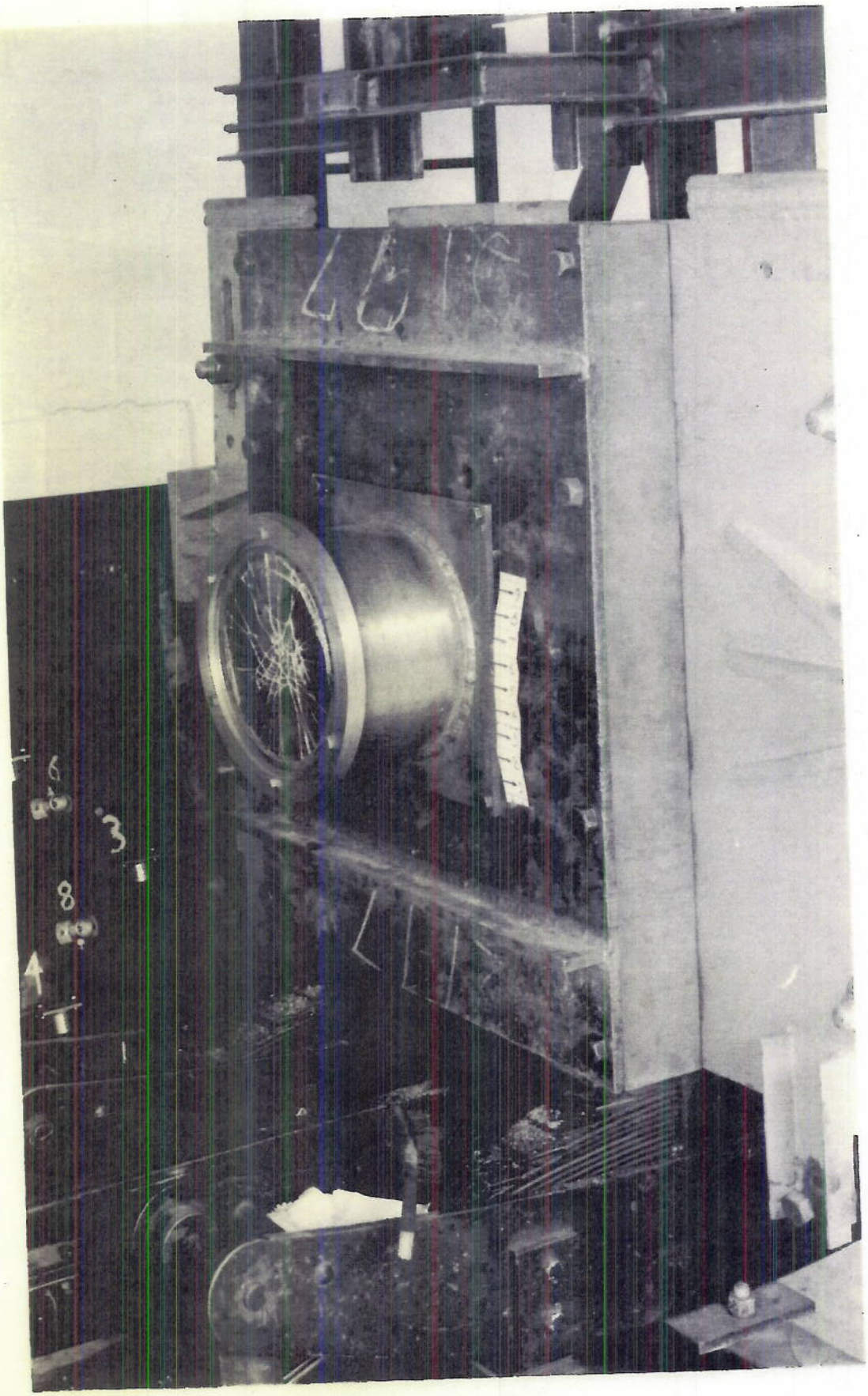

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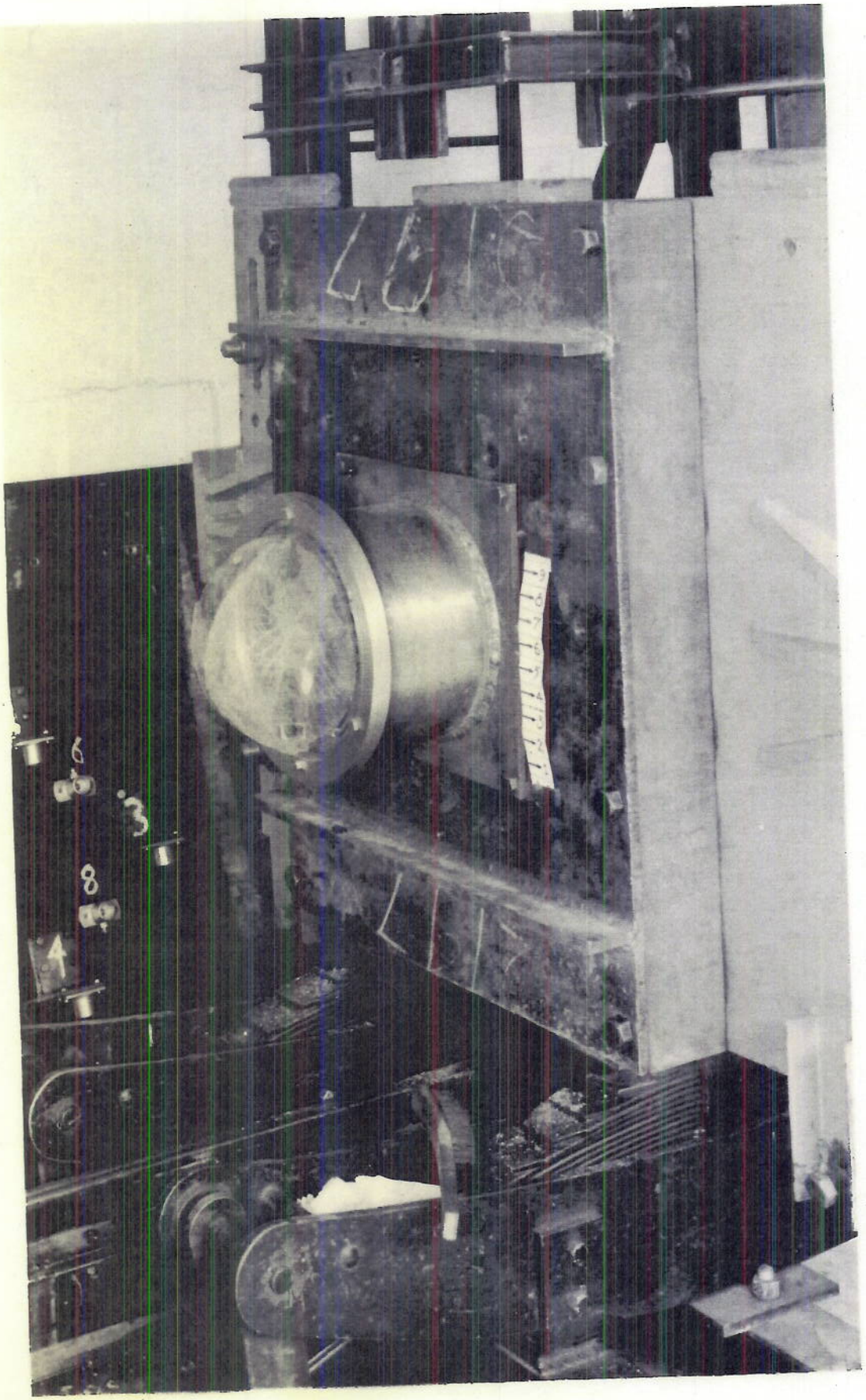

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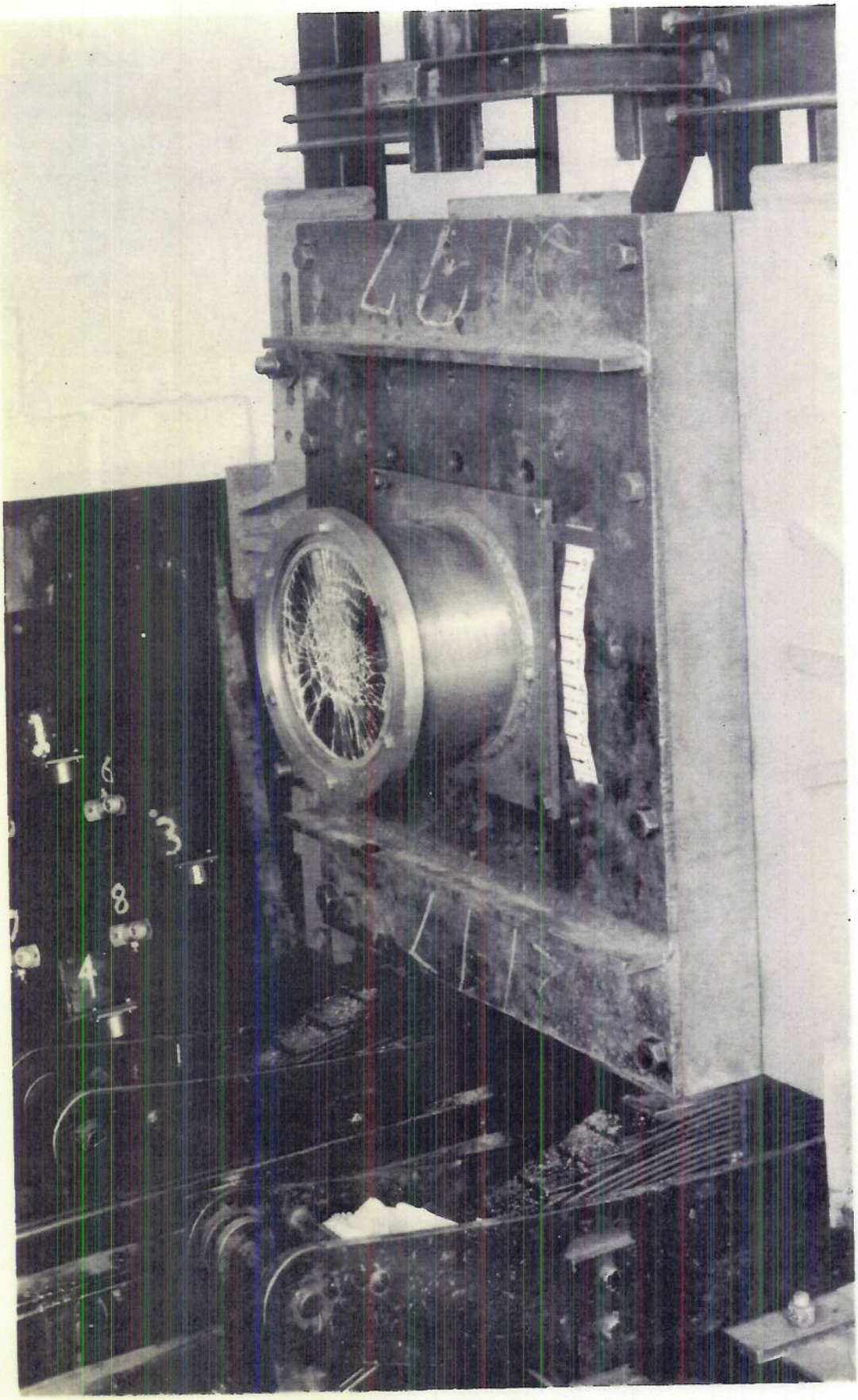

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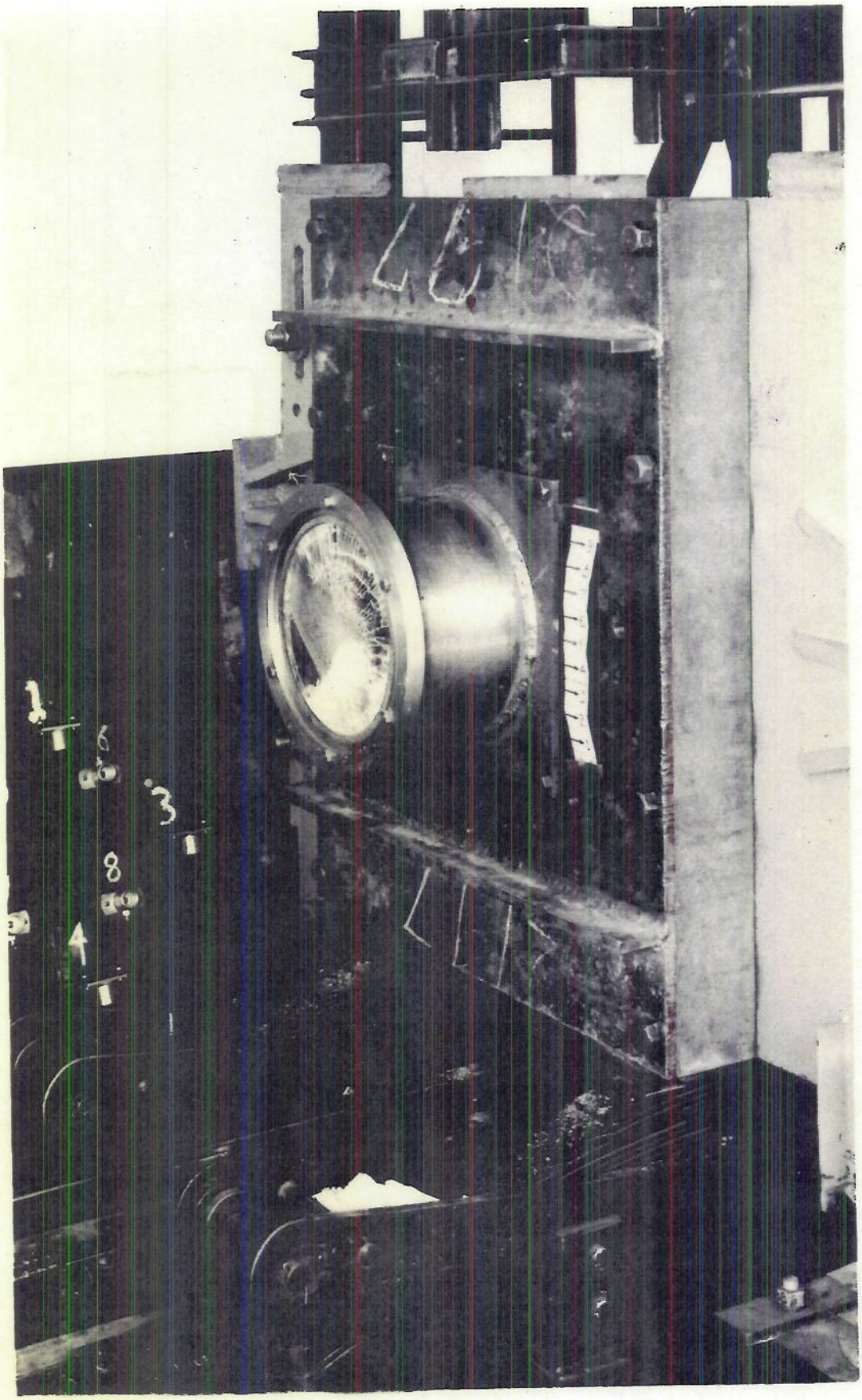
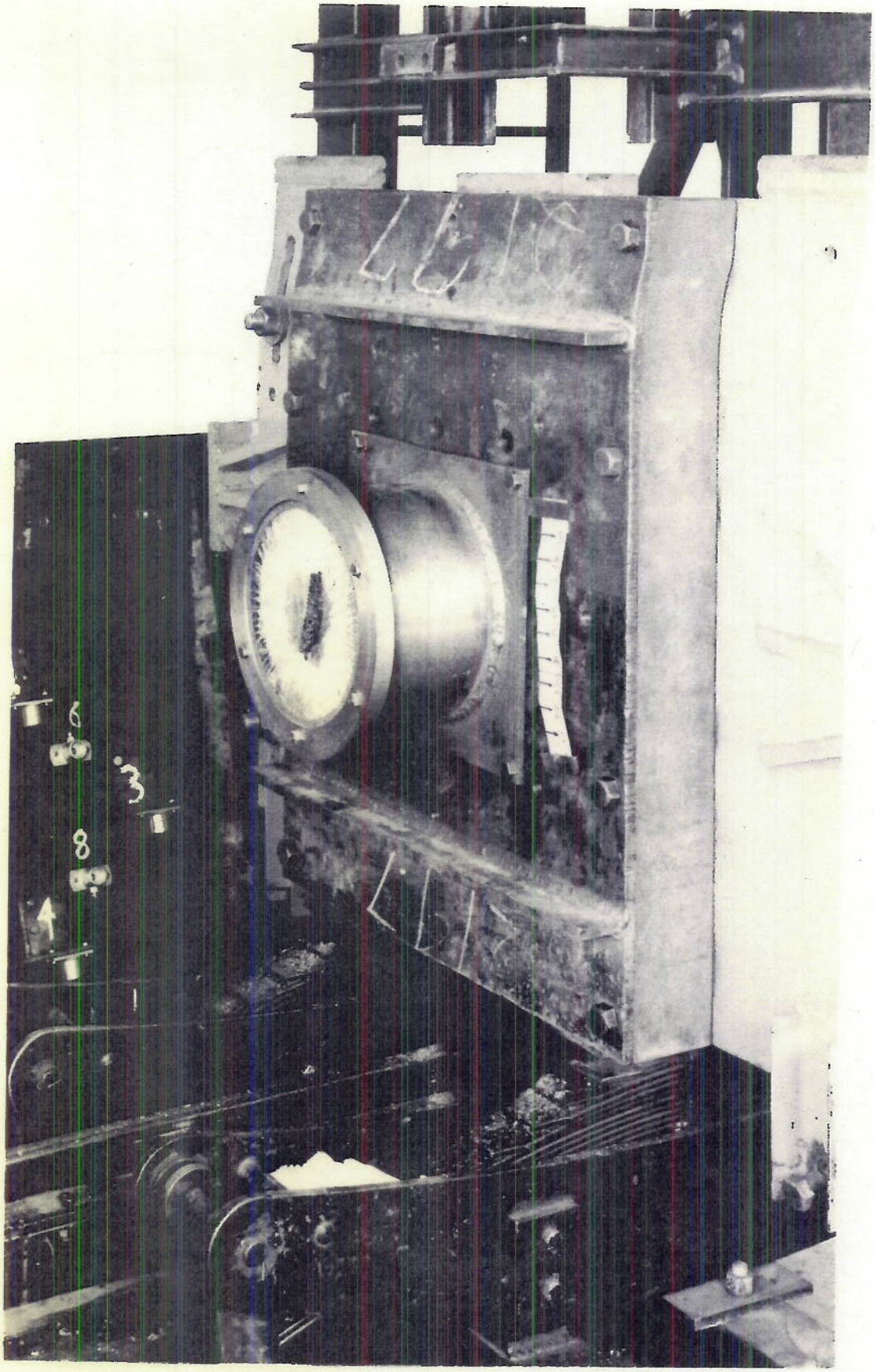


PLATE 11

PLATE 12

PLATE 13



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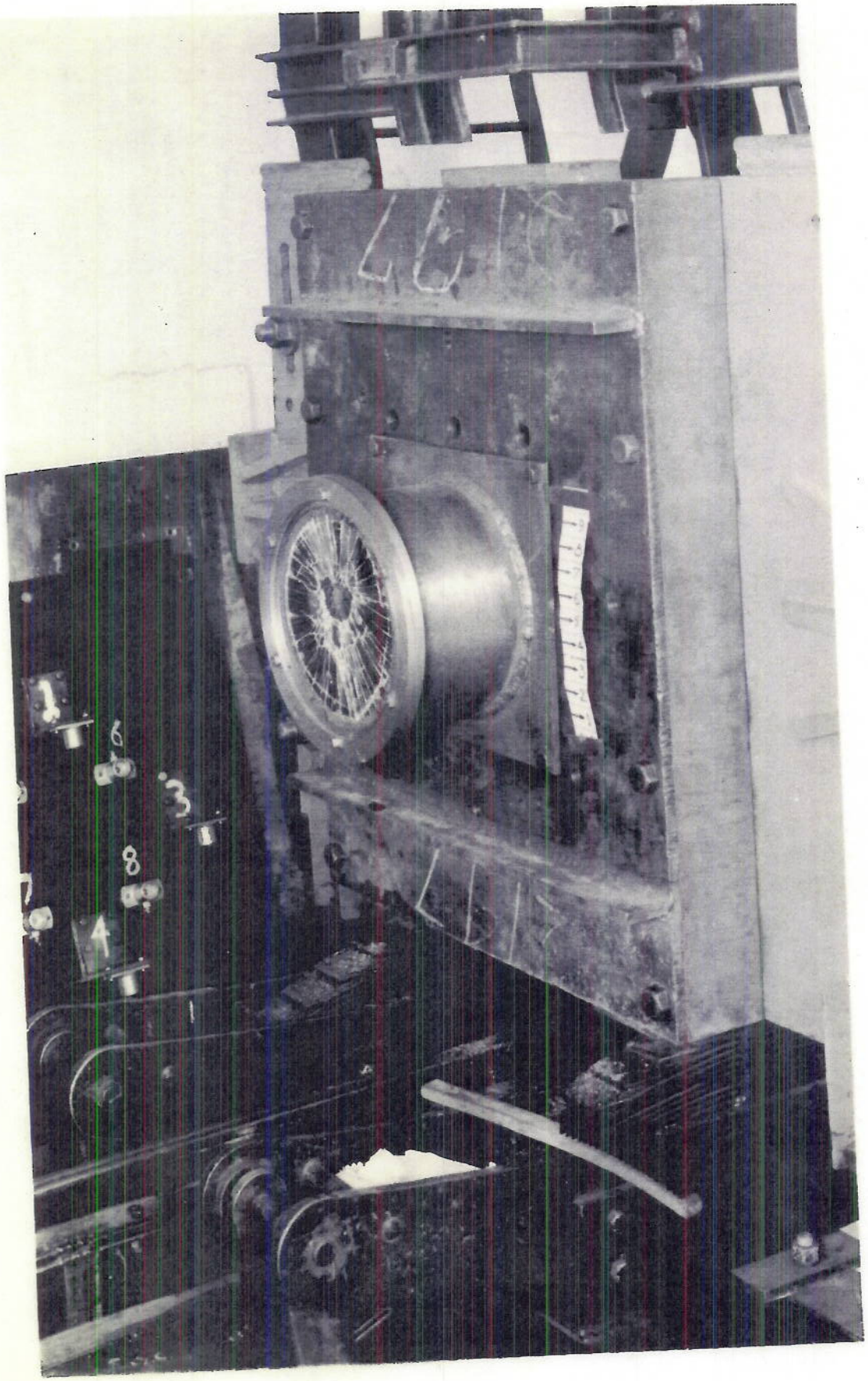

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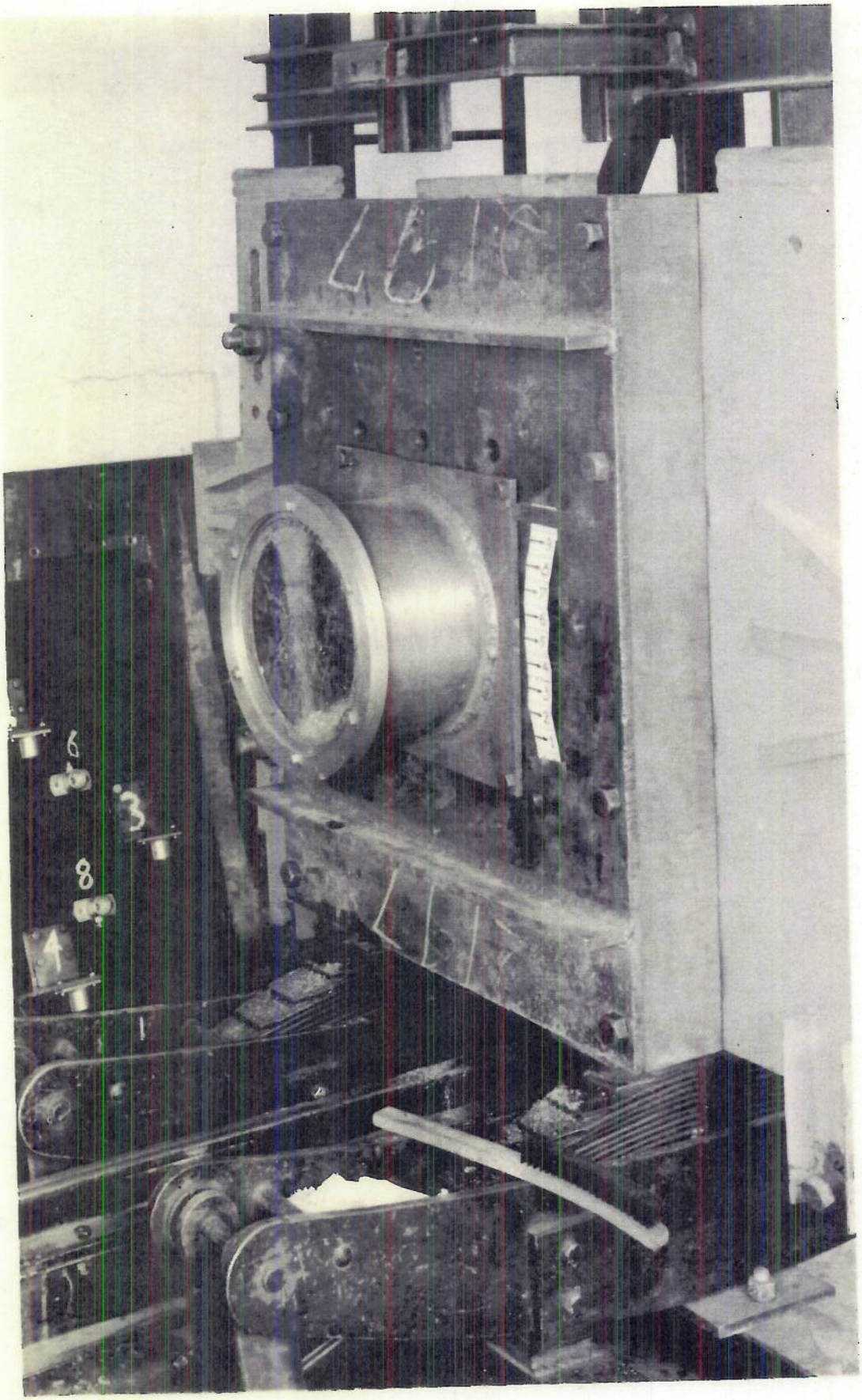

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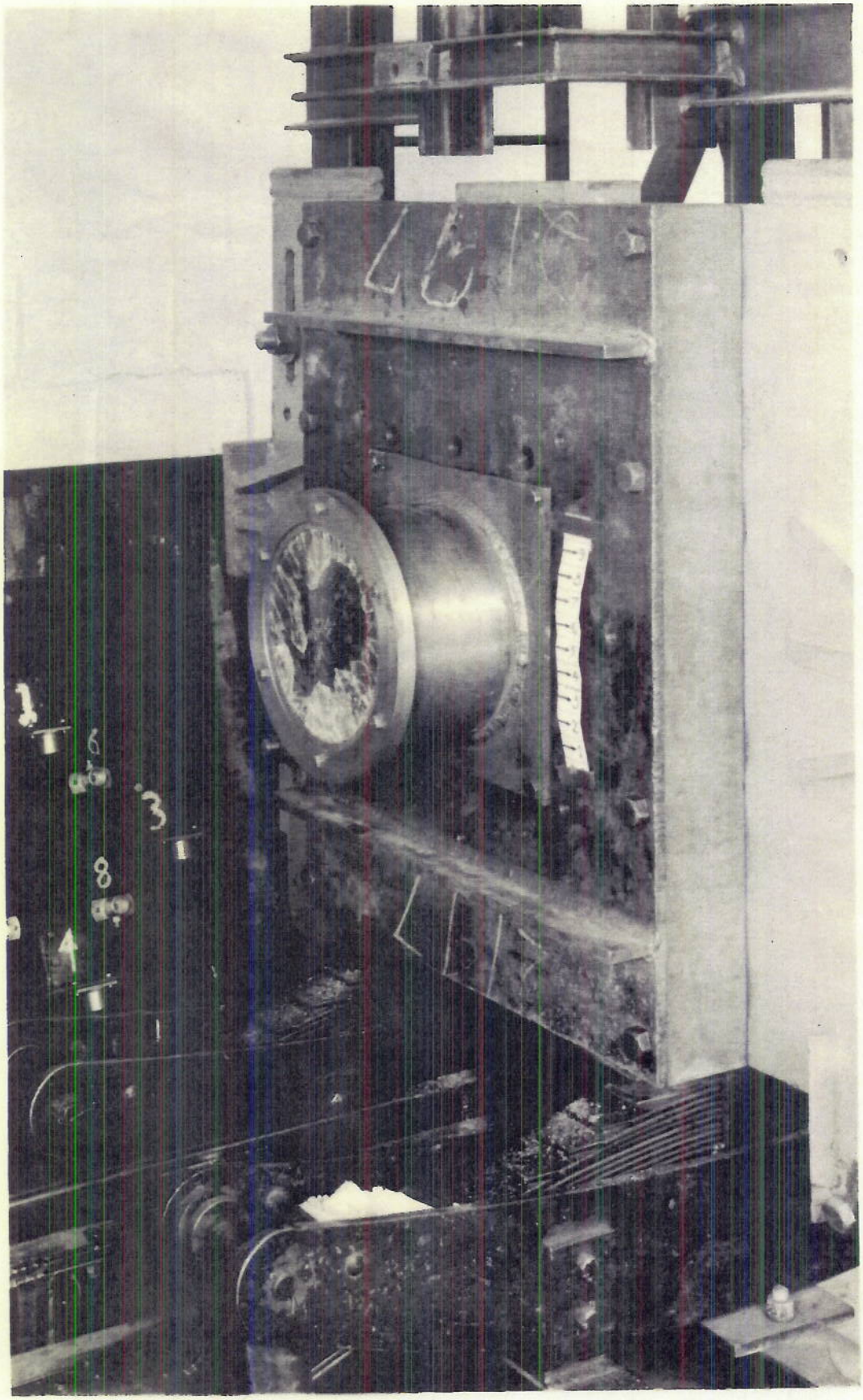

PLATE 17