TEST REPORT ON

CYCLIC MOVEMENT OF BEMO USA CORPORATION'S BEMO STANDING SEAM PANEL SYSTEM (24 GA., 16" WIDE PANEL)

TESTED FOR:
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TEST WITNESSED BY:
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TESTING DATES: March 4 to 10, 2004
REPORTING DATE: March 30, 2004

ENCON® Project C1336-2

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4.05.2004

SECTION I

1.1 SUMMARY & RESULTS

Test was conducted on Bemo USA Corporation's 16" wide, 24 ga. Bemo standing seam metal roof panel and clip at ENCON[SM] Consultants, Inc.'s Test Facility, Tulsa, Oklahoma. The purpose of the test was to determine the wear and tear of the panel and clip after repetitive cyclic movement.

The above test was witnessed by John Weller, P.E., and Bala Sockalingam, Ph.D., P.E., of ENCON Consultants. The test was conducted using two piece sliding Bemo panel clips. The height of the clip was 3-1/4" and the length of the upper clip tab was 3". Half of the clips used in the test consisted of stainless steel clip tab and base and the other half consisted of stainless steel tab and galvanized base. The clip tab was capable of translating ±1-7/8". The clip base was attached to a 16 ga. purlin with 2 each #1/4-14 self- drilling fasteners. The panels were then seamed with mechanical seaming tool to form the panel seam. The panels spanned over 3 supports with spans being 3.5' and 5.0'. The clips were subjected to positive load of 10 lbs each.

The panels were attached to the piston of the air cylinder, which moved the panels a distance of 0.5" on either side of the clip centerline (1" total travel). The time period of each cycle was approximately 5.2 sec. The panel and clip setup was subjected to 100000 cycles. The test was started on March 4, 2004 and concluded on March 10, 2004.

The test setup was inspected periodically for wear and tear. The panel and clip setup continued to slide after 100000 cycles. The panel showed no signs of wear through the top. The contact surfaces between the clip and panel showed no signs of wear. There was some wear on the contact surfaces of the clip tab and base. This did not impair the function of the clip and the panel and clip tab continued to move with respect to the clip base.

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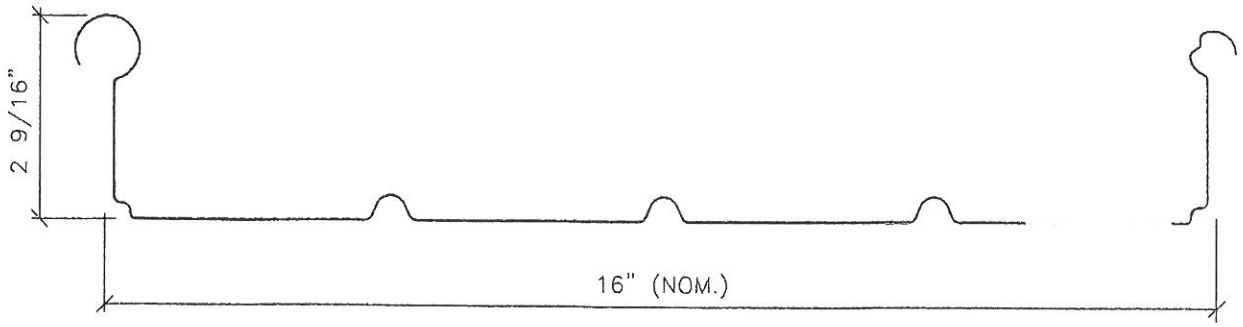
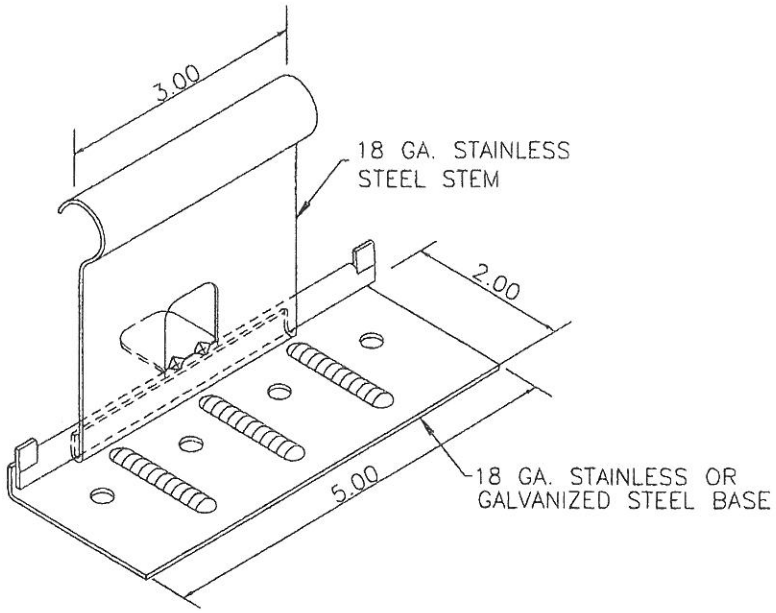
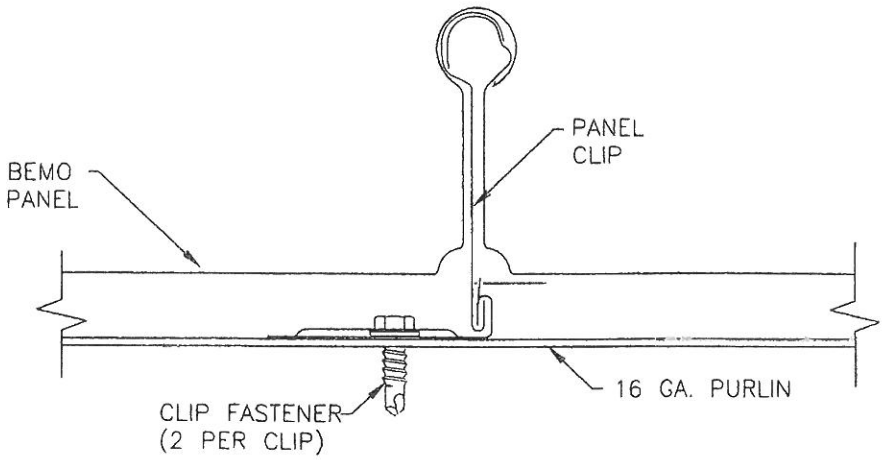


24 GA. BEMO PANEL



BEMO CLIP



PANEL SIDELAP

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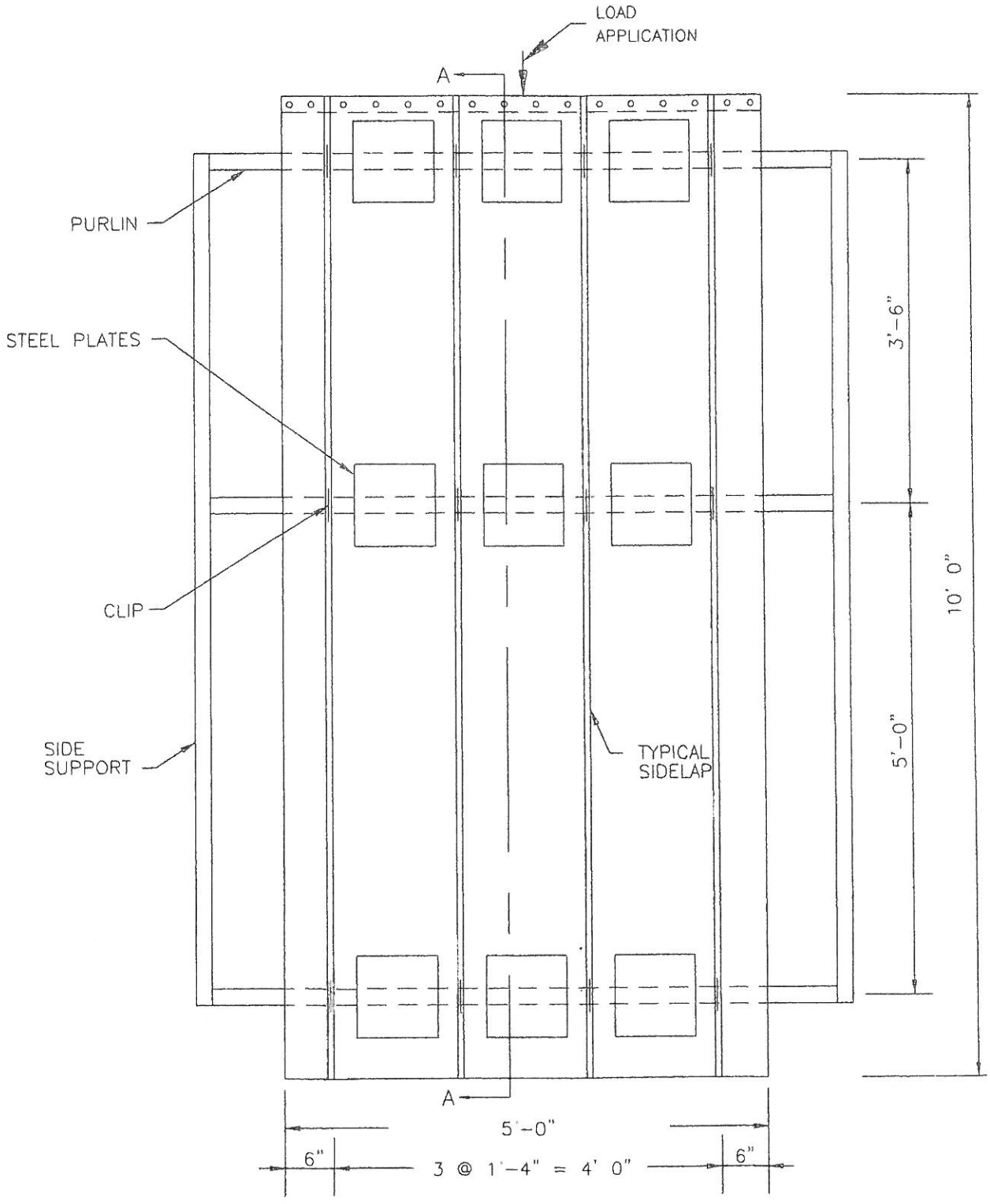

1/1 PLAN VIEW OF TEST ROOF

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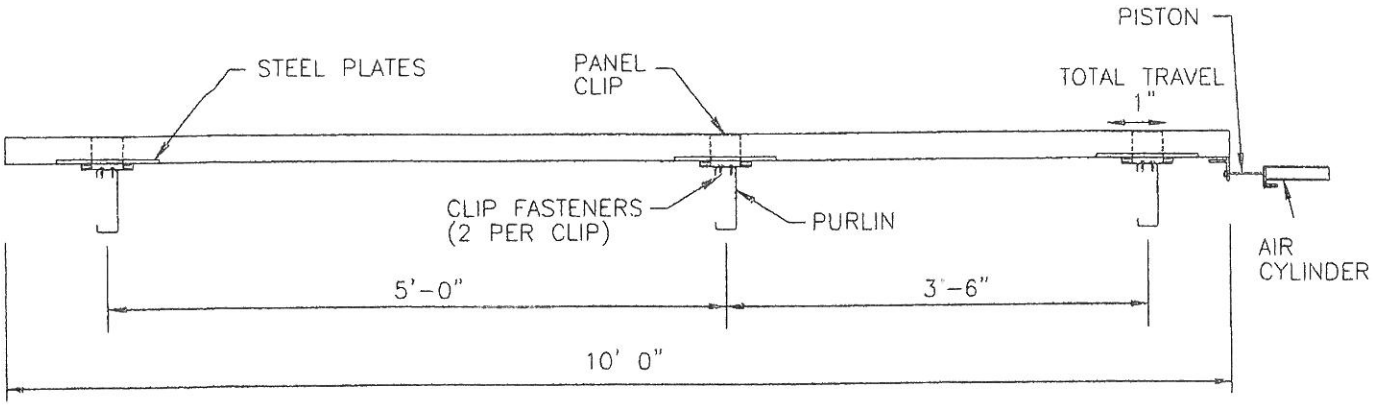

1/2 SECTION VIEW A-A

SECTION II

2.1 DESCRIPTION OF TEST

OBJECTIVES

The purpose of the test was to determine the wear and tear of the panel and clip after repetitive cyclic movement.

The test method consisted of the following:

1. assembling the test panels and clips to form a typical roof construction;
2. subjecting the panel and clip setup to cyclic movement.
3. observing the test setup over a specified time period and reporting any structural damage to the clip resulting from the cyclic movement.

The test setup was tested to 100000 cyclic movements of 1"

TEST SETUP

The test setup consisted of 3 full panels and 2 partial panel widths. The clips were attached to the purlin with self-drilling screws. The panels were then seamed with mechanical seaming tool to form the panel seam. The panels spanned over 3 supports with spans being 3.5' and 5.0'. The clips were subjected to positive load of 10 lbs each.

The panels were attached to the piston of the air cylinder, which moved the clip tab a distance of 0.5" on either side of the clip base. The air cylinder was connected to the air supply through a solenoid. A timer was used to power the solenoid valves. This controlled the flow of air into the air cylinder. The time period of each cycle was approximately 5.2 sec. The panel and clip setup was subjected to 100000 cycles.

TEST PROCEDURE

There is no standard test procedure, as specified by ASTM or other testing agencies, for testing panel clip system cyclical movement. This test replicates the movement of the panel and clip when subjected to repetitive thermal cycles. The panel and clip was observed throughout the test period for structural damage to the clip and panel due to the cyclic movement.

TEST RESULTS

There was no sign of wear through from the top. There was no metal thickness loss between the panel and clip contact surfaces. The panel and clip setup was structurally adequate to continue performing after the 100,000 cycles were conducted.

SECTION III

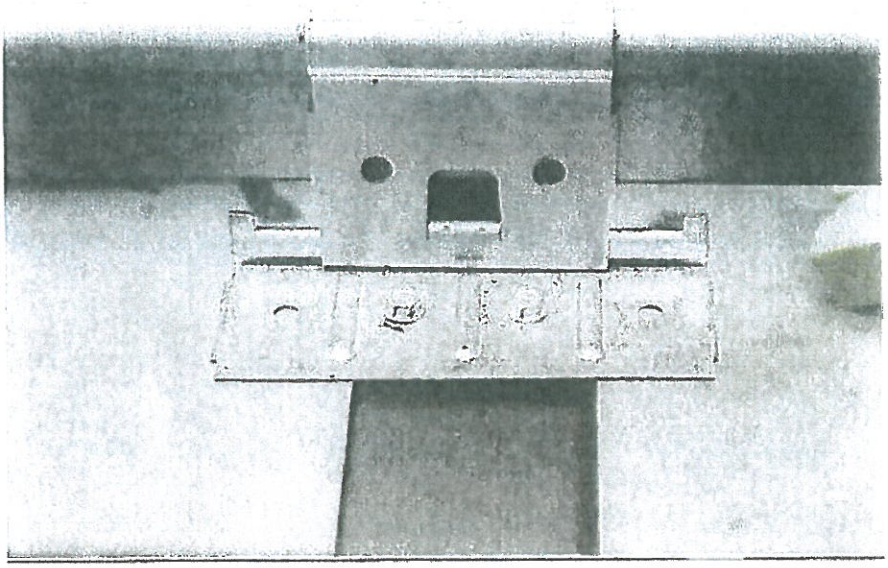

PHOTO 1

View of the panel clip (with galvanized base) attachment to the purlin.
(DSC00001)

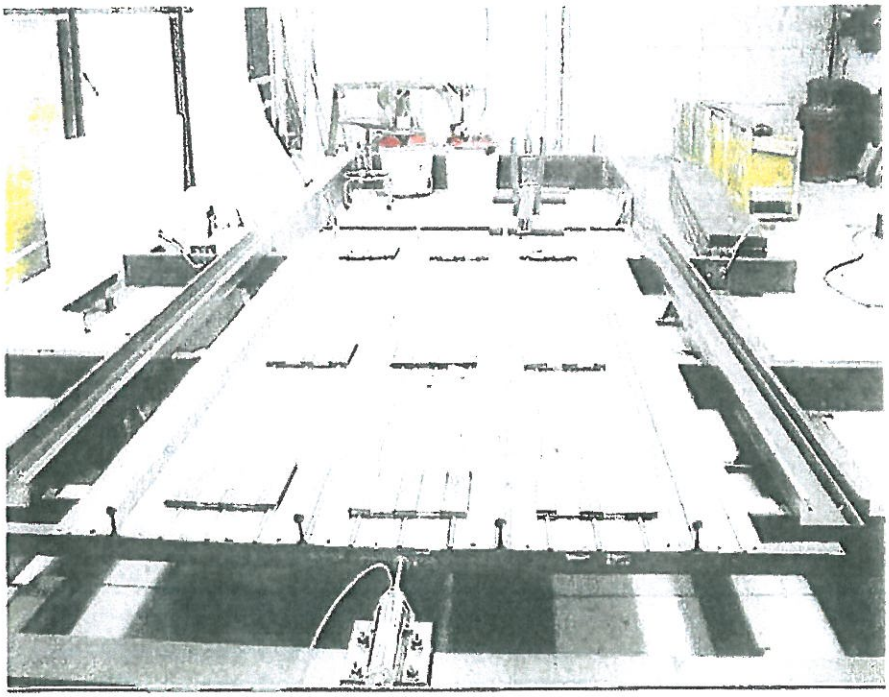

PHOTO 2

View of the test assembly.
(DSC00004)

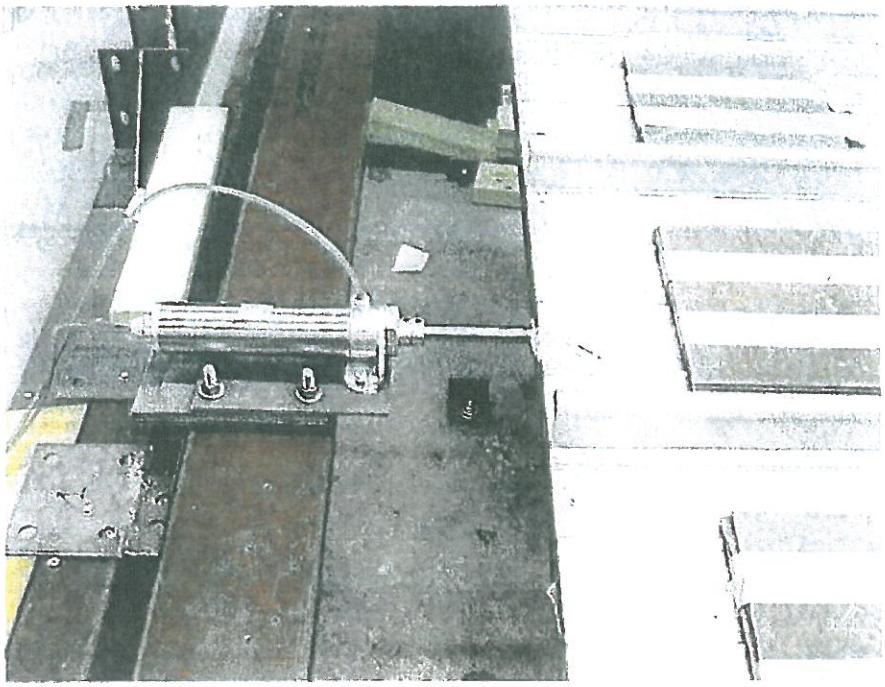

PHOTO 3

View of the test setup at the start of cycle.
(DSC00006)

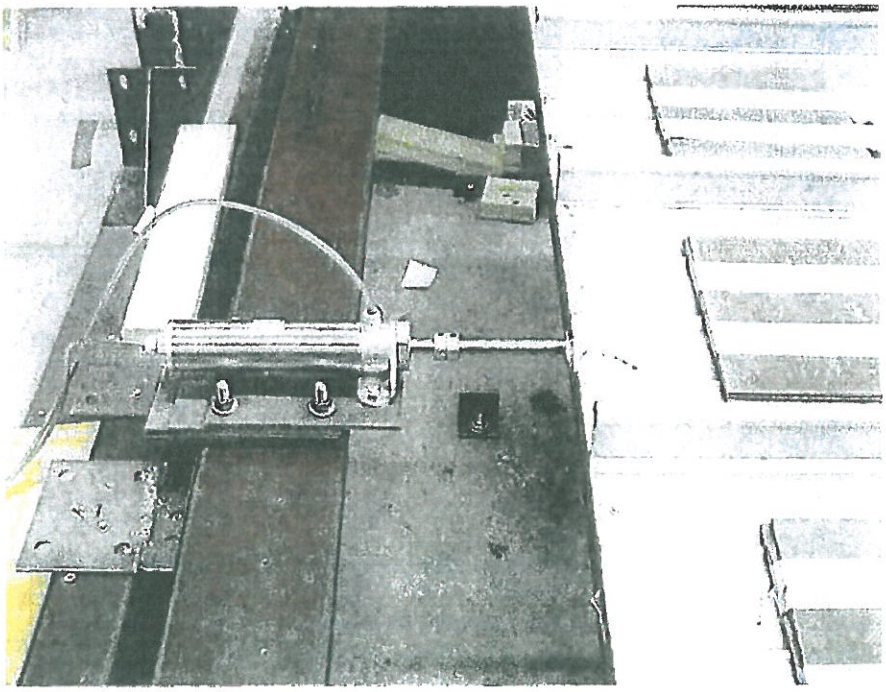

PHOTO 4

View of the test setup at maximum movement of 1".
(DSC00007)

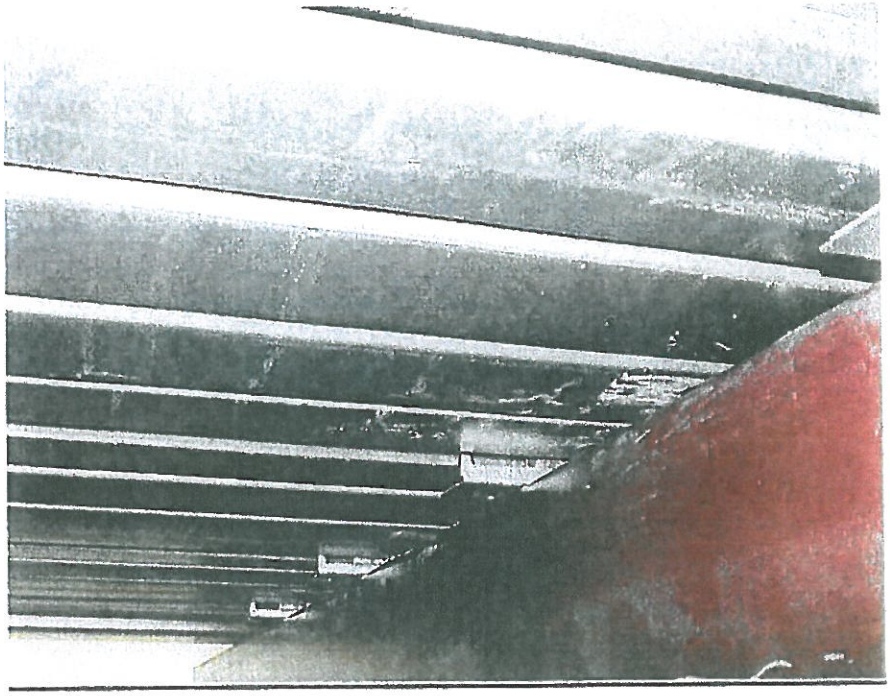

PHOTO 5

View of the clip movement.
(DSC00013)

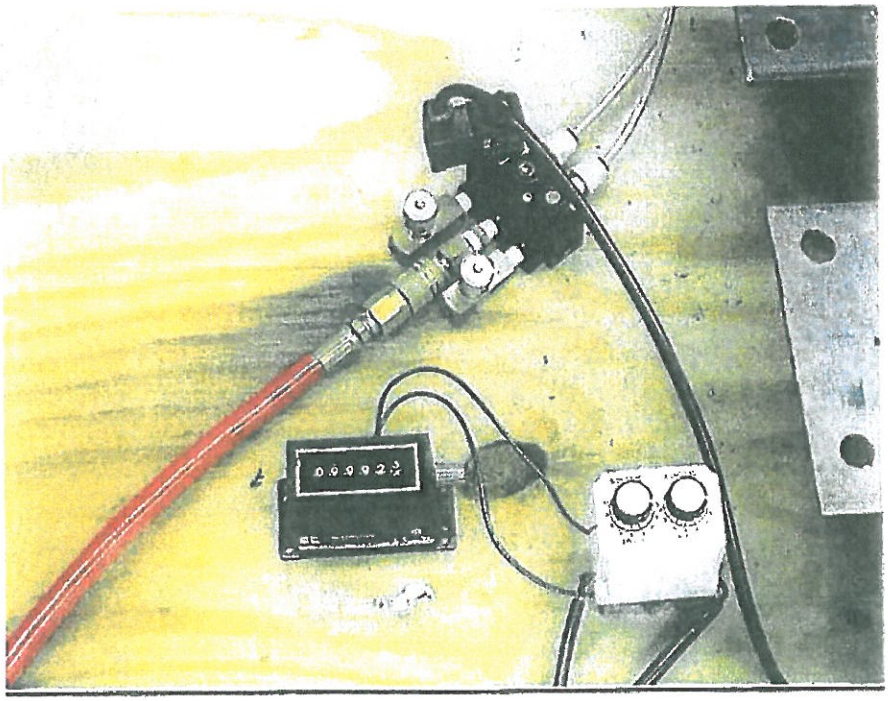

PHOTO 6

View of the test setup at the end of 99923 cycles.
(DSC00016)

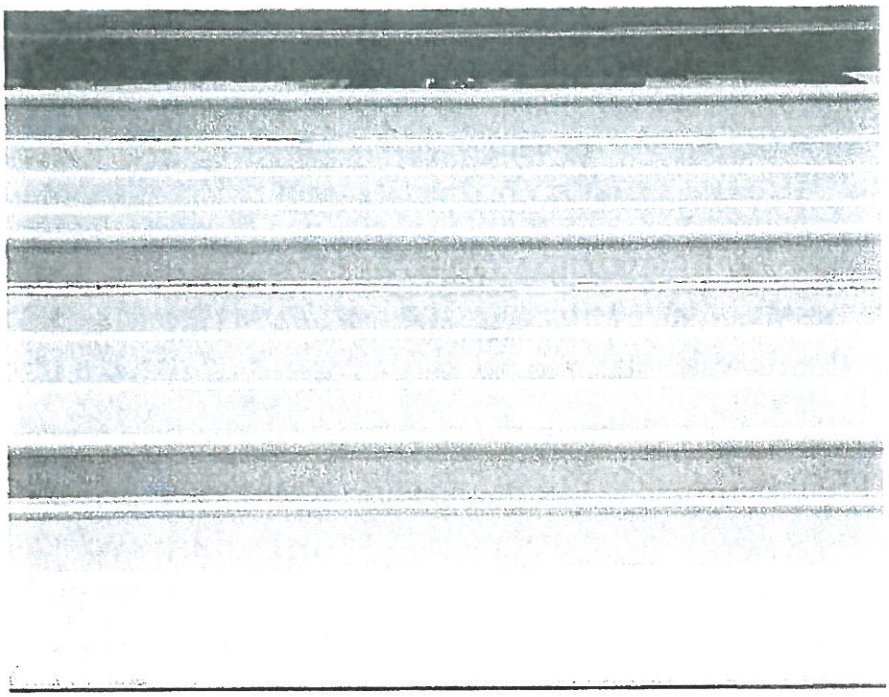

PHOTO 7

View of the test setup at the end of 100000 cycles. There were no signs of wear through panel top.
(DSC00019)

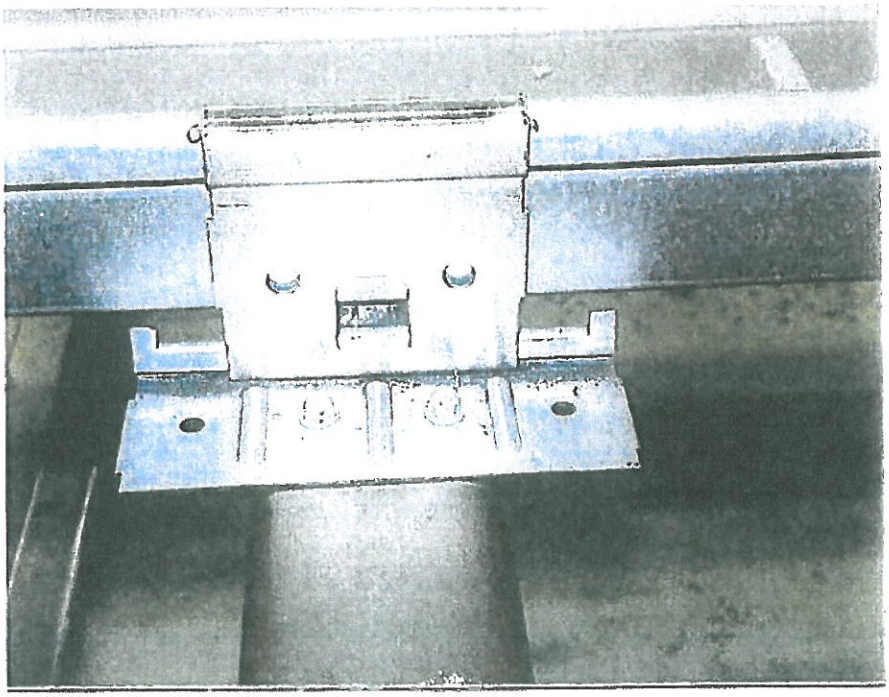

PHOTO 8

View of the clip at the end of the test.
(DSC00021)
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APPENDIX

TEST CONDITIONS

A. OWNERSHIP OF ENCON WORK PRODUCT

All test results developed as a part of this work shall be CLIENT's property. All samples submitted to ENCON for testing shall become the property of ENCON. CLIENT understands that any test program including procedures and test machines incorporated as a part of this work is a result of continuing long-term research and development by ENCON and because of this all ENCON test procedures, test drawings and other intellectual property relating to this work is and shall remain the property of ENCON. Test samples were disposed of shortly after completion of the tests unless other arrangements were agreed to in writing prior to the test.

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