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EVALUATION OF 3M MONITOR-MARK COLD SIDE INDICATOR(U)  
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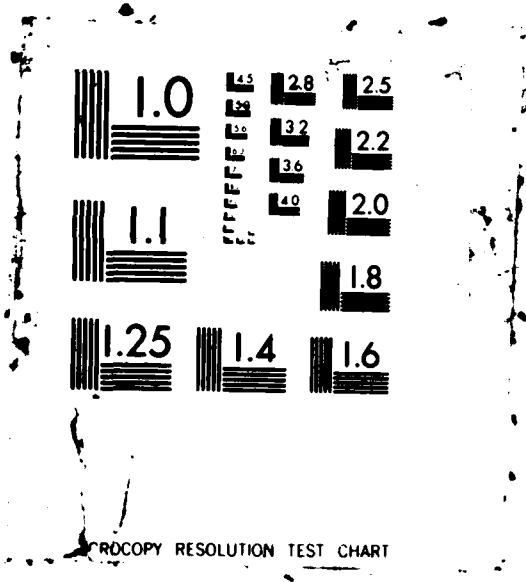
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EDWARD P. MORAVEC, JR

Physicist  
Materials Engineering Branch  
HQ AFLC/DSTZT

AUTOVON 787-4519  
Commercial (513) 257-4519

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EVALUATION OF 3M MONITOR-MARK COLD SIDE INDICATOR

HQ AFLC/DSTZ  
AIR FORCE PACKAGING EVALUATION AGENCY  
Wright-Patterson AFB, Ohio 45433-5999

February 1987

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AFPEA PROJECT NO: 86-P-141

TITLE: Evaluation of 3M Monitor-Mark Cold Side Indicator

ABSTRACT

The 3M Company has developed a new packaging product, the Monitor-Mark cold side indicator, which indicates when a package has been exposed to temperatures of 41 degrees F or less. The purpose of this study was to evaluate the accuracy of the indicator as well as its reliability after exposure to typical packaging environments. Test results indicated that the Monitor-Mark performs reliably.

PREPARED BY:

*Edward P. Moravec Jr.*  
EDWARD P. MORAVEC, JR, Physicist  
Materials Engineering Branch  
AF Packaging Evaluation Agency

REVIEWED BY:

*Matthew A. Venetos*  
MATTHEW A. VENETOS  
Chief, Materials Engineering Branch  
AF Packaging Evaluation Agency

PUBLICATION DATE:

03 MAR 1987

APPROVED BY:

*Jack E. Thompson*  
JACK E. THOMPSON  
Chief, AF Packaging  
Evaluation Agency

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## INTRODUCTION

The 3M Company's new irreversible low temperature indicator, the 3M Monitor-Mark Cold Side Indicator, was evaluated because of its potential for applications in the prevention and solution of problems of damage to packaged products due to exposure to low temperatures. The objectives of this study were to determine the accuracy as well as the reliability of the indicator when subjected to shock and vibration conditions typical of those that occur during the handling and transport of packaged goods.

## DESCRIPTION

The 3M Monitor-Mark Cold Side Indicator contains a specially designed liquid-filled tube with a clear bulb at one end. The clear bulb indicates, by turning violet in color when the device is exposed to a temperature of 41 degrees F or less. The entire unit is enclosed in a 5/8 X 3/16 X 3/8 inch plastic housing with pressure sensitive adhesive backing for mounting to the interior or exterior surfaces of a package (see photograph 1).

## TEST EQUIPMENT

Accelerometer, piezoelectric, Endevco, Model 2233E.  
Charge amplifier, Endevco Model 2740B.  
Chamber, high and low temperature, +170 degrees F to -100 degrees F, Tenney Engineering, Inc.  
Oscilloscope, Tektronix, Model 564B.  
Shock test machine, Monterey Research Laboratory, Inc, IMPAC 2424, Mark II.  
Thermometer, mercury, -20 degrees C to + 110 degrees C

## TEST PROCEDURE

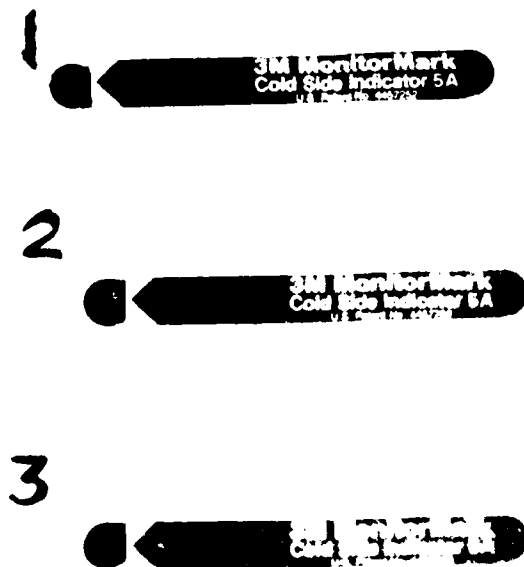
Three specimens were tested. Specimen No. 1 was subjected to four hours of exposure at +145 degrees F, and was then allowed to return to ambient temperature. Specimen No. 2 received one 30G, 31 millisecond shock pulse at 73 degrees F. Specimen No. 3 was used as a control receiving no preconditioning prior to cooling. After preconditioning the three specimens were decrementally cooled, in 5 degree F decrements, simultaneously from 70 degrees F to 40 degrees F. The duration of each decrement period was one hour. The specimens were inspected for indication at the end of each decrement period and immediately after reaching 40 degrees F.

## TEST RESULTS

Preconditioning of Specimen No. 1 for four hours at +145 degrees F did not effect the accuracy of the indicator. Likewise the accuracy of Specimen No. 2 was not effected by the shock pulse of 30Gs and 31 milliseconds. Decremental cooling of all three specimens did not cause actuation until the end of the one hour 40 degree F period, at which time a clear indication was given.

## CONCLUSIONS

Test data indicates that the Monitor-Mark Cold Site Indicator reliably and accurately indicates when temperatures below 41 degrees F are experienced in a typical packaging transportation handling environment.



Photograph 1 - Test Specimens After Actuation at 40 Degrees F

APPENDIX I  
TEST DATA, DECREMENTAL COOLING

<u>Time</u>	<u>Test Chamber Thermocouple in Duct Air Stream (degrees F)</u>	<u>Thermometer on Side Wall (degrees F)</u>	<u>Indication</u>
8:10	70	73.4	
9:10	70	70.9	No
9:30	65	65.5	
10:30	65	64.0	No
10:45	60	59.8	
11:45	62	61.2	No
11:50	55	56.5	
12:45	56	54.3	No
12:55	50	51.1	No
1:53	50	51.8	No
2:00	45	45.3	No
2:59	45	45.3	No
3:06	40	40.6	No
4:06	40	40.6	#1, 2, 3 indicated.

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