



NAVAL FACILITIES ENGINEERING SERVICE CENTER
Port Hueneme, California 93043-4370

**Technical Memorandum
TM-2308-SHR**

TEST REPORT OF MEDIA PROTECTION SYSTEMS

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<p>13. ABSTRACT (Maximum 200 words)</p> <p>The Department of Defense (DoD) Lock Program at the Naval Facilities Engineering Service Center (NEESC) conducted an investigation of the fire protection capabilities of commercially available media protection products, specifically those containers that fit inside GSA approved security file cabinets.</p> <p>Due to weight and cost restrictions, in August 1991 the General Services Administration (GSA) canceled the specification for fire-resistant security containers. Since that time fire protection has been provided mainly by duplicating and storing information in remote, secure vaults. This procedure can be prohibitively expensive.</p> <p>Technology has now provided improved methods for reducing damage caused by fire. The majority of sensitive and classified information is now recorded on digital electronic media. This media permits the storage of vast amounts of information on small magnetic tapes, compact discs, or "floppy" disks. Commercial "fireproof" containers are now available that are small enough to fit within legal-size GSA-approved Class 6 security file cabinets. These new products, called media protection systems, can protect small volumes of electronic media from intense structural fires.</p> <p>The DoD Lock Program hired a nationally recognized fire test facility to conduct fire tests on ten commercially available products. Underwriters' Laboratories UL-72, Class 125 standard test for fire resistance was used. This test simulates the heat stress of common structural fires. The tests determined that two commercial media protection systems, the Fire Cooler 1000 and Fire Cooler 1100, met the requirements of UL-72 Class 125. These products are recommended for the protection of magnetic storage media.</p>				
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EXECUTIVE SUMMARY

The Department of Defense (DoD) Lock Program at the Naval Facilities Engineering Service Center (NFESC) conducted an investigation of the fire protection capabilities of commercially available media protection products, specifically those containers that fit inside GSA approved security file cabinets.

Due to weight and cost restrictions, in August 1991 the General Services Administration (GSA) canceled the specification for fire-resistant security containers. Since that time fire protection has been provided mainly by duplicating and storing information in remote, secure vaults. This procedure can be prohibitively expensive.

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The DoD Lock Program hired a nationally recognized fire test facility to conduct fire tests on ten commercially available products. Underwriters' Laboratories UL-72, Class 125 standard test for fire resistance was used. This test simulates the heat stress of common structural fires. The tests determined that two commercial media protection systems, the Fire Cooler 1000 and Fire Cooler 1100, met the requirements of UL-72 Class 125. These products are recommended for the protection of magnetic storage media.

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INTRODUCTION

Background

The General Services Administration (GSA) is responsible for the specifications and procurement of storage systems for sensitive and classified information. However, due to weight and cost factors, GSA discontinued fire resistance requirements for storage systems.

Most sensitive and classified information is maintained on some form of digital storage media. This media includes floppy disks, compact disks, and magnetic tape, all of which are capable of storing thousands of pages of printed information on a single disk or tape. Unfortunately, these electronic storage media are very vulnerable to heat and moisture.

Fire-resistant computer media containers are now available as commercial-off-the-shelf (COTS) products. These containers are called media protection systems (MPS) and are designed to insulate computer media against most structural fires. They utilize a relatively new technology called gaseous protection systems. When a MPS container is exposed to intense heat, the container cools itself by a process called ablative sublimation. Some MPS containers are small enough to fit within legal-size GSA-approved security file cabinets (Photo 1).

Purpose

The purpose of this project was to identify effective media protection systems that were commercially available and that could fit within the drawer of a legal-size Class 5 or Class 6 GSA approved security file cabinet.

PROJECT DESCRIPTION

Research Plan

1. Industry Search - Conduct a detailed search to identify commercially available media protection systems that could fit within the drawers of GSA-approved security file cabinets.
2. Operational Evaluation - Evaluate commercial products identified during the industry search as possible candidates for procurement and testing.
3. Test and Evaluation - Develop a test plan based on Underwriters' Laboratories, Inc., standard for fire-resistant computer media containers. Perform a test utilizing an American Society for Testing and Materials (ASTM) E119 rated horizontal test furnace.
4. Final Reports - Prepare a technical data sheet (TDS) and a technical report (TR).

Testing Criteria

1. Media protection equipment can be defined as any self-contained device designed to protect computer media from damage by heat and heat-generated moisture. This definition could include large, floor-mounted containers, though none were considered because they are too large to fit inside a legal-size GSA approved Class 5 or Class 6 security file cabinets. Therefore, the sizes of the test specimens for this project were limited to those products that could fit inside the drawer of a legal-size GSA approved Class 5 or Class 6 security file cabinet.

2. Two-drawer GSA-approved Class 5 and Class 6 legal-size security file cabinets typically have external dimensions of 28 inches high, 19 inches wide, and 28 inches deep.
3. The testing standards for this project were specified by UL-72, "Tests for Fire Resistance of Record Protection Equipment." The Class-125 criteria was used as it relates directly to non-paper electronic data storage media such as magnetic tapes, compact discs, and flexible magnetic disks. Class-125 thresholds are measured at a maximum of 125°F and an 80 percent humidity level.
4. The explosion and impact tests associated with UL-72 were not included in this project. Also, the humidity sensors were permitted an error range of ± 4 percent instead of the UL-72 standard of ± 1.5 percent. Test specimens were evaluated only for their ability to withstand exposure to the heat and humidity conditions encountered in typical structural fires.
5. Furnace temperatures were controlled to achieve a time-temperature curve specified by the UL-72 test standards. This exposure may not be representative of all fire conditions but is designed to equal or exceed the thermal conditions encountered in most structural fires.

Testing Facility and Equipment

1. The test facility utilized for this project was Omega Point Laboratories, Inc. This facility is a nationally recognized, independent testing facility located in Elmendorf, Texas. Omega Point Laboratories, Inc., is certified by the Council of American Building Officials, Building Officials & Code Administration International, the Southern Building Code Congress International, and the U.S. Department of Housing and Urban Development.
2. The ASTM E119 test furnace consisted of a steel frame lined with sheet metal and 6 inches of ceramic fiber. An access door and viewing ports were built into the front wall. The furnace was of horizontal design, measuring 12 feet high, 18 feet long, and 7 feet deep. The furnace was fitted with 12 symmetrically located nozzles designed to burn a propane air fuel mixture. These burners were located 6 feet below the top of the furnace and produced an even distribution of heat across the upper surface of the test specimens. At normal gas pressures the burners deliver 20 million BTUs per hour, heating the furnace to temperatures in excess of 2,000°F and accurately meeting the UL heat standards.

Testing Procedure

1. A total of six two-drawer, legal-size Class 6 GSA-approved security file cabinets were provided to Omega Point Laboratories. Three of these containers were used in each fire exposure. Two independent fire exposures were conducted on 2 consecutive days.
2. Prior to the fire exposures, the combination lock and aluminum handle of each cabinet were removed. A single COTS test specimen was placed inside each drawer, permitting simultaneous testing of six specimens. The containers and their contents are identified in Table 1.

Table 1. Location of COTS Specimens

<u>GSA Container Number</u>	<u>Upper Drawer</u>	<u>Lower Drawer</u>
1	Sentry 1710 in Ceramic Soft-Sided Box	Ceramic Soft-Sided Box
2	Fire Cooler 1000	Fire Cooler 1100
3	Sentry 1710	Media Cooler
4	Transformer 125T	Transformer 125H
5	Downey Box	Downey Box
6	Albacore Box	Albacore Box

- In addition to installing multiple temperature and humidity sensors in each specimen, two floppy disks containing 1 megabyte of digital data were placed inside each test specimen (Photo 2). This procedure was established to determine if the data on the disks were truly readable after being exposed to the fire tests.
- The furnace temperature was determined by averaging the measurements from numerous thermocouples located symmetrically within the furnace, including sensors that were placed 12 inches away from the test specimens. During the actual tests, the furnace temperature was monitored at least every 15 seconds to ensure compliance with the standardized temperature curve.
- The furnace temperatures were manually controlled to closely match the temperature curve requirement of UL-72. This testing standard required that the area under the furnace's time-temperature curve be within 10 percent of the area under the standard curve for the UL-72 test. This standard time-temperature curve is shown in Figure 1.

- The temperature outside the COTS specimens was monitored with one additional thermocouple placed within each cabinet drawer. This thermocouple measured the temperature to which the test specimen was exposed. Time-temperature curves from these thermocouples are shown in Appendix A.
- The protected, insulated environment inside each COTS specimen was monitored using two thermocouples and one humidity sensor.

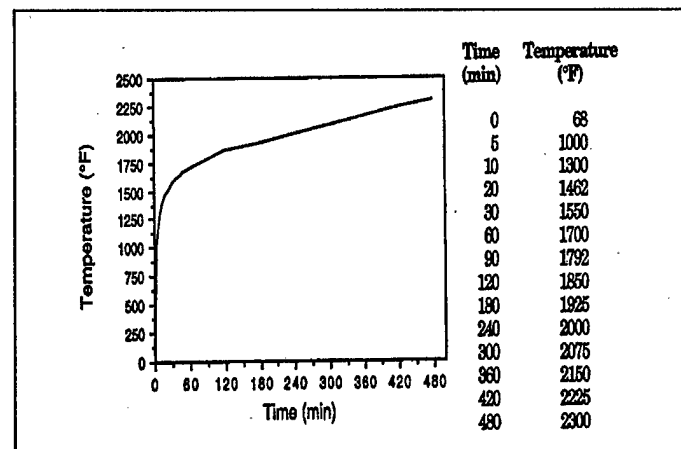


Figure 1. UL-72 Temperature Curve

- The thermocouples that were used for the first fire exposure were electrically welded Chromel-Alumel units (type K), insulated with fiberglass sheathing. Thermocouples used in the second fire exposure consisted of 1/16-inch diameter Inconel-sheathed probe assemblies.

TEST RESULTS

First Fire Exposure

1. The first fire exposure was conducted by placing three Class 6 GSA approved security containers (ID numbers 1, 2 and 3) into the horizontal furnace on concrete masonry pedestals. Thermocouples were then connected to the computer data acquisition system via lead wires routed up into the security containers from the floor. The furnace was fired at 2:26 p.m. on December 3, 1997. Mr. Victor Vella was the U.S. Government representative who observed the test. The UL-72 time-temperature curve (i.e., ASTM E-119 curve) was maintained for 60 minutes. The integrated area under this curve was within 10 percent of the standard curve, as specified. This time-temperature curve for the first exposure is shown in Figure 2.

2. Thermocouple readings from the interior of the GSA approved security file cabinets (containers 1, 2, and 3) represent temperatures on the outside of the test specimens. These temperatures are shown in Appendix A and the readings are summarized in Table 2.

3. Observations made during the first test are recorded in Table 3. Note that flames were observed from all cabinets after only 14 minutes, indicating that paint and other trace combustibles were consumed very quickly. The GSA cabinets were heated to a red incandescence during the fire exposures (Photo 3).

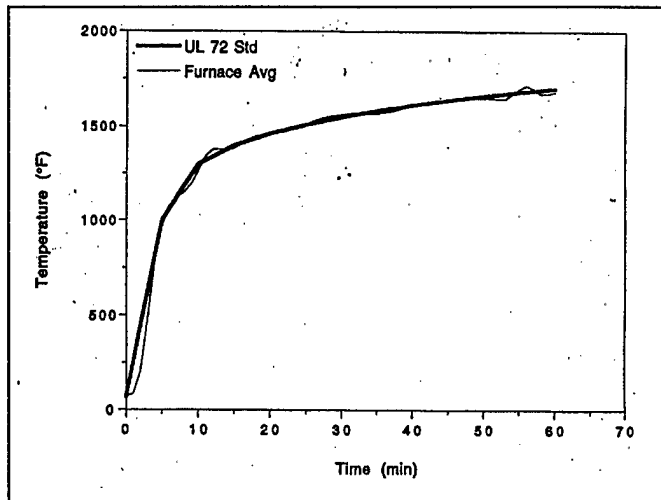


Figure 2. Furnace Temperatures (First Exposure)

Table 2. Cabinet Temperatures (First Fire Exposure)

<u>GSA Container No.</u>	<u>Minutes Required to Reach a Temperature of</u>		
	<u>500°</u>	<u>1,000°</u>	<u>1,500°</u>
1	8	16	41
2	9	24	60
3	9	12	40

Table 3. Observations during the First Fire Exposure

<u>Time (min-sec)</u>	<u>Observation</u>
00:00	Furnace fired at 2:26 p.m. on 3 December 1997
14:00	Flames observed from both drawers of Cabinet #3
14:47	Flames from all drawers of all cabinets
60:00	Furnace extinguished

4. All thermocouples and humidity sensors placed within the test specimens failed during the first fire exposure. This malfunction is attributed to interference between holes drilled into the drawers and frames of the security containers, allowing drawer movement to damage the sensor wires. This damage created an effective thermo-junction that measured the temperatures outside the containers. These erroneous temperatures were recorded. Due to the sensors failing, the only means to determine pass or failure of the test specimens was to evaluate the condition of the floppy disks placed within each specimen. An evaluation of the performance of the media protection products tested during the first exposure is summarized below (pictures of each specimen are shown in Appendix B):
 - a) Sentry 1710 (enclosed with a Ceramic Soft Box) - This product, when enclosed in the specially fabricated Ceramic Soft Box, protected the electronic media. The floppy disks were undamaged and readable after the fire exposure (Photo 4).
 - b) Sentry 1710 (without the Ceramic Soft Box) - This product (Photo 5) did not protect the enclosed floppy disks. The disks and the test specimen were destroyed.
 - c) The Ceramic Soft Box - This specially constructed container, when used without the Sentry 1710 product, did not protect the electronic media. The disks and the test specimen were destroyed.
 - d) Fire Cooler 1000 - This product (Photo 6) did protect the enclosed floppy disks. They were fully functional and the data on the floppy disks were readable after the exposure (Photo 7).
 - e) Fire Cooler 1100 - This product was also able to protect the floppy disks. They were fully functional and the data on the floppy disks were readable after the exposure (Photo 8).
 - f) Media Cooler - This product did not protect the enclosed disks. The disks and the test specimen were destroyed (Photo 9).

Second Fire Exposure

1. The second fire exposure was conducted by placing the second group of three GSA approved Class 6 security file cabinets (ID numbers 4, 5, and 6) into the furnace on identical concrete blocks. Thermocouples were connected in a different manner to preclude damage to the lead wires when the drawers were closed. The furnace was fired at 4:06 p.m. on December 4, 1997. Mr. Victor Vella was the U.S. Government representative during this test. The UL-72 time-temperature curve (i.e., ASTM E-119 curve) was maintained for 60 minutes. The integrated area under this curve was within 10 percent of the area under the standard time-temperature curve. Actual furnace temperatures are shown in Figure 3.

2. Observations made during the first test are shown in Table 4. Note that flames were observed from two of the cabinets after only 9 minutes, indicating that trace combustibles were consumed quickly.
3. Thermocouple readings from the interior of the cabinets (containers 4, 5, and 6) are representative of the temperatures outside the COTS specimens. The temperature data is summarized in Table 5 and given in Appendix A.

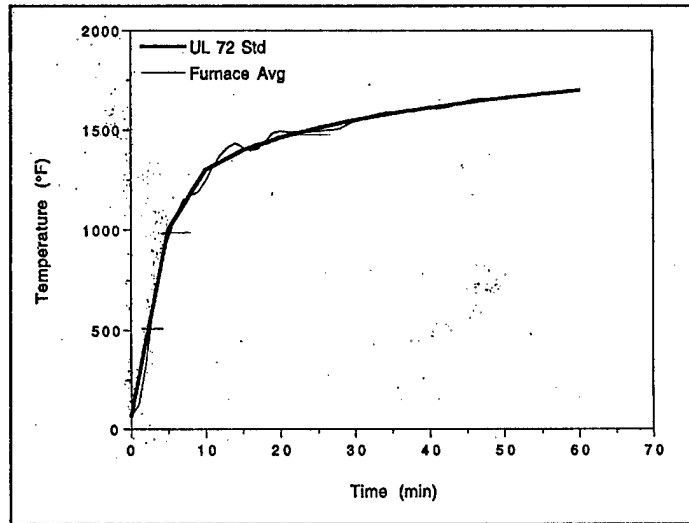


Figure 3. Furnace Temperatures (Second Exposure)

Table 4. Observations during Second Fire Exposure

<u>Time (min-sec)</u>	<u>Observation</u>
00:00	Furnace fired at 4:06 p.m. on 4 December 1997
03:00	Paint on all the cabinets is mostly consumed
09:15	Flames observed from both drawers of Cabinets #4 and #5
60:00	Furnace extinguished

Table 5. Cabinet Temperatures (Second Fire Exposure)

<u>GSA Container</u>	<u>Minutes Required to Reach a Temperature of</u>		
	<u>500°</u>	<u>1,000°</u>	<u>1,500°</u>
4	9	20	60
5	10	16	40
6	7	18	36

4. All sensors, except the two humidity sensors, operated normally during the second exposure. The specimens tested during this exposure are evaluated below. The evaluation is based on both sensor data and the final condition of the floppy disks placed inside the specimens. Temperature and humidity data are shown in Appendix A.
 - a) Transformer 125T – This product (Photo 10) failed the test. Thermocouples indicate the interior temperature exceeded 125 degrees (Class 125 test limit) after approximately 30 minutes of exposure, and climbed to over 1,500 degrees after 60 minutes of exposure. The relative humidity level remained at about 83 percent. The floppy disks and the test specimen were destroyed.
 - b) Transformer 125H – This product (Photo 11) failed the test. Thermocouples indicate the interior temperature exceeded the Class 125 limit after approximately 30 minutes of exposure, climbing to over 750 degrees before the furnace was extinguished. The relative humidity level was not measured due to sensor failure. The floppy disks and the test specimen were destroyed.

- c) Downey Box - This product (Photo 12) failed the test. Thermocouple data in both the Downey Box specimens indicate the interior temperature exceeded Class 125 limits after approximately 18 minutes of exposure, and climbed to approximately 250 degrees before the furnace was extinguished. The relative humidity level remained at about 82 percent. The floppy disks were warped and unusable and the test specimen was destroyed.
- d) Albacore Box - This product (Photo 13) failed the test. Thermocouple data in both the Albacore Box specimens indicate the interior temperature exceeded 125 degrees (Class 125 test limit) after approximately 21 minutes of exposure, and climbed to approximately 300 degrees before the furnace was extinguished. The relative humidity sensor for the specimen in the top drawer failed. The sensor in the bottom specimen indicated about 83 percent relative humidity. The floppy disks and test specimen were destroyed (Photo 14).

CONCLUSIONS

Based on these test results it can be concluded that:

1. The Fire Cooler 1000 and Fire Cooler 1100 products can protect electronic storage media such as floppy disks, CDROMs, magnetic tape, and hard drives. *Note: the Fire Cooler 1000 and 1100 are certified by UL-72, Class 125 as stand alone media protection systems, though they are not authorized for storage of classified information unless they are placed in an approved container such as a Class 5 or Class 6 GSA approved file cabinet.*
2. The Sentry 1710 product, when enclosed in a specially fabricated Ceramic Soft Box, did protect the digital recording media during the UL-72 fire test. However, the Ceramic Soft Box requires customized construction, is very expensive, and is not practical for general office use.
3. All other COTS specimens failed the UL-72 fire test. With recorded internal temperatures much greater than the Class-125 test limits, the digital media in these products were destroyed or unusable.

RECOMMENDATIONS

1. It is recommended that agencies consider using media protection containers to protect electronic media from fire damage. The Fire Cooler 1000 and Fire Cooler 1100 are the only products that:
 - Satisfactorily passed the UL-72 fire test
 - Are small enough to fit inside the drawers of a GSA Class 6 security container
 - Are convenient for general office use
2. The Fire Cooler 1000 and Fire Cooler 1100 protection containers are available through Media Protection Products, Inc., 2495 Main Street, Suite 547, Buffalo, NY, 14214. Contact by phone at (800) 445-3309 or E-mail to CUSTSVCS@FIRECOOLER.COM.
3. For further information regarding this evaluation, contact The *DOD Lock Program* at the Naval Facilities Engineering Service Center (NFESC-66), 1100 23rd Avenue, Port Hueneme, CA 93043-4370 (phone DSN 551-1212 or commercial 805-982-1212).

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2. Omega Point Laboratories, Inc., UL-72 Tests for Fire Resistance of Record Protection Equipment (Modified), Project Number 15775-102137, 30 Dec, 1997.
3. Omega Point Laboratories, Inc., Photographic records of the UL-72 test of fire resistance of record protection equipment, conducted on 3 and 4 Dec, 1997.

APPENDIX A

Sensor Data from The UL-72 Fire Test

<u>Description</u>	<u>Page</u>
Interior Cabinet Temperatures – Cabinet #1	
Interior Cabinet Temperatures – Cabinet #2	A-2
Interior Cabinet Temperatures – Cabinet #3	
Interior Cabinet Temperatures – Cabinet #4	A-3
Interior Cabinet Temperatures – Cabinet #5	
Interior Cabinet Temperatures – Cabinet #6	A-4
Furnace Temperature – First Fire Exposure	
Furnace Temperature – Second Fire Exposure	A-5
Internal Temperature Curve – Albacore Box (top)	
Internal Temperature Curve – Albacore Box (bottom)	A-6
Internal Temperature Curve – Downey Box (top)	
Internal Temperature Curve – Downey Box (bottom)	A-7
Internal Temperature Curve – Transformer 125T	
Internal Temperature Curve – Transformer 125H	A-8
Relative Humidity – Albacore Box (top)	
Relative Humidity – Albacore Box (bottom)	A-9
Relative Humidity – Downey Box (top)	
Relative Humidity – Downey Box (bottom)	A-10
Relative Humidity – Transformer 125T	
Relative Humidity – Transformer 125H	A-11

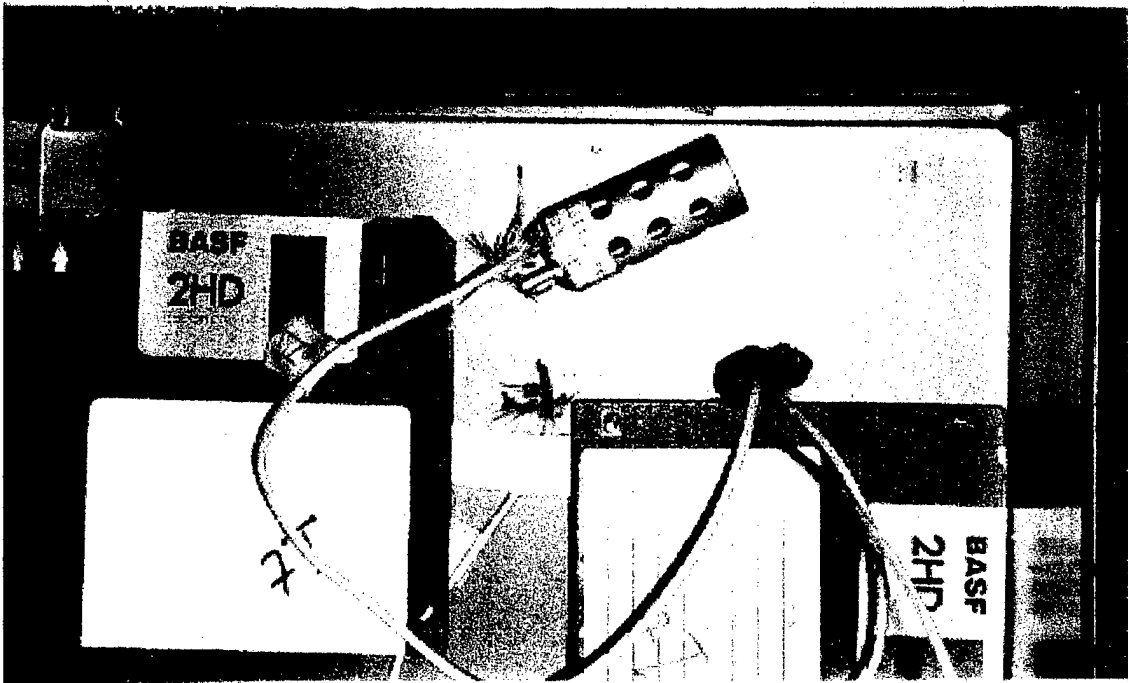
APPENDIX B

Photographic Record of the UL-72 Fire Test

<u>Description</u>	<u>Photo</u>
GSA approved Class 6 security file cabinets (legal-size) prior to fire exposure.	1
Humidity sensor installed in test specimen.	2
Security file cabinets heated to a red incandescence.	3
Sentry 1710 enclosed in a ceramic soft-sided box after fire exposure.	4
Sentry 1710 prior to fire exposure.	5
Fire Cooler 1000 prior to fire exposure.	6
Fire Cooler 1000 after fire exposure.	7
Fire Cooler 1100 after fire exposure.	8
Media Cooler after fire exposure.	9
Transformer 125T prior to fire exposure.	10
Transformer 125H prior to fire exposure.	11
Downey Box prior to fire exposure.	12
Albacore Box prior to fire exposure.	13
Albacore Box after fire exposure.	14



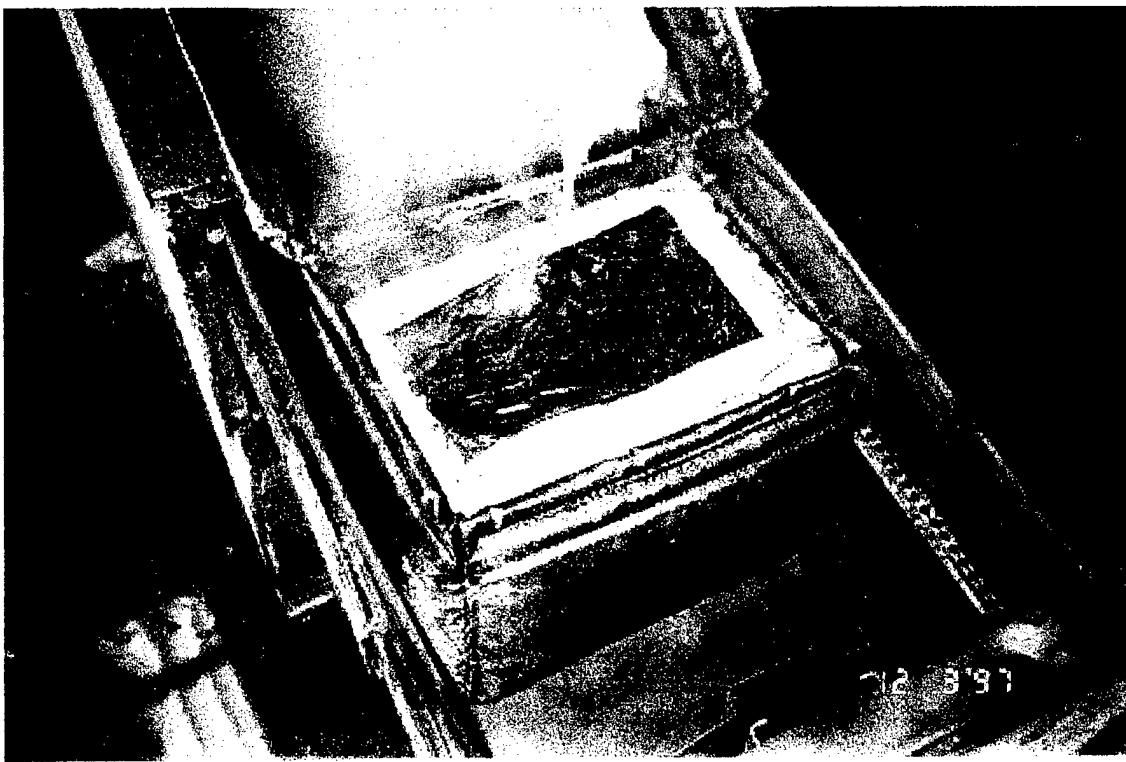
Photograph 1



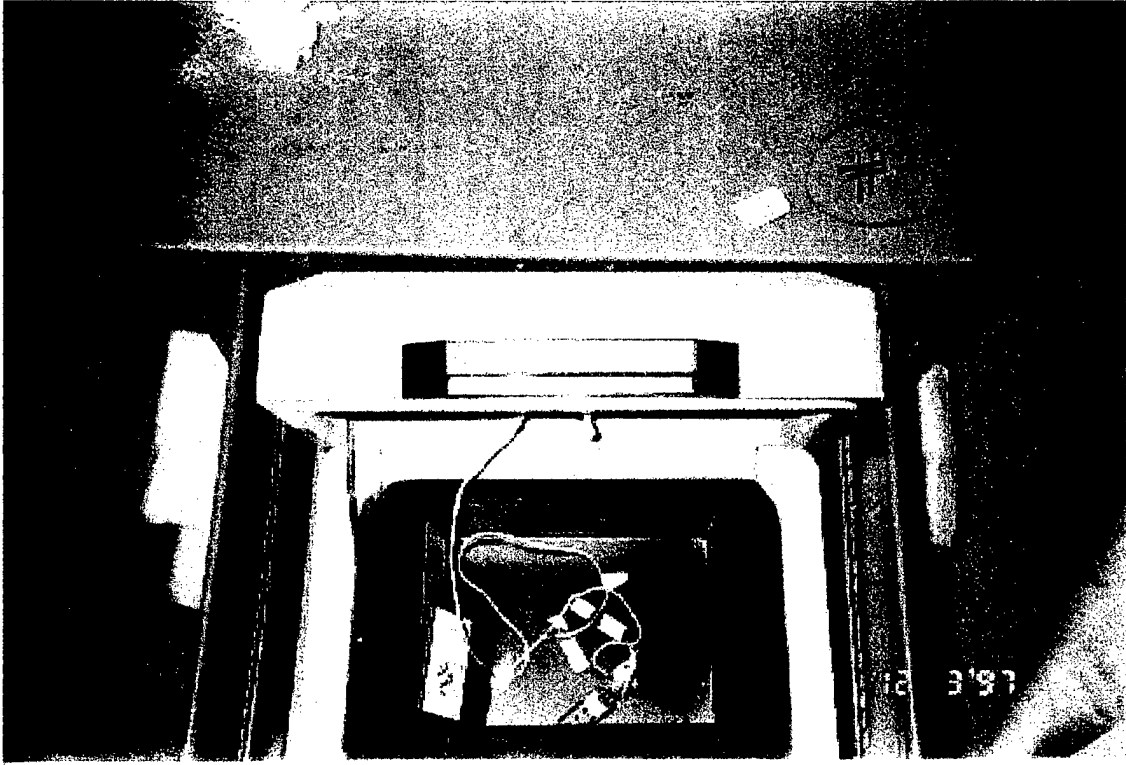
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Photograph 3



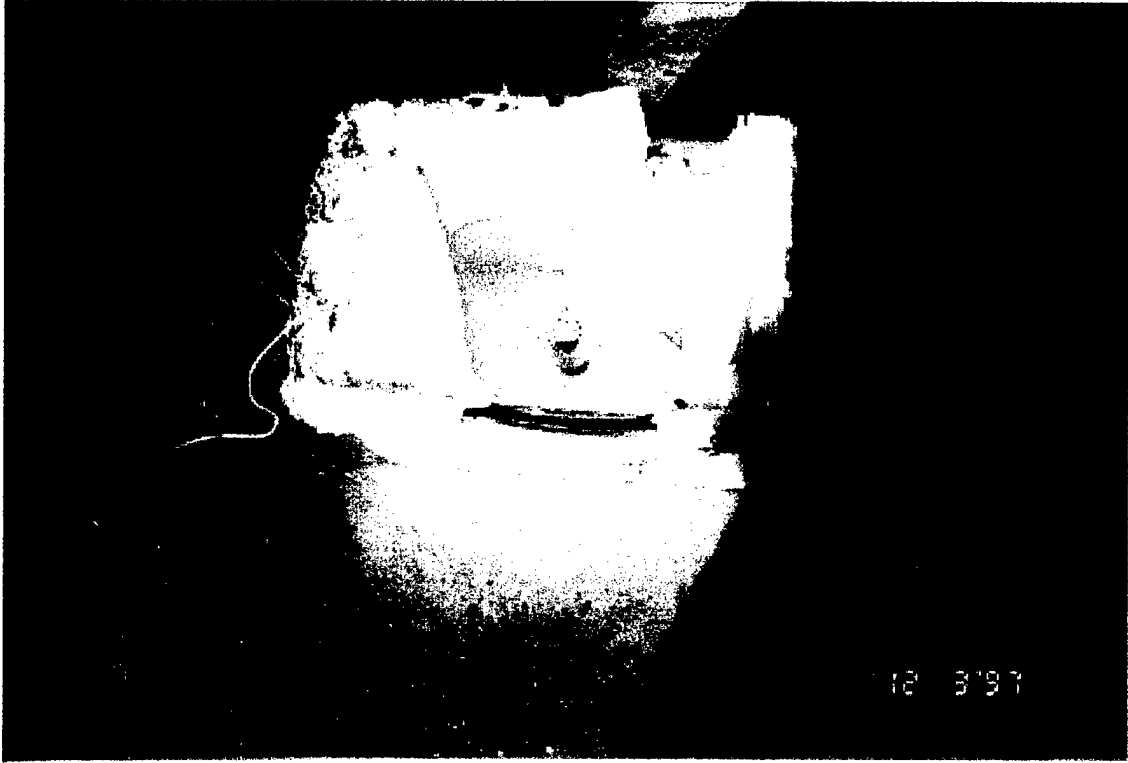
Photograph 4



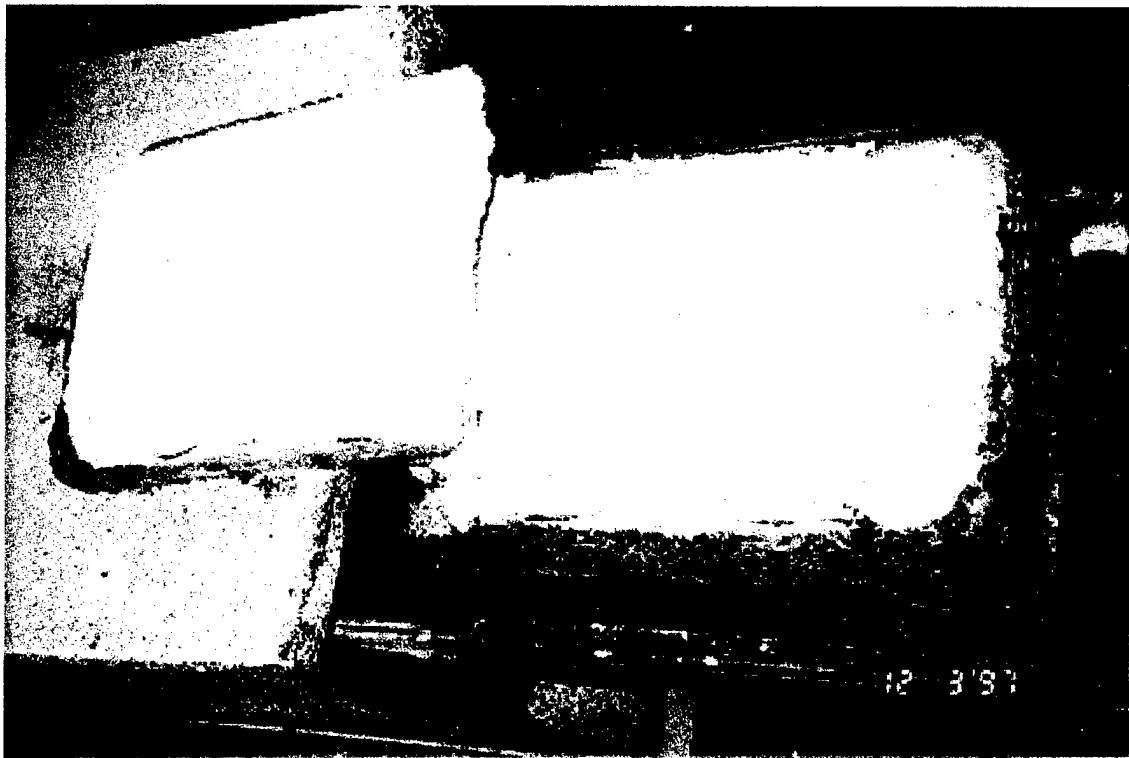
Photograph 5



Photograph 6



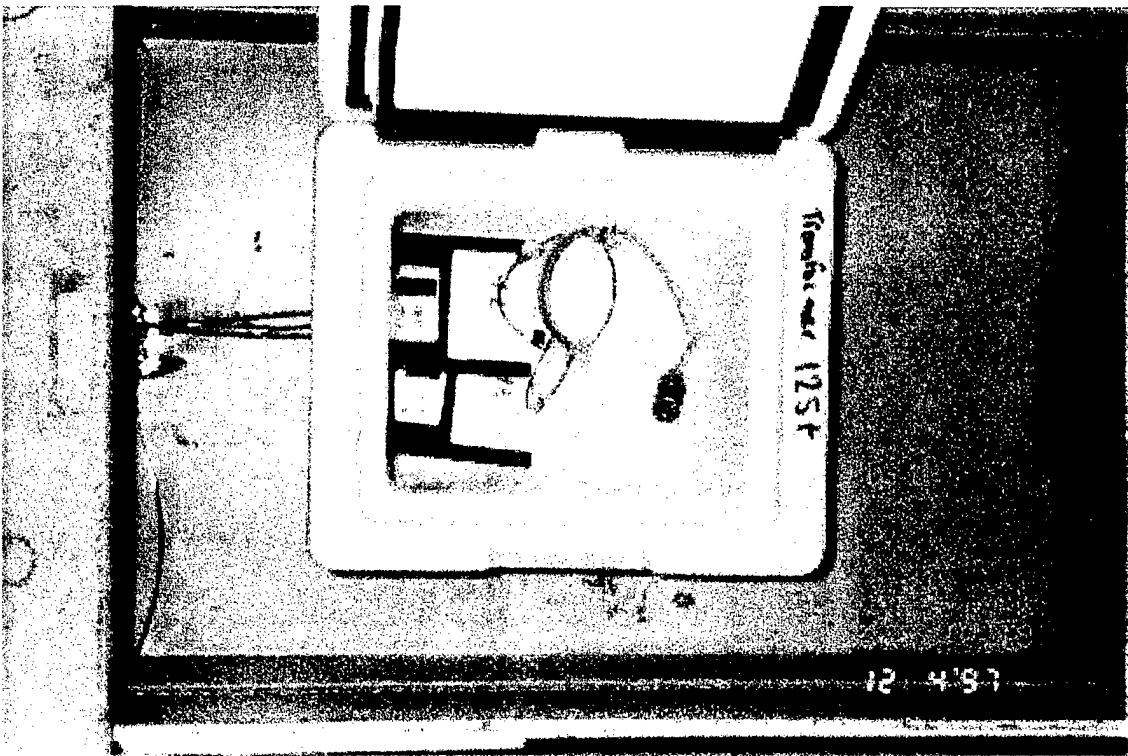
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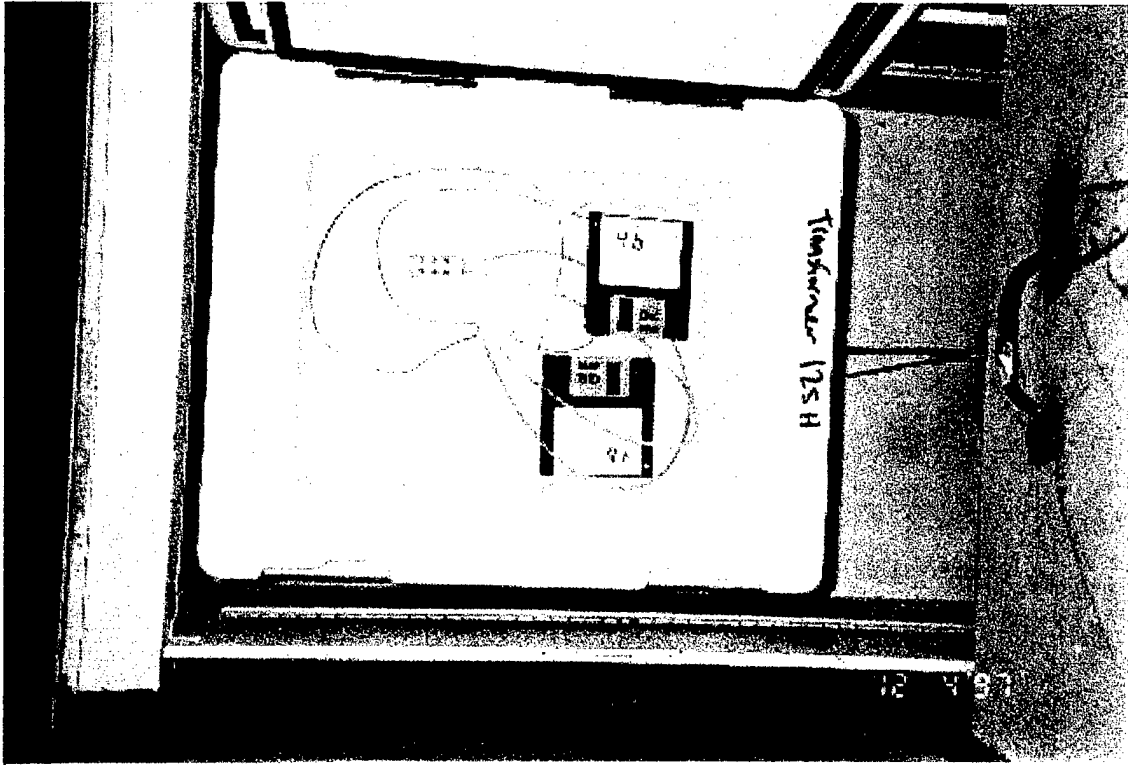
Photograph 8



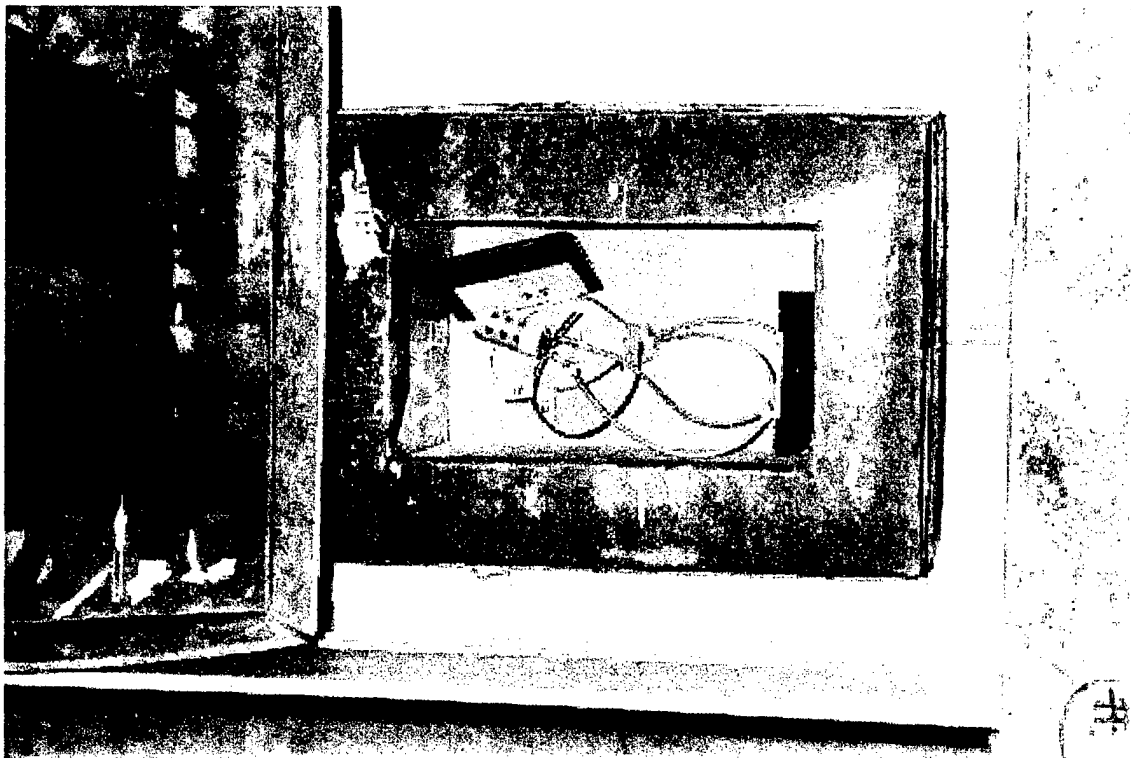
Photograph 9



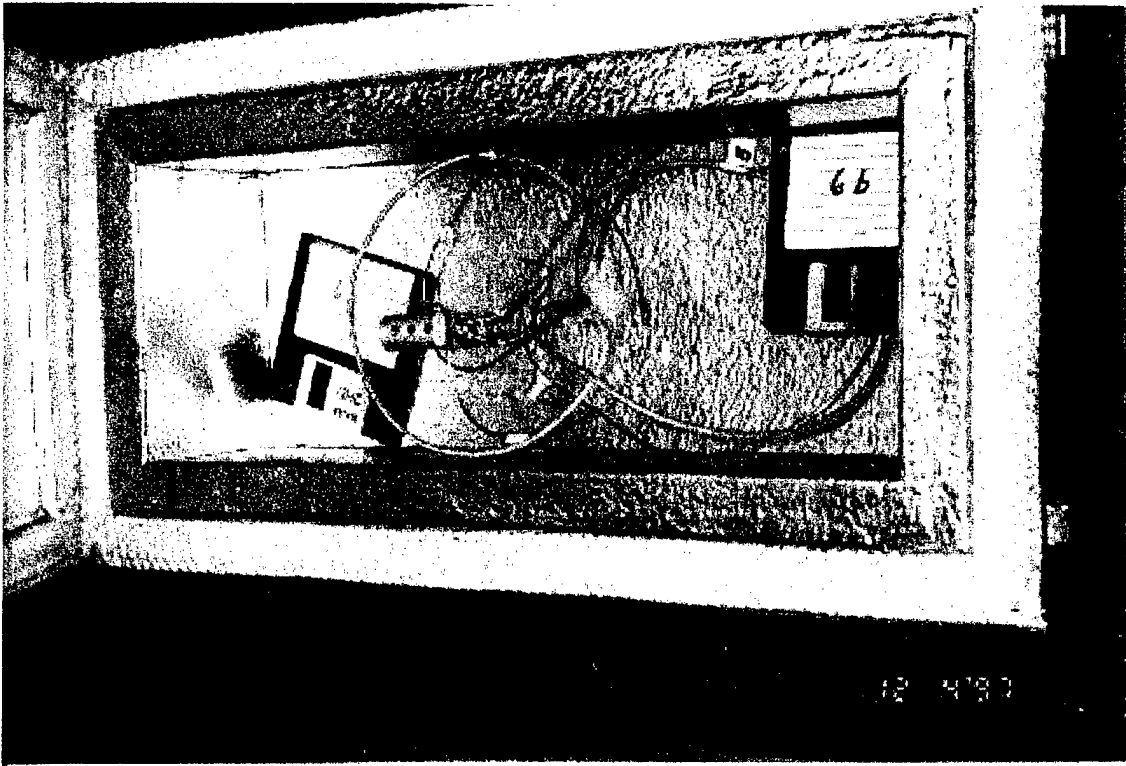
Photograph 10



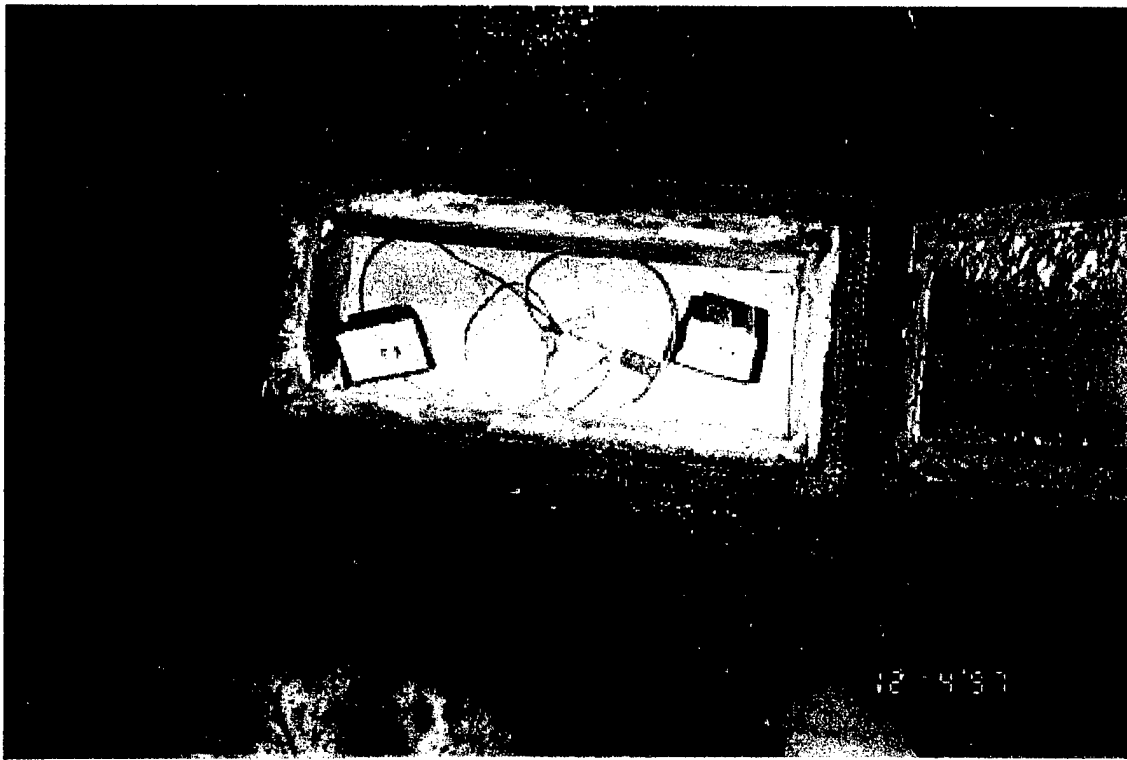
Photograph 11



Photograph 12



Photograph 13



Photograph 14