Article: Fixtures at an exhibition: Results of practical tests for a new museum, Part I
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Source: *Objects Specialty Group Postprints, Volume One, 1991*
Pages: 13-28
Compiler: Pamela Hatchfield

Fixtures at an Exhibition:
Results of Practical Tests for a New Museum
Part I

Donna K. Strahan*

Last month the Walters Art Gallery opened Hackerman House a newly renovated 1850's mansion devoted to the display of Asian Art. The building is located on historic Mt. Vernon Square in Baltimore, Maryland. It is connected to the Walters by a bridge and now houses over 900 objects on two floors. The first floor is set up as a 19th c. Asian art connoisseur's residence, necessitating the reuse of existing built-in library cases and period cabinets and furniture. The second floor is set up as a modern exhibition space where many new exhibition cases in a range of shapes and sizes were needed to house the wide variety of objects in the collection.

The Exhibits Department at the Walters works very closely with the Conservation Division and many discussions and tests were carried out before case construction for Hackerman House began. The testing of materials to be used in the museum environment has been performed by the conservation laboratory since the early 1980's. It is museum policy that before the exhibits department uses any fabrics, glues, woods, sealants, paints, etc. samples are sent to the lab for testing. Since we have been testing on a regular basis, no damage has occurred from improper case or storage materials. In this paper I will only speak about the wood products and sealants we tested for Hackerman House.

Let's remind ourselves why testing is so important by looking at a few of the past problems which occurred at the Walters because of the use of untested materials in exhibition cases and storage areas.

Back in 1979, the yellow fabric used to display an Islamic sword caused severe irreversible damage to the blade. It is not clear exactly what was in the fabric to cause the damage but if it had been tested first it certainly would have failed and thus not been used.

While it is very difficult to grow silver sulfide acanthite crystals in a laboratory, we have been able to grow them in our storeroom. In the second example, rubber mats used in storage released sulfur as they began to deteriorate. They caused irreversible damage to hundreds of metal objects. These are just two examples of previous problems due to poor selection of materials to be used near art objects.

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The Walters is a small public museum without the scientific instrumentation and staff to analyze the selected materials. Therefore, our testing methods are simply a modification of the empirical test Oddy described in the 1975 Stockholm preprints in an attempt to correlate our results with actual museum situations. Often several different samples for each situation are tested. Therefore, if the first selection fails a second choice can be made from the samples which passed. The exhibits department is always racing for an opening deadline and needs quick answers.

Tests involve a jar, with a sheet of mylar on the bottom to separate the test materials from condensation; a test tube with distilled water; the sample with polished and degreased metal coupons - Cu, Ag, Pb, Fe. Since the tests are run for both vapor corrosion and contact corrosion the coupons are partially set in contact with the material being tested. All tests for permanent exhibitions are run with a control jar for 1 month at 40°C. Tests for temporary exhibitions are run for two weeks. The control is run with metal coupons to determine if any change occurred due only to heat and humidity. Using the control coupons for comparison, each jar's coupons are visually inspected for signs of corrosion.

The exhibits department wanted to use one of two wood products for building the cases for Hackerman House. Because solid wood was too expensive they selected MDO plywood and MEDEX. MDO or Medium Density overlaid plywood is made of softwood veneers and phenol formaldehyde adhesives and resins. In the past this was the best material available to us even though it is horrible. Then Medex came along with better working properties. Medex is a trade name for a particle board made of chipped softwoods and combined with a polyurea resin matrix. The company says that it contains no formaldehyde. Just knowing the ingredients was enough to turn them both down. But we had no other alternatives.

Ann Boulton (see Part II) and I initially tested a single sample of both wood products. Since whichever product was selected, it had to be sealed, we also tested the wood products with three sealants. However, the results were confusing. Therefore, about 10 samples of each, (10 plain MDO, 10 plain MEDEX, 5 of each sealant on glass slides, 10 MDO coated with each sealant - 30 samples, 10 MEDEX coated with each sealant - 30 samples) a total of 95 samples were tested in order to gain a more consistent result.

Several peripheral but important points were learned from these tests:

1. A tight seal on the test container is necessary. We found that the loss of water negated the test. Jars where

water evaporated gave no reaction. All jars with water still present had a reaction occur - if the material was corrosive. Therefore, it is easy to misinterpret a single test if all factors are not considered.

2. Use of cotton in the test tube as is usually recommended did not alter the RH within the jar. We performed tests with cotton in the test tubes at the bottom, top and test tubes with no cotton. They all read 100% RH within an hour. Note: the paper RH strip has corroded the copper coupon.

The results that you see are typical of each product. All coupons of the MDO samples were extremely corroded, particularly the Pb and Fe. This is probably due to the formaldehyde resin. All samples of MEDEX had very slight corrosion on the Pb and none on the other coupons. (Fig. 1)

A rough idea of the pH of the two wood products was determined by placing pH strips in jars with the samples. Controls were run with water and without water. The pH of both Medex and MDO is 4 to 5. Since both products are made of softwoods it is not surprising that they have a low pH.

Of these two wood products Medex was the superior one, although it was not perfect. It is very expensive compared to MDO but the carpenters prefer it because it can be milled like wood. Therefore, Medex was selected for use in the new museum but the search for a replacement is ongoing.

Because the selected wood for building the cases was not perfect it was hoped that a sealant could be found to seal all the interior surfaces of the case and prevent off-gassing. We all know that the ideal case would be made of aluminum and glass or at least sealed with Marvelseal (a laminated material which does not allow vapor transmission made of aluminum foil, nylon, polyethylene) or saran wrap but these suggestions met with opposition from exhibits. So a compromise was made.

Three sealants were chosen for testing. All are water-borne coatings and therefore not offensive or hazardous for the shop to work with.

1. Polyglaze by Camgar - water-borne polyurethane
2. Fabulon by Fabulon Products - water-borne polyurethane
3. Shieldz Primer by Wm. Zinsser and Co. - water-based acrylic paint

First, each was painted on an inert glass slide, air dried and tested by itself without wood. All three passed; therefore, any corrosion which occurred in further tests on wood samples would probably be due to the wood products and not the coating.

Next, two coats of each sealant were painted on cubes of MEDEX and MDO in order to see if the sealant would actually act as a barrier and prevent the wood from corroding the coupons. Again 10 samples of each coated cube were tested. The results show that none of the coatings is an adequate sealant, but Shieldz Primer is the best of the three. (Fig. 2)

The cases in Hackerman House are intentionally not air tight to avoid a build up of any gases. Pb coupons are placed in an inconspicuous location in the case to monitor any organic acid pollutants.

In summary, this simple empirical test method is valid, inexpensive and requires little time. It appears from our testing that Medex, with a polyurea resin matrix along with its good working qualities, is the most reasonable product for cases at the moment. Of the sealants, the acrylic water based paint sealed best. The problem of off-gasing while not eliminated is cut down with the sealant. However, these materials are proprietary materials and the formulas change without notice, so it is important to test and retest frequently.

Since we do not work in a vacuum but work with other museum people who have different needs and monetary limitations, situations will not always be ideal. There is no perfect material. But we are doing our best to control the exhibit environment within the capabilities of the institution for which we work.

Normally we do not have time to run more than one sample of each material, but at present we have Matthew Crawford, a volunteer in the lab, who is very dedicated to the project. Therefore, we are able to do more thorough testing of materials.

Don't forget to test your case materials. You never know what might come out of them. Thank you.

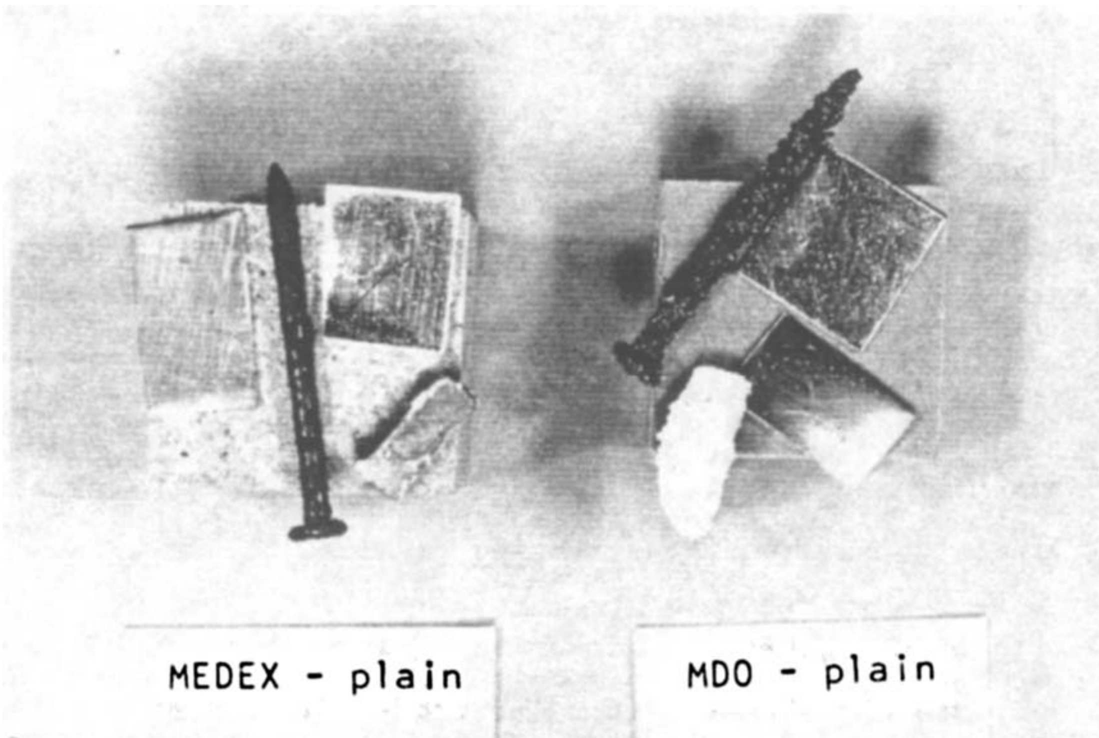

Fig.1. Examples of metal coupons on blocks of uncoated MEDEX and MDO after testing.

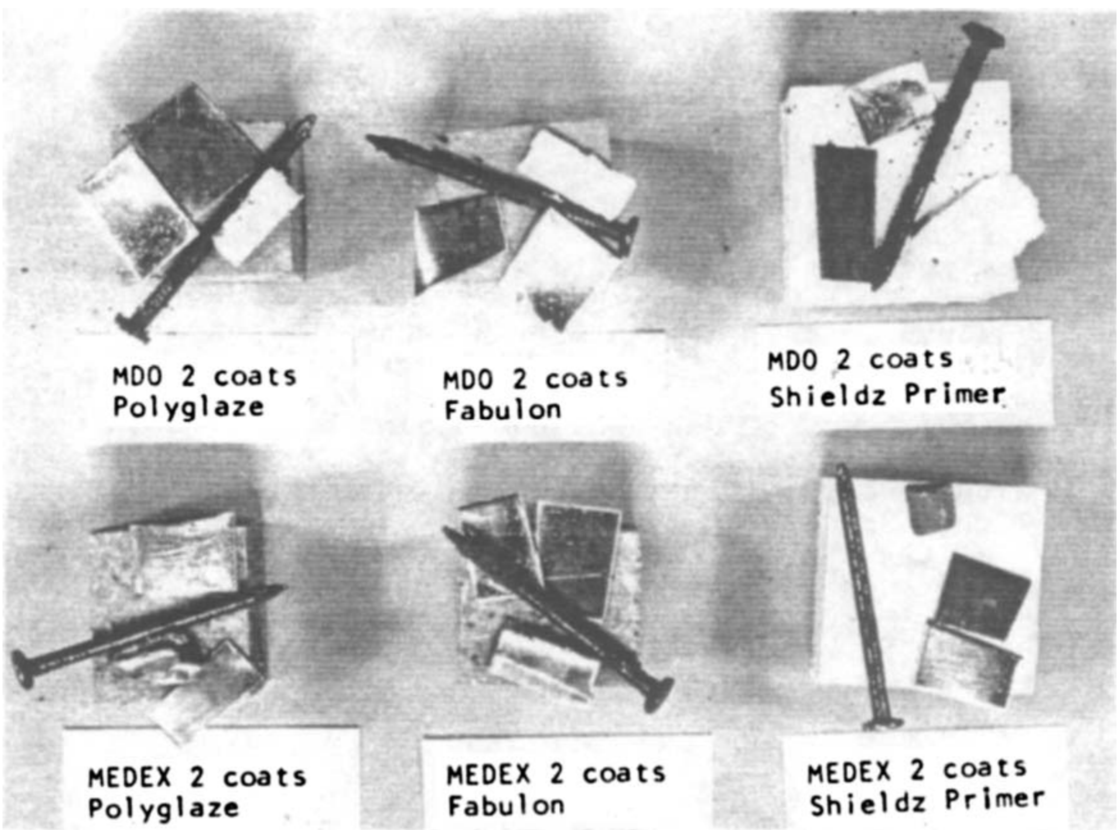

Fig. 2. Examples of metal coupons on blocks of MEDEX and MDO coated with various sealants after testing.

FIXTURES AT AN EXHIBITION: RESULTS OF PRACTICAL EXPERIMENTS FOR A NEW MUSEUM--PART II. Ann Boulton*

INTRODUCTION

For those of you who missed Donna's talk this morning a brief introduction to Hackerman House. Hackerman House is a mansion built in 1850 which was recently acquired by the Walters Art Gallery in Baltimore. The house has been physically linked to the Walters Art gallery by an elevated walkway across the alley which separates the two buildings. Hackerman House has just undergone extensive renovations and now functions as the Walters Museum of Asian Art. The galleries opened to the public on May 5th of this year. My talk will discuss one small aspect of the design for the exhibit cases which were built to house the Asian collection.

Ten of the cases for Hackerman House were intended to hold archaeological objects made of bronze. A number of these objects had a past history of bronze disease, and we wanted to create a microclimate with dry silica gel of 30% RH in these cases to prevent further outbreaks of bronze disease.

Microclimates such as these had certainly been established in the past at the Walters, but we had had some problems in achieving low relative humidity which we believed were due at least in part to the deck design of the cases. One design was to leave a quarter inch gap around the edge of the deck to allow for the passage of air from the silica gel compartment to the case vitrine where the art object was displayed (figs.1 & 2). We felt that the quarter inch gap was not wide enough and wanted to widen this gap to a half inch. This was very unpopular with the exhibit designer. He never liked the quarter inch gap and hated the idea of a half inch gap.

Another type of deck which had also been used in the past at the Walters but not without problems was a perforated deck with no gap left at the edges. Once the deck was covered with fabric the holes were not visible. We were concerned that the type of fabric chosen to cover the holes might affect the passage of air between the silica gel compartment below the deck and the object compartment above. This deck design was the favorite of the exhibit designer because there was no unsightly gap around the edge as with the other design.

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EXPERIMENT

Donna Strahan's and my experiment was in two parts. The first part was to compare the efficiency of the three types of wooden unsealed decks: the solid deck with a quarter inch gap at the edge, the solid deck with a half inch gap at the edge and the perforated deck with no gap at the edge. This was done by measuring the time it took the air in each test case to become dry. Our reasoning was that if the deck design inhibited the flow of air then it should take longer for the air in the case to become dry.

The second part of the experiment was to compare some different types of fabrics used to cover the perforated decks. We wanted to know if the fiber content or weave would affect the flow of air from the silica gel compartment. Again this was done by measuring the time it took the air in each case to become dry. Fabrics chosen for comparison were: wool, 100% cotton, and 50/50 cotton-polyester blend. Wool was chosen for comparison because it was a thick, tightly woven fabric. We do not use wool in our exhibition cases.

The design of the first part of the experiment was as follows: four test cases were constructed of MDO plywood (this was before we switched to Medex) and four Plexiglas vitrines were ordered. These cases were of the "table top" style that was used extensively in Hackerman House. The plywood was allowed to sit for several weeks in the 50% RH environment of the museum before the cases were constructed. The vitrines were 8 cubic feet in volume so 4 pounds of silica gel were placed in the bottom of each case. (We use a formula of 8oz. of silica gel per cubic foot of airspace). The silica gel had been dried for several days in our oven and was near 0% RH. Over the dry gel the plywood decks were installed, one with a quarter inch gap, one with a half inch gap and one with perforations only. The MDO plywood used for the decks had a factory-applied primer on both sides, but we did not seal the edges as we were still testing sealants at this stage. The forth case had no deck and was used as a control. Pastorelli and Rapkin hygrometers calibrated to a recording hygrothermograph were hung from the top of each vitrine and the cases were closed.

The relative humidity in the cases when they were closed was 50%. The drop in relative humidity was recorded at irregular intervals (fig.3). From this experiment we saw that there was very little difference in performance between the decks with the quarter and half inch gaps and that the perforated deck appears to be slightly more efficient. Now a disclaimer. These hygometers are not terribly accurate so slight differences of 2% or so must be discounted.

We all know that wood itself is a good buffer. It is true that the perforated deck had 5.5 ounces less wood in it. This amount of wood was removed during the drilling of the holes in the deck.

No doubt the smaller amount of wood in the deck released less moisture in the air which could account for the greater efficiency of the perforated deck. Was the perforated deck more efficient only because it contained less buffer material or did the actual design of the deck influence it also?

To shed some light on this question we did two more experiments. A solid wooden deck with a quarter inch gap was compared with a solid Plexiglas deck with a quarter inch gap (fig.4). Next, a perforated wooden deck was compared with a perforated Plexiglas deck (fig.5). Our thought was that the Plexiglas would release very little moisture and should be more efficient than the wood decks if the design had no influence. The results of the tests show that the solid decks are nearly identical in efficiency no matter what their material. The perforated plexiglas deck is more efficient than the perforated wooden deck. From this pair of experiments we can deduce then, that the smaller amount of buffer material does have an effect but that the design of the deck is also a factor. You might wonder whether the perforated deck simply has more surface area exposed for the air to travel through. That is actually not true. The deck with the half inch gap had slightly less that 20 square inches of unobstructed surface area around it and the perforated deck had slightly less than 16 square inches of unobstructed surface area. We selected the perforated decks for our cases as they performed slightly better for whatever reasons and because they were preferred by the exhibit designer.

The second part of our experiment was to test several different fabrics to see whether fiber content or weave would affect the ability of air to pass through the deck. We chose 100% wool, 100%cotton and 50/50 cotton polyester blend. The experiment was set up in the same manner as the first one except that all the decks were perforated, each covered with a different fabric and the control was a perforated deck with no fabric. You can see from the chart (fig. 6) that there is very little difference in the response of the control with no fabric to that of the wool and the cotton poly blend. The cotton appears to slow down the RH drop slightly. Of course a fabric like Ultrasuede which has a plastic backing would affect the ability of the air to pass through the deck. This may seem quite obvious to us but it might not be obvious to the exhibit designer.

How did these decks work in real life? Of course there are many problems. The concept of controlling the environment with silica gel for some reason seems to elude other museum staff members. The first problem was that the deck fabric chosen was thin and white through which you could see the holes in the deck. So another layer of heavier fabric had to be put on the deck first. Then the decision was made to staple silver cloth to the underneath side of many decks so that the dry air ultimately had to penetrate three layers of fabric in some cases. Then much of the exposed deck was covered with labels. This was alleviated by putting small matboard spacers under each label to lift it slightly off the deck. When objects were displayed on large fabric covered blocks we requested that holes be drilled in the backs of the blocks. In some cases objects were displayed on already existing bases made of solid stone rather than on fabric blocks. We are lobbying to have spacers put under these bases to lift them slightly.

To see what effect three layers of fabric would have on the air flow we did yet another experiment in which we compared a perforated deck with no fabric to one which was covered with three layers: 100% cotton velveteen, 100% cotton sateen and 100% cotton flannel (silver cloth). Two of these three layers were rather thick and all were made of cotton which is also a buffer. We were rather surprised to see that there was very little difference in performance of the two decks (fig.7). The fabric layers did not seem to inhibit the air flow.

SUMMARY

Our experiments helped us choose the most efficient deck design for our new cases. The perforated deck seemed to be more efficient than the solid decks with gaps at the edges. This was not only because there was less wood to act as a buffer in the perforated deck but was also partly due to the actual design of the deck. The fabric covering the holes of the perforated deck did not seem to inhibit the flow of air as one might expect. Neither the fiber type nor the number of layers of fabric had any real effect on the air flow.

The problem with perforated decks in actual use is that because the holes are covered with fabric, non-conservation museum staff forget about them. Many things can be put on the decks such as labels and blocks which cover the holes and prevent the passage of air. The exhibition staff has to be frequently reminded that the holes must remain unblocked to allow the silica gel to do its job.

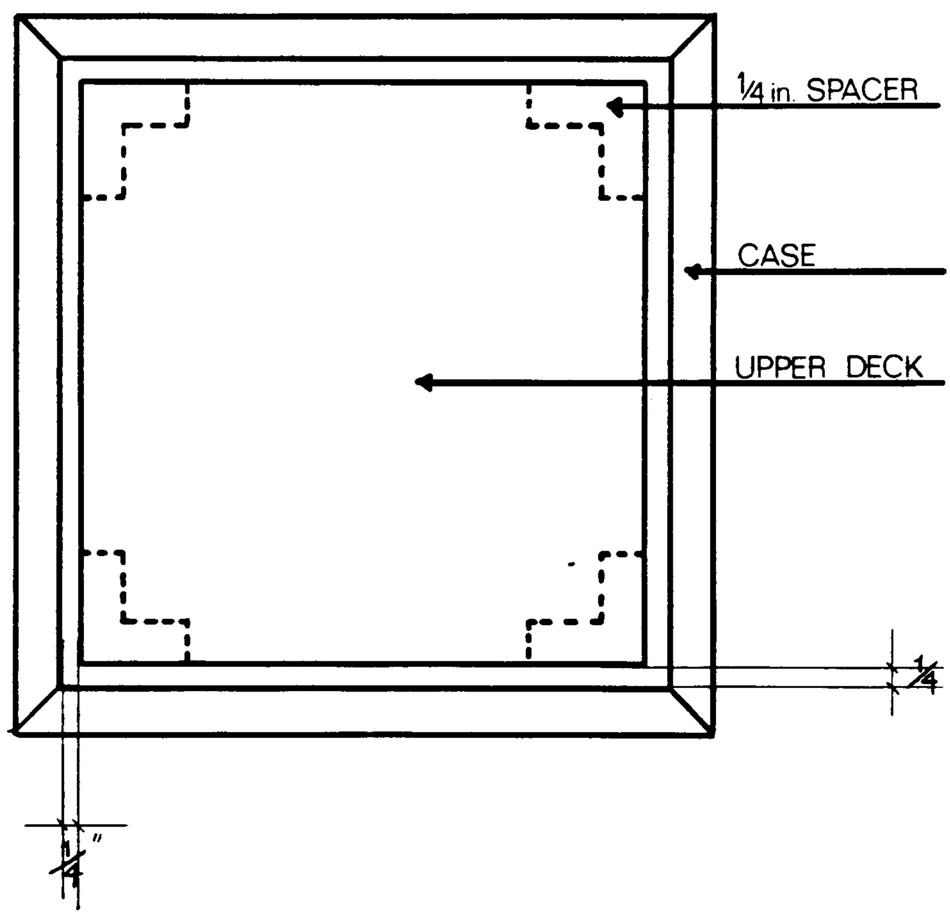

fig.1 Top view of deck with quarter inch gap.

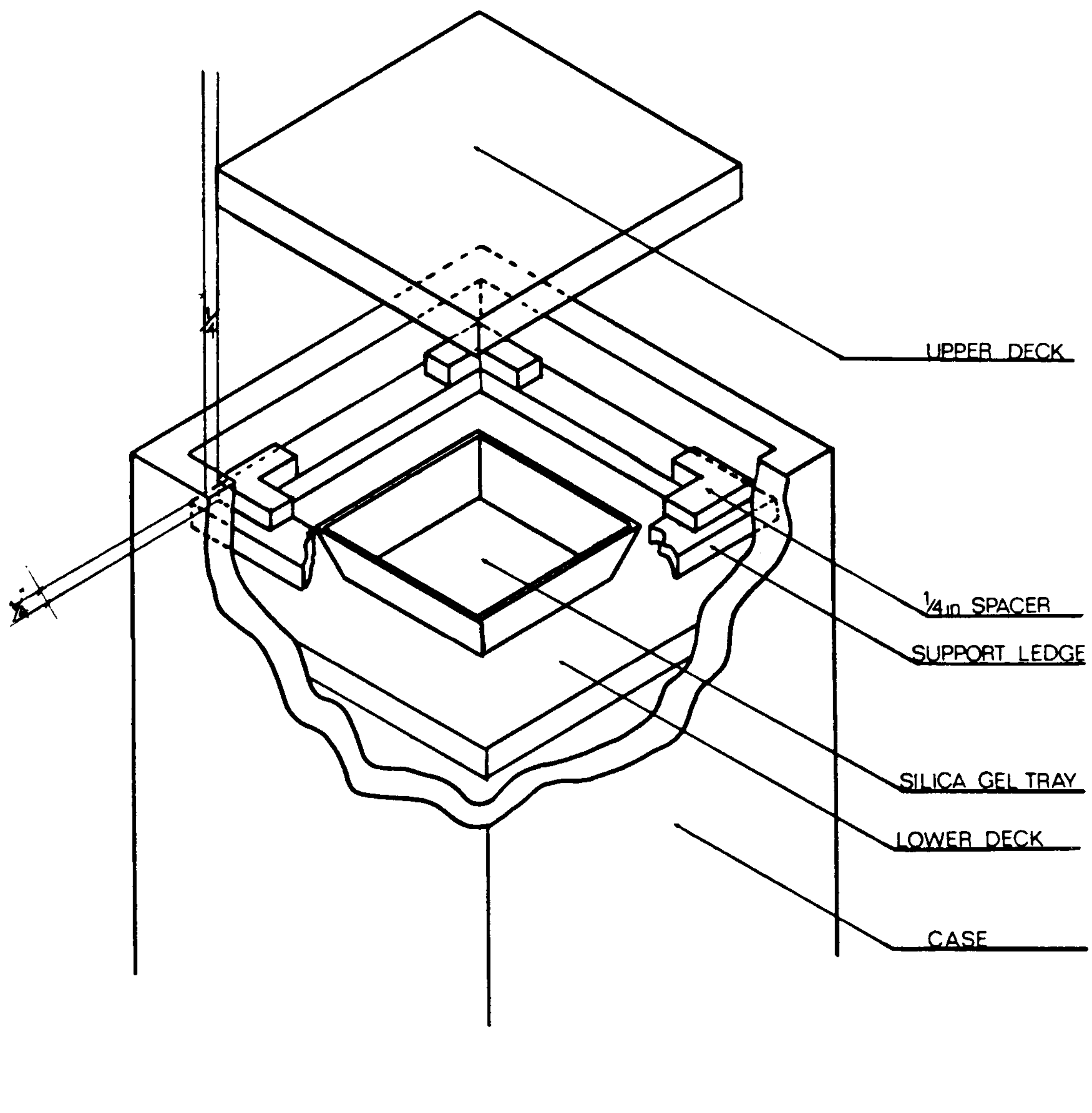

fig.2 Case with deck with quarter
inch gap.

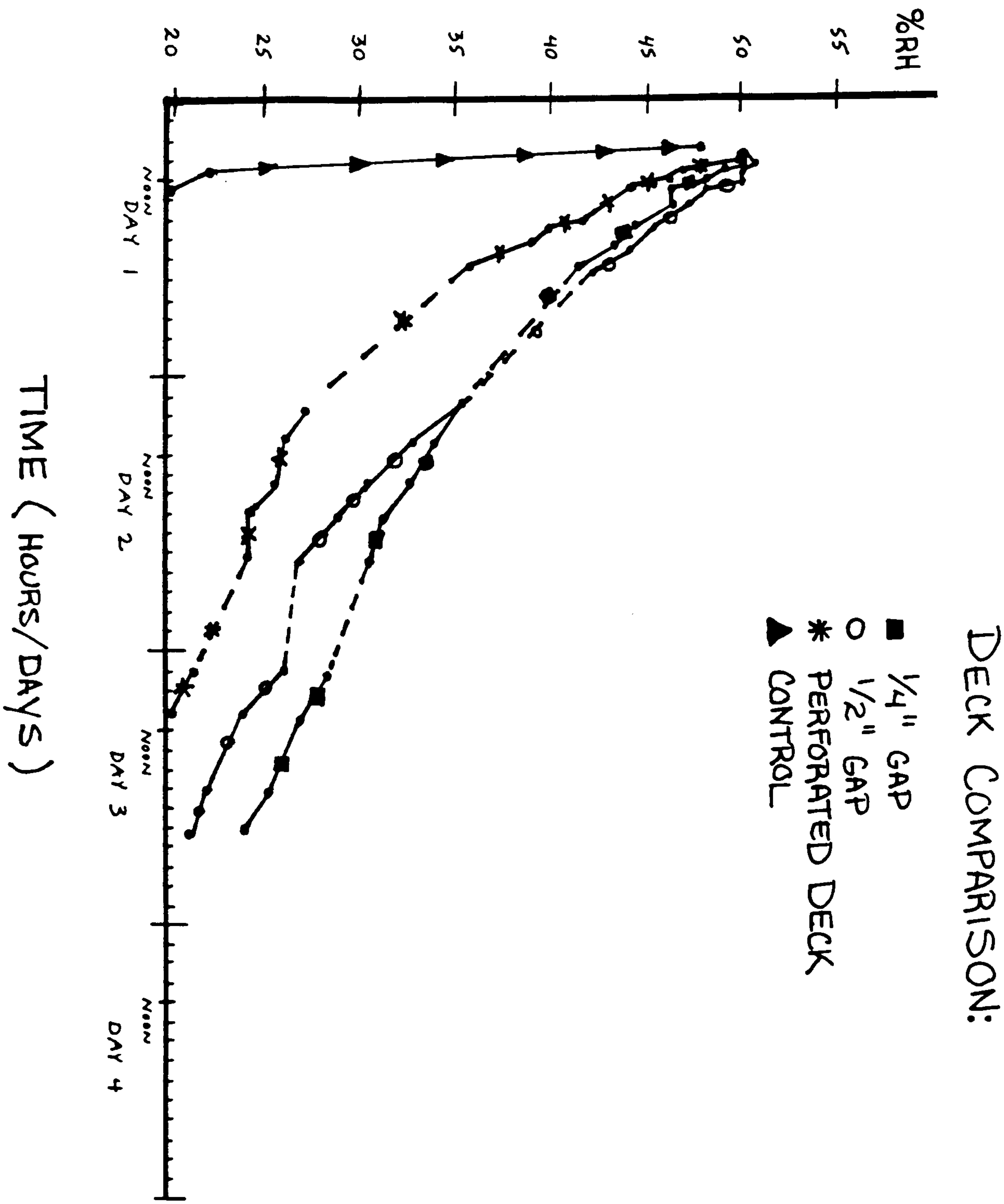

fig.3 Deck comparison

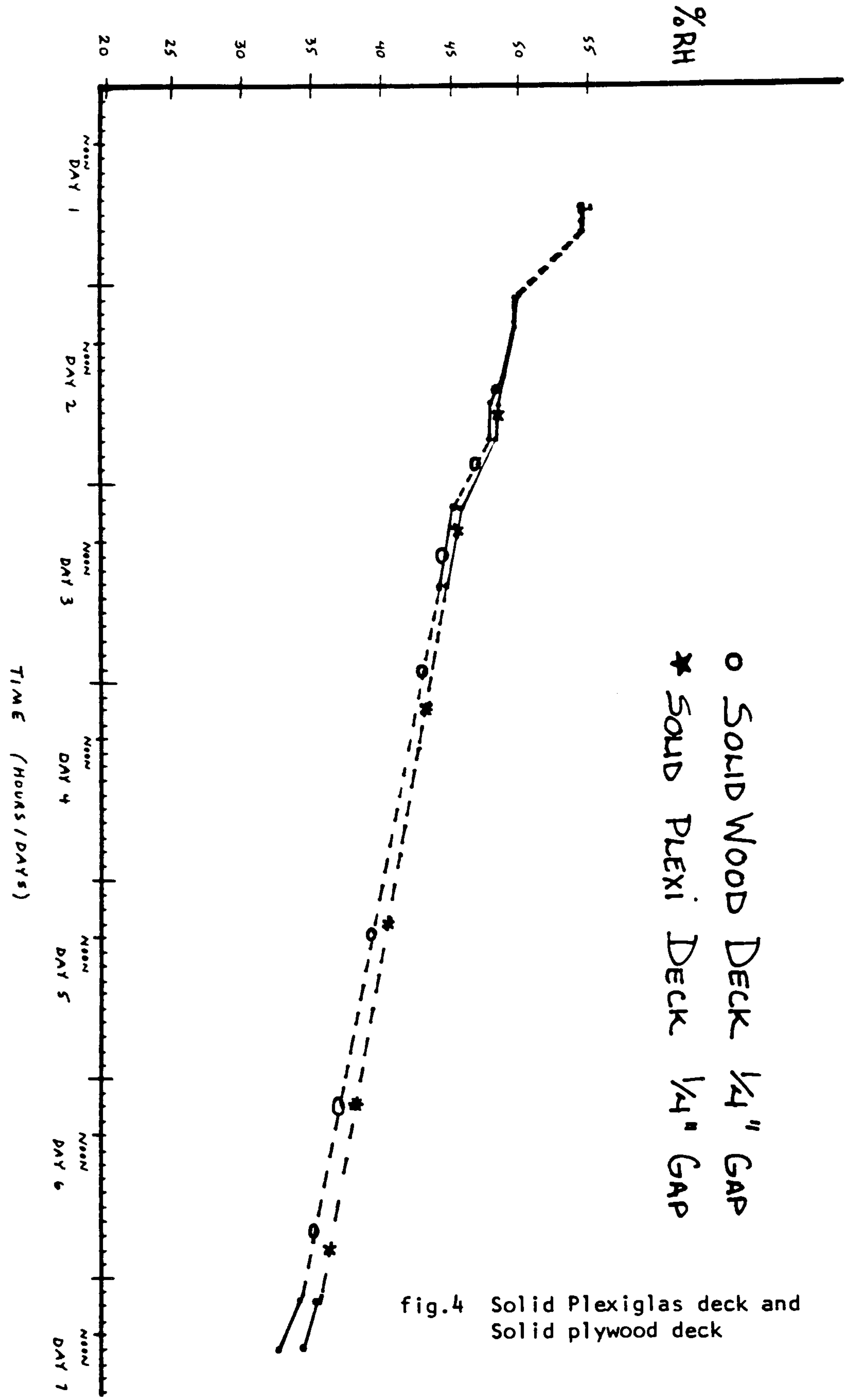

fig.4 Solid Plexiglas deck and
Solid plywood deck

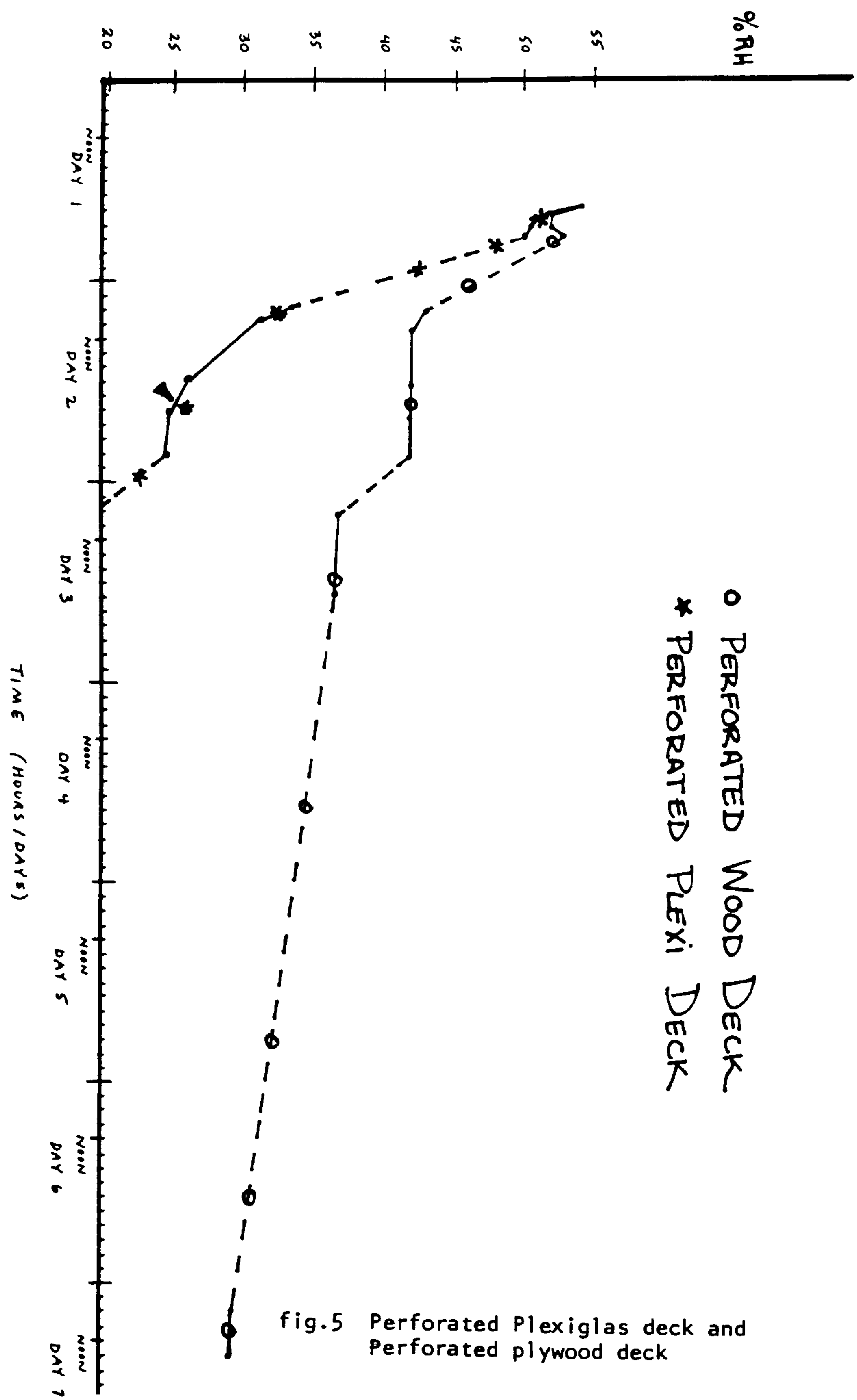

fig.5 Perforated Plexiglas deck and Perforated plywood deck

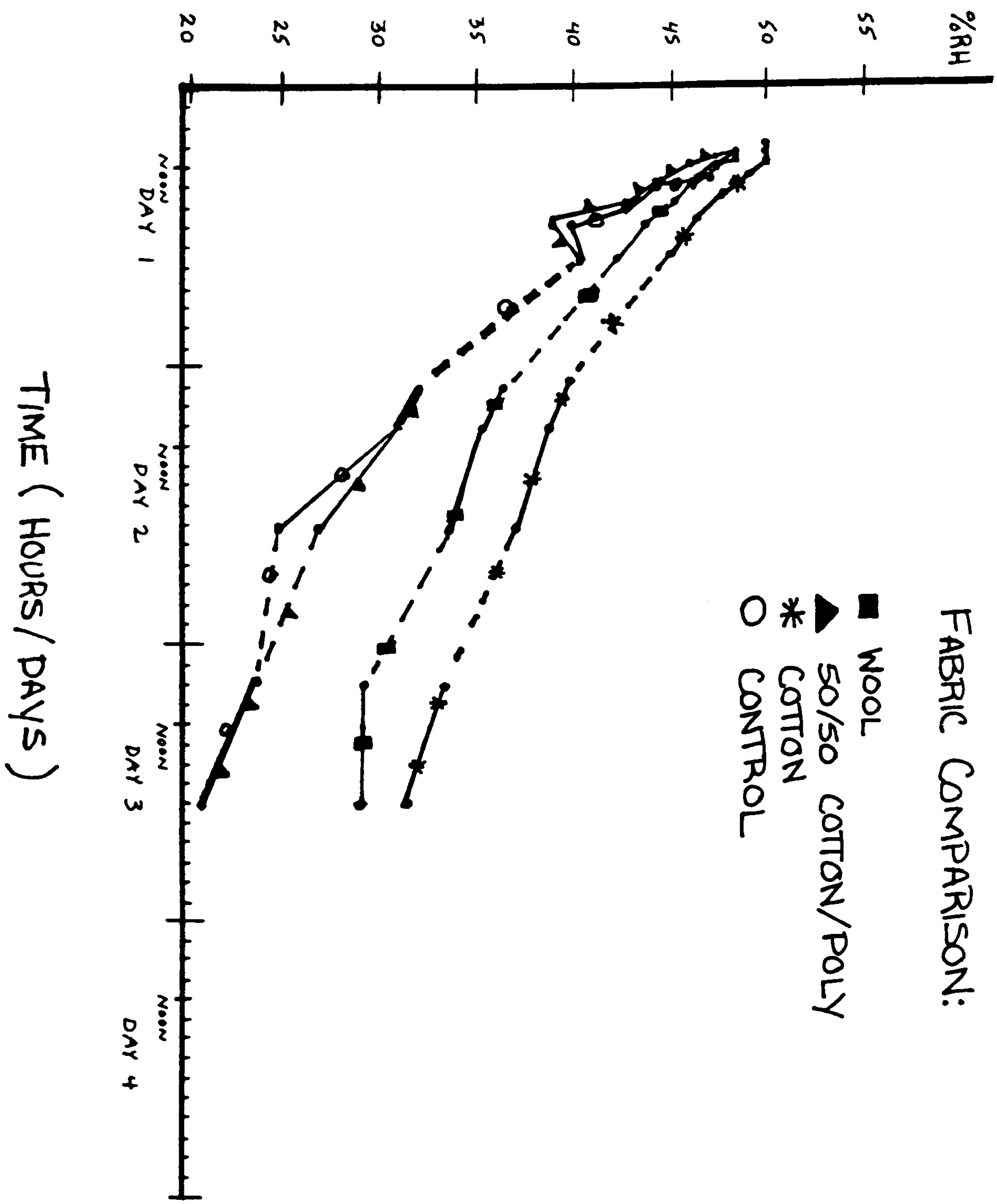

fig.6 Fabric comparison

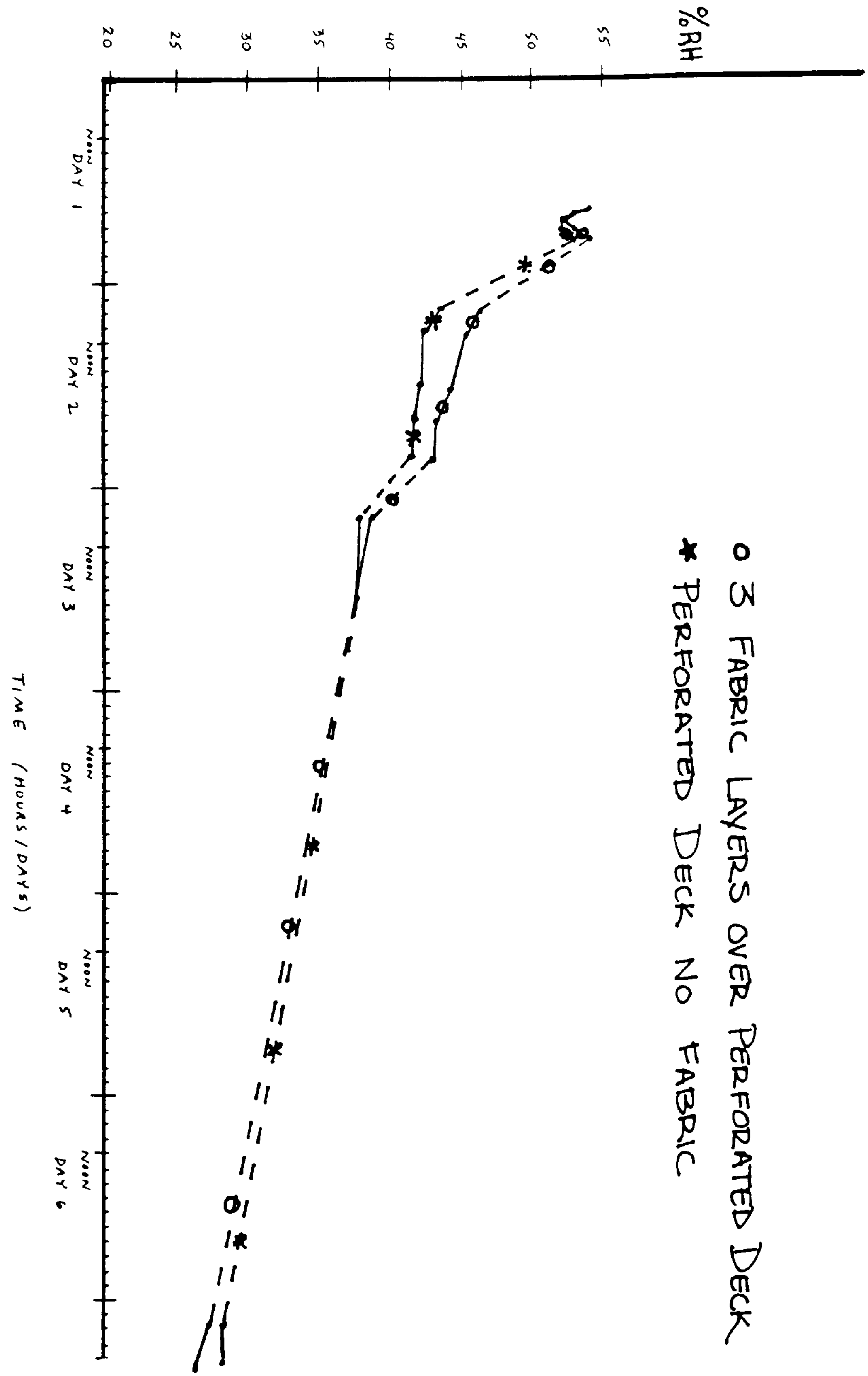

fig.7 Three layers of fabric