

**INVESTIGATION OF THE TIMESAVER PROCESS FOR
DE-BURRING AND CLEANING THE PLATE
FOR THE ATLAS TILECALORIMETER**

BY

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Introduction:

The Timesaver belt grinding machine has been selected by the Atlas collaboration for deburring the master and spacer plates after die stamping and laser cutting, respectively. However, the question has been raised as to whether or not the plates are sufficiently clean after going through the Timesaver machine to immediately be glued into a submodule assembly. This would greatly enhance the production of submodules because the task of cleaning individual master and spacer plates is labor intensive and time consuming as well as raises environmental issues with the detergent that is used. In order to investigate the possibility of using the Timesaver process to clean the plates as well as debur them, several plates were run through the machine and their cleanliness inspected before and after. In addition, several glue samples were subjected to the same process, glued, and then pulled apart in an attempt to gauge the cleanliness of the plates.

The Timesaver Machine:

The machine that is being investigated is the 137HDMW. This machine has a one-head belt, washes the plate continuously with Trimsol coolant, and has a dryer at the exit of the machine. The brochure for this machine is attached in Appendix 1. The advantage of this machine is that the plates are continuously flooded with coolant that washes away the oil and the grit from the grinding process. The dryer at the exit of the machine consists of several blowers that are designed to completely remove all moisture from the plates. Trimsol coolant is used in the machine. This coolant is environmentally friendly and can be disposed of down a common drain. Trimsol is currently being used in Argonne's machine shops and is therefore accepted by Argonne's ES&H department. A desirable feature of Trimsol is that it contains a rust inhibiting agent. This feature of Trimsol is evident on the plates that were tested. After six weeks, the plates that were used in this test still do not exhibit any signs of surface rust.

For the tests that were conducted, three separate machines were used. The first, Machine A, was identical to the machine that would be purchased except it had an additional head to which a Scotch Brite[®] belt was attached. This head did not engage the plates during our tests. Also, this machine had one less blower on the exit dryer than the machine that would be purchased. Machine A had a 50 durometer roller that applied the pressure between the plates and the grinding belt. The second machine, Machine B, was identical to Machine A except that it was older and had a 38 durometer roller. The third machine, Machine C, was identical to Machine A except it was a 'dry' machine and did not have the coolant applied to the plates and rollers. The same 80 grit belt was used in all three of these machines.

All of the machines operated at 25 feet per minute. At this speed it took a master plate 30 seconds to go through the machine. This speed appeared to be the fastest that plates should be run through the machine without fatiguing the operators.

Test Design:

No master or spacer plates existed at ANL that had not already gone through the Timesaver process. Therefore, eleven master plate blanks were used for this test because they had not undergone Timesaver and they were coated with the level of oil we expected would have to be cleaned from the stamped master plates. Ten of these blanks were sheared into the

approximate trapezoidal shape of a master plate. The eleventh blank was sheared into 20 rectangular pieces approximately the size of the smallest spacer plate. This size was chosen because the Timesaver machine had a minimum size that could be used in the machine and the smallest spacer plate was only slightly larger than this minimum. Finally, 20 strips 25mm by 150mm were sheared to server as glue test pieces.

Test Results:

After the initial setup of the machine in which the height of the roller was set using one of the spacer plates, five of the simulated master plates were run by Machine A. Before the plates were run through the machine, a clean rag was wiped over the surface of the plate which showed a heavy covering of oil. Upon exiting the machine there was no perceptible moisture on the plate and a second wipe test with a clean cloth showed no signs of oil or grime. Next, 10 of the simulated spacer plates were run into the machine and the same results achieved. On all of the plates the sheared edge was deburred and a uniform surface finish observed. Ten of the glue specimens were then run through the machine. The Scotch Brite® roller was then lowered and the same wipe test was performed on two simulated master plates and the remaining spacer plates. The same results were observed with the wipe test and no moisture was seen on the plates upon exiting the machine. The Scotch Brite® roller produced a smoother surface finish than a roller alone.

Next, the 80 grit belt was transferred to Machine B. Two of the simulated master plates were run through this machine. The same wipe test was performed on these plates. Upon exiting the machine, no moisture was observed and there was no perceptible oil or grime seen on the rag after wiping the plates. Ten of the glue specimens were then run through the machine.

Finally, the last simulated master plate was run through Machine C that was a 'dry' machine and did not apply coolant to the plates. The dust collector for this machine was only operating at 50% efficiency. Upon exiting the machine, extremely heavy grit covered the plate that was approximately 1mm thick.

During the initial setup of each machine, the thickness of the plates was measured. After both sides of the plate were run through the machine, the thickness of the plate had been reduced by .025mm.

Glue Test:

The twenty strips were glued together into 10 pairs upon return to Argonne for measuring the lap shear of the glue. The strips that composed each pair were overlapped by 25mm thereby forming a 25mm × 25mm glue area. Each strip was 5mm thick. In the submodules, the average glue line thickness is .05mm. In order to test the lap shear using this glue line, two blocks were fabricated that were 10.05mm thick (5mm + 5mm + .05mm). The glue was buttered onto the glue area, the two strips plated in contact and a heavy bar that rested at its ends on the machined 10.05mm block with the test piece plated in between. This is a similar technique to that being used to establish the height of the submodule during stacking. The glue was allowed to cure at room temperature for 72 hours before performing the lap test. Specimen numbers 38-1 through 38-5 were run through Machine B that had a 38 durometer roller. Specimen number 50-1

through 50-5 were run through Machine A that had a 50 durometer roller. The results of the tests are tabulated below.

Specimen Number	Stress N/mm ²
38-1	7.6
38-2	11.0
38-3	11.4
38-4	11.4
38-5	6.9
50-1	9.3
50-2	9.3
50-3	10.7
50-4	10.0
50-5	10.5

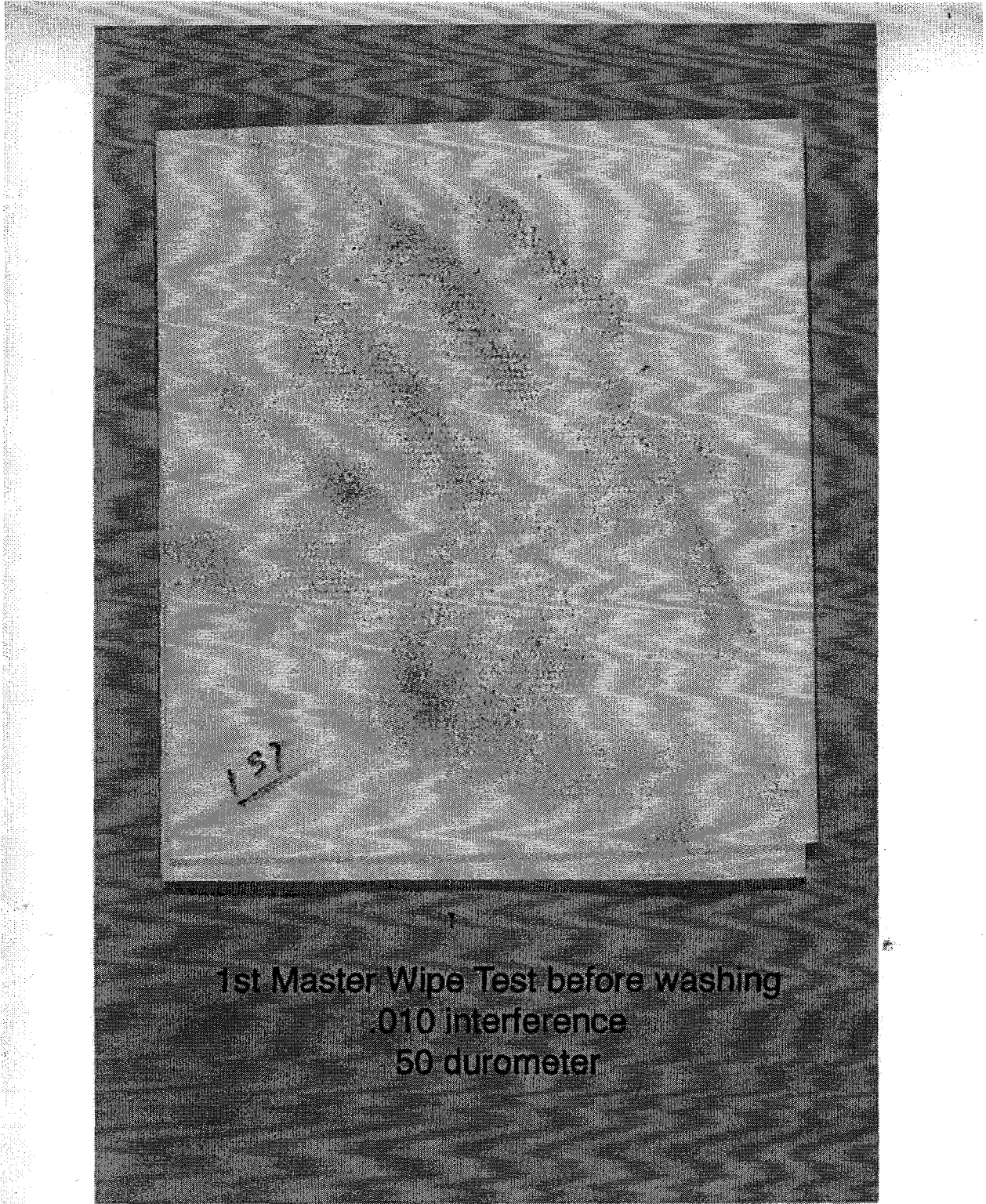
All of the test specimens fall within the required range of glue strength. In addition, there does not appear to be a perceptible difference due to the difference in the durometer of the roller used. These test results are better than those obtained in an earlier glue test at Argonne (reference ANL Technical Note ANL-HEP-TR-94-86) that yielded shear stresses of approximately one-half of that obtained in this test. It is difficult to surmise the cause of these differences, however, it may be due to the lack of control of the glue line thickness in the earlier test and that the test samples in the earlier test were cured in an oven rather than at ambient temperature over time as in this test.

Conclusion:

From this series of tests it can be concluded that the 'wet' Timesaver machine can adequately prepare the surface of the master and spacer plates as well as clean the plates for gluing. The machine was able to adequately remove all of the oil and grime from the test plates. Also, from the single test on the 'dry' machine it appears that significant cleaning will be required to adequately clean the plates before gluing in order to remove the remaining grit.

Appendix A

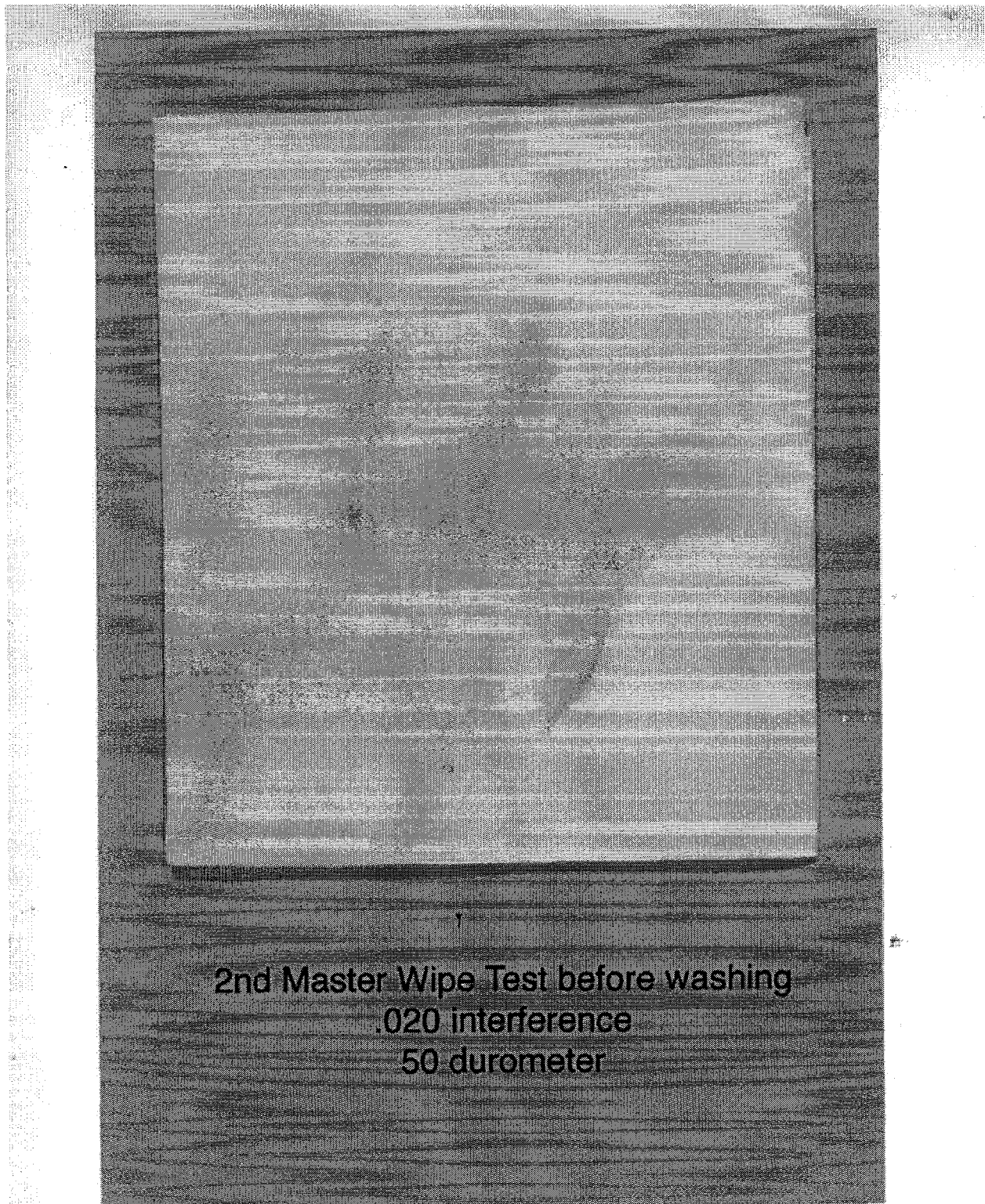
Photographs of Wipe Tests



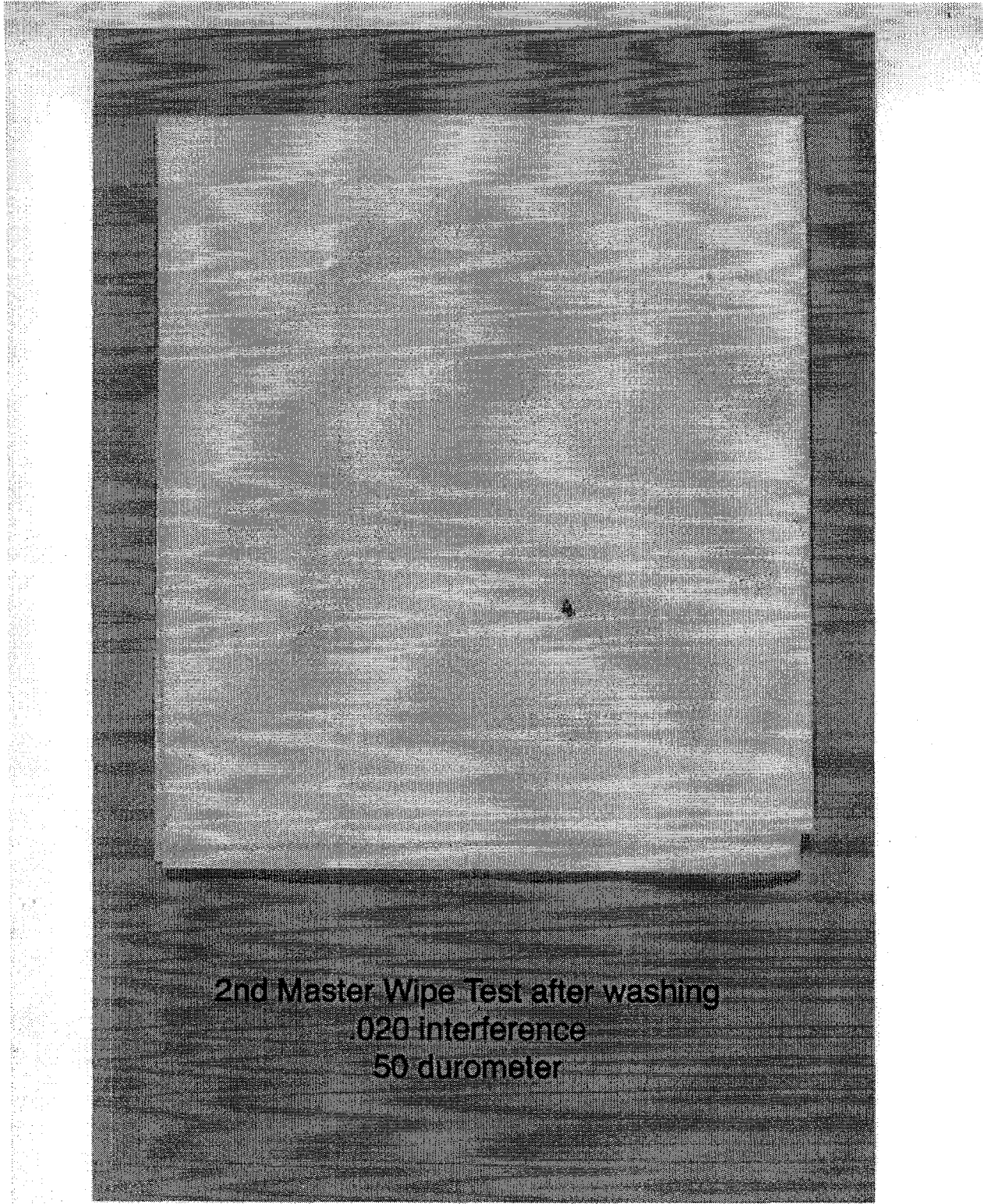
1st Master Wipe Test before washing
.010 interference
50 durometer

241D

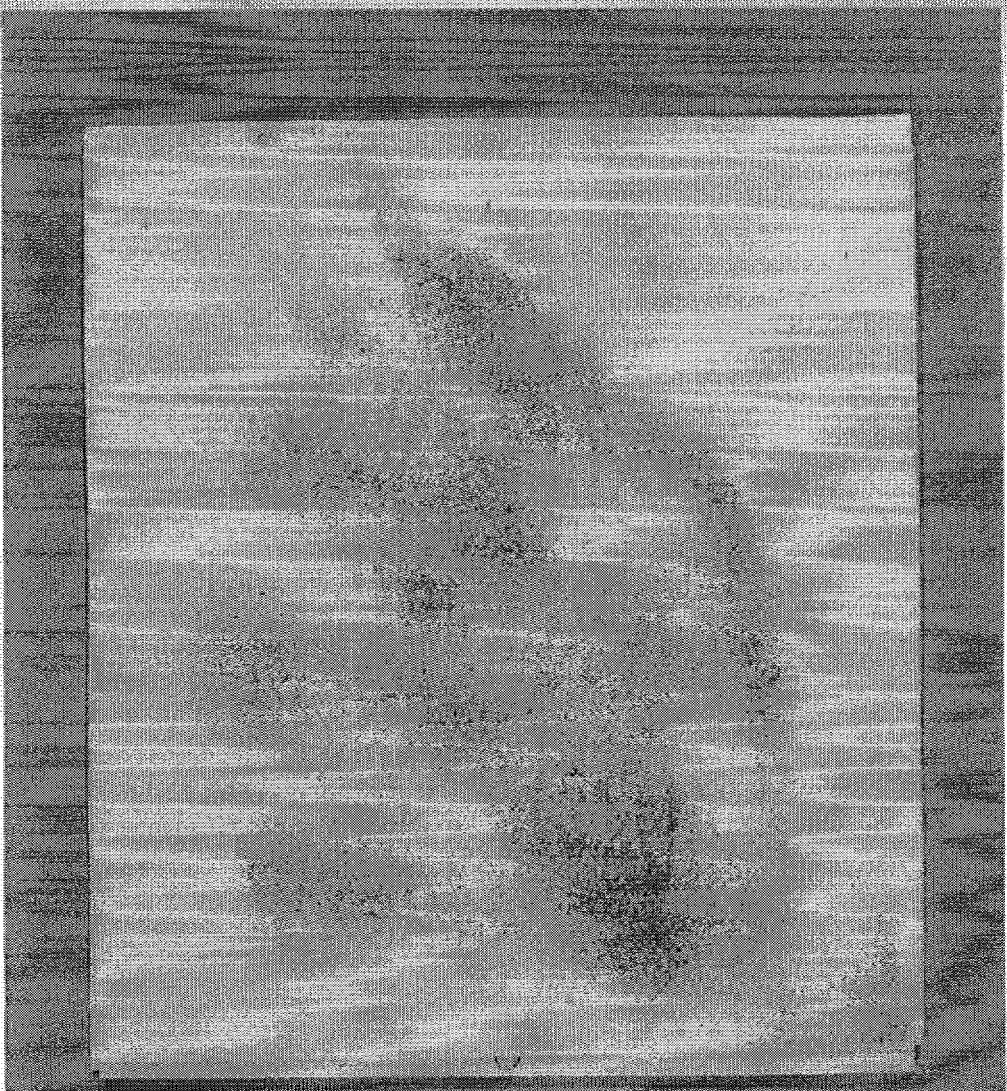
1st Master Wipe Test after washing
.010 interference
50 durometer



2nd Master Wipe Test before washing
.020 interference
50 durometer



2nd Master Wipe Test after washing
.020 interference
50 durometer

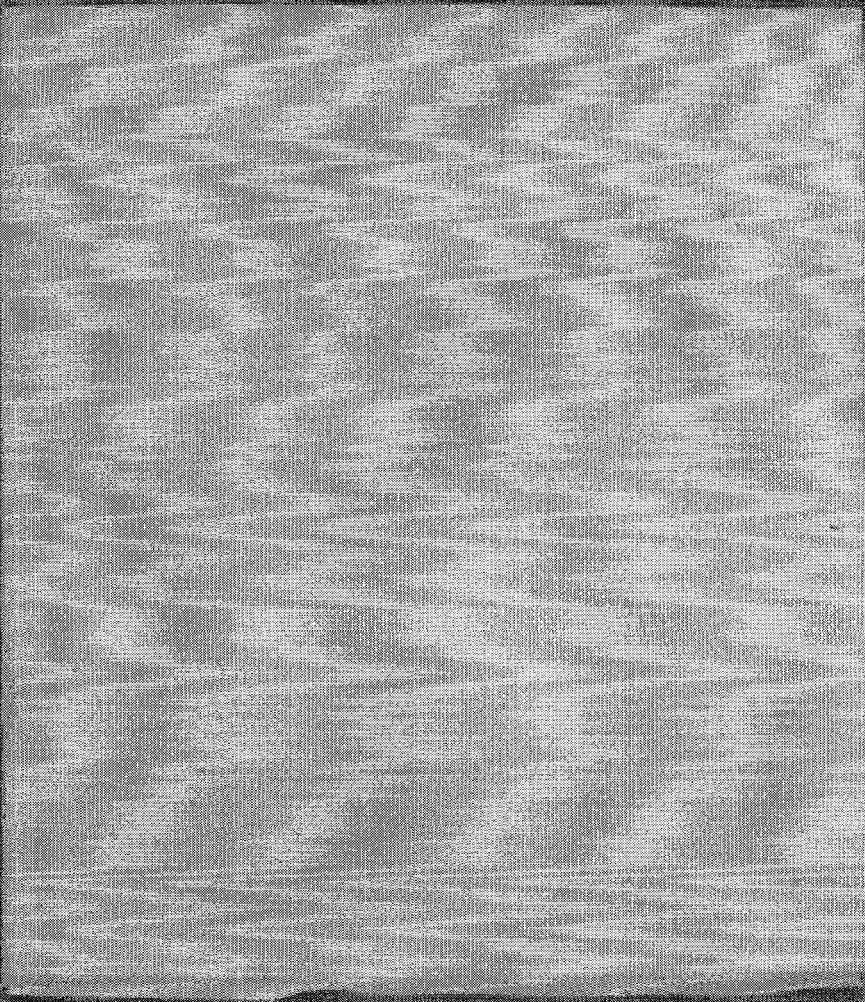


3rd Master Wipe Test before washing

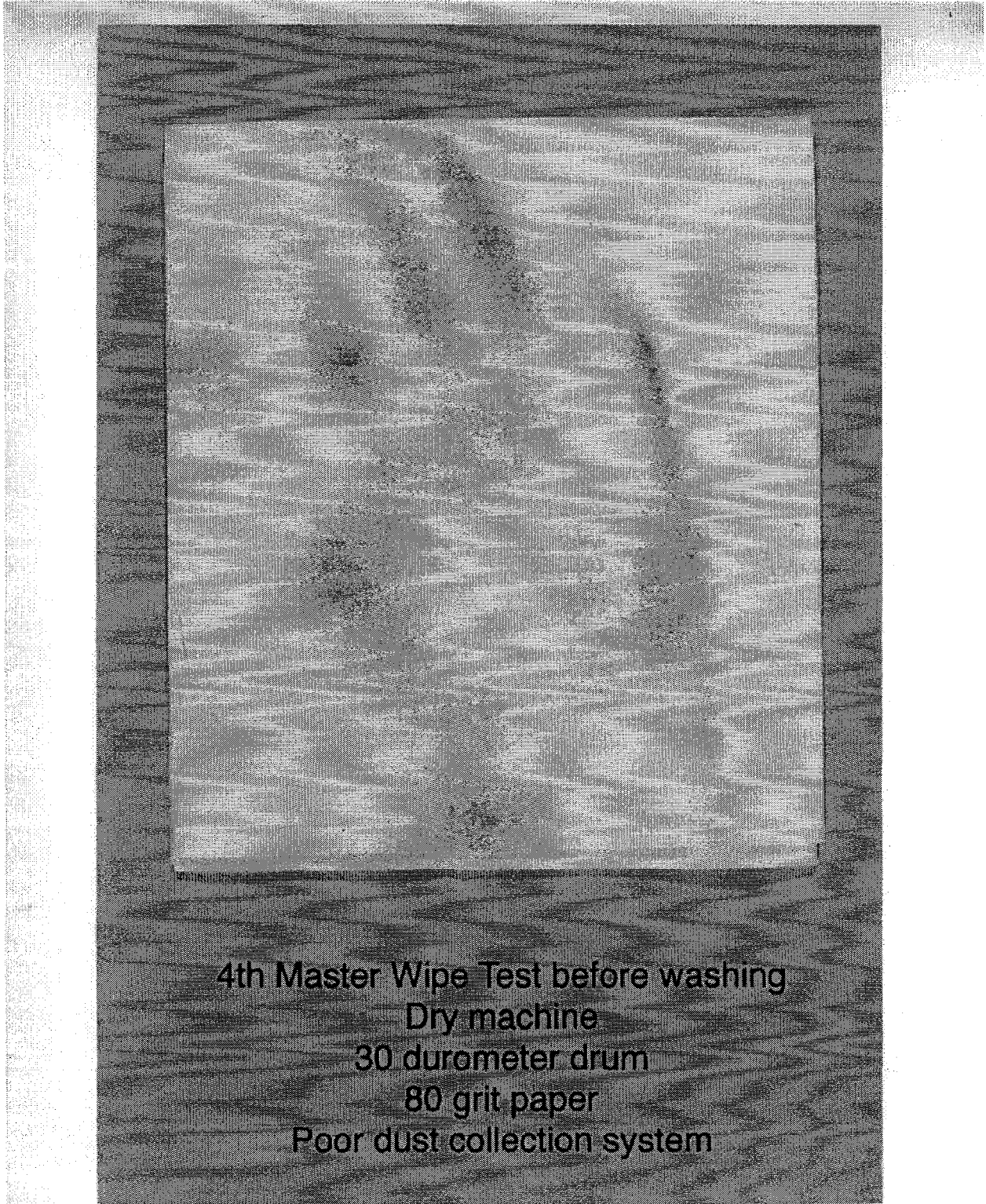
80 grit

50 durometer

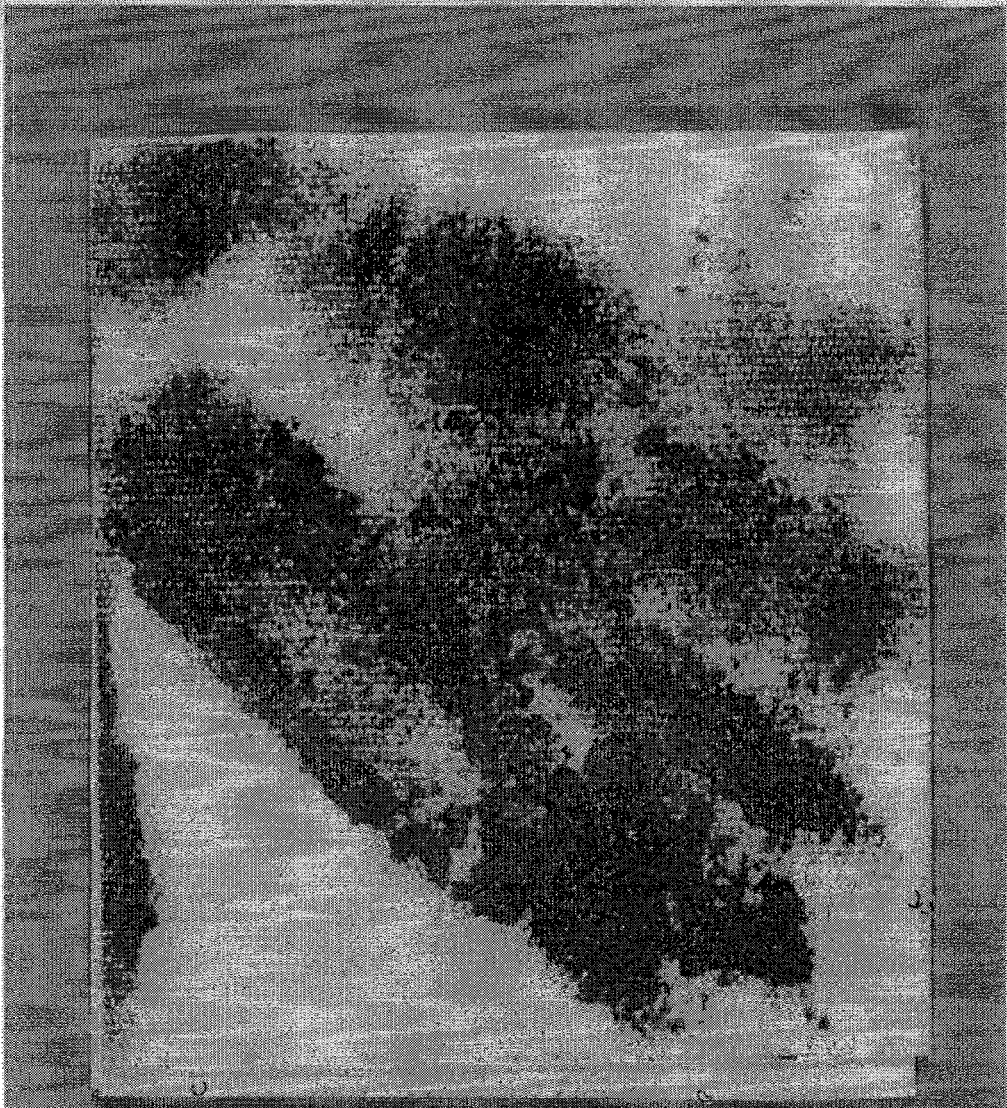
.171/osc. Scotch Brite® brush



3rd Master Wipe Test after washing
80 grit
50 durometer
.171/osc. Scotch Brite[®] brush



4th Master Wipe Test before washing
Dry machine
30 durometer drum
80 grit paper
Poor dust collection system



4th Master Wipe Test after washing
Dry machine
30 durometer drum
80 grit paper
Poor dust collection system

Cost/Benefit Analysis of Timesaver

Current Production Plan for Washing

Cleaning at ANL	\$ 69,950
Cleaning at UofC	22,627
Cleaning at UofI	28,068
Timesaver on Master and Spacer Plates during plate procurement	192,627
Washing Systems at ANL, UC and UI	49,488

Total Cost **\$362,760**

Proposed Production Plan

Cost of 3 Timesaver Machines @ \$57,120/each	\$171,362
Cost of Timesaver based on 6 man-hours of tech time at ANL	120,855

Total Cost **\$292,217**

Savings **\$ 70,543**