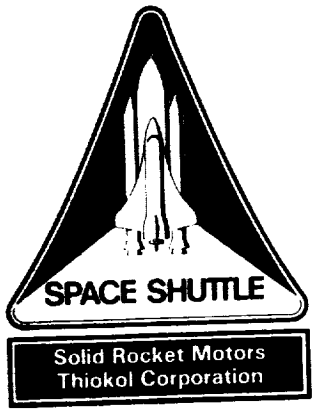
CR-184003

TWR-50012



Final Report for the M-52 Spray Booth Qualification Test

July 1990

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	**NAS8-30490**
DR No.	**5-3**
WBS No.	**4B102-10-07**
ECS No.	**SS3456**

Thiokol CORPORATION

SPACE OPERATIONS

P.O. Box 707, Brigham City, UT 84302-0707 (801) 863-3511

Publications No. 91073

Thiokol CORPORATION
SPACE OPERATIONS

TWR-50012

Final Report for the M-52 Spray Booth Qualification Test

Prepared by:

Test Planning and Reports
Systems Engineer

Approved by:

Requirements Manager

7-17-90
Design Engineer

Program Manager

Systems Integration Engineer

System Safety

(18) July 90
Reliability

P C Tydeck 7-18-90
Data Management/Release
ECS No. SS3456

ABSTRACT

This report documents the procedures, performance, and results obtained from the M-52 spray booth qualification test. The test was conducted at Thiokol Corporation, Space Operations, M-52 Inert Parts Preparation facility. The purpose of this testing sequence was to ensure the spray booth would produce flight qualified hardware.

The testing sequence was conducted in two series. The first series was conducted under CTP-0142, Revision A. The second series was conducted in accordance with CTP-0142, Revision B.

The test sequence started with CTP-0142, Revision A. The series consisted of the contamination removal test and the performance test. The contamination removal test was used to assess the Teflon level in the spray booth. The performance test consisted painting and Chemloking a forward dome inside the spray booth per flight procedures. During the performance test, two sets of witness panels (case/insulation and steel/epoxy/steel) were prepared and pull tested.

The CTP-0142, Revision B, series of testing consisted of re-testing the steel\ epoxy\steel witness panels. The pull tests analysis indicates the results of the tensile tests were comparable to the systems tunnel witness panel database. The exposed panel set and the control panel set average tensile values were above the A-basis lower limits established on the systems tunnel witness panel database.

It is recommended that the M-52 spray booth be qualified for producing flight hardware.

CONTENTS

Appendixes

FIGURES

ABBREVIATIONS AND ACRONYMS

μ	microns
deg	degree
ft	foot
ft^2	square foot
ft^3	cubic foot
FTIR	Fourier transform infrared (spectroscopy)
hr	hour
mg	milligram
NA	not applicable
NASA	National Aeronautics and Space Administration
NVR	nonvolatile residue
pli	pounds per linear inch
psi	pounds per square inch
R&D	research and development
RSRM	redesigned solid rocket motor
TRR	test readiness review

1

INTRODUCTION

This report documents the procedures, performance, and results obtained from the M-52 spray booth qualification test. The test was conducted at Thiokol Corporation, Space Operations, M-52 Inert Parts Preparation facility. The purpose of this testing sequence was to ensure the spray booth would produce flight qualified hardware.

The testing sequence was conducted in two series. The first series was conducted under CTP-0142, Revision A. The second series was conducted in accordance with CTP-0142, Revision B. The second series was conducted due to the failure of the epoxy/steel/epoxy witness panels to meet the pass/fail criteria. The pass/fail criteria taken from TWR-60445 is:

a. Detectable Teflon shall constitute a test failure. There must be no detectable Teflon as verified by Fourier transform infrared (FTIR) (spectroscopy) analysis of the surface wipes, environmental fallout panels, and the NASA Test Box filter. No atypical levels of nonvolatile residue (NVR), as verified by NVR analysis of surface wipes and environmental fallout panels (compared to nominal paint pit conditions) are acceptable.

b. Inability to preform flight process shall constitute a test failure. Demonstrate that paint/Chemlok® process can be performed on flight hardware inside the spray booth.

c. Processed hardware must meet established standards. Compare witness panel bond strength data to existing witness panel statistical database. Cross-hatch paint adhesion tests must be within developed redesigned solid rocket motor (RSRM) witness panel data history.

The steel/epoxy/steel bond strength configuration was used because it was more sensitive to contaminants. An engineering assessment indicated that the pull test results were outside the established tolerance of three standard deviations. This assessment violated pass/fail Criteria C.

The design team re-evaluated the testing sequence. The result of this evaluation was Revision B to CTP-0142. The revision addressed only the steel/epoxy/steel witness panels. The pass/fail criteria was rewritten into the test readiness review (TRR) package as follows:

a. Contamination Removal Test

1. Teflon – No indications from FTIR analysis on booth wipes or environmental fallout panels.
2. NVR – Amount of NVR is below the accurately detectable limit of 2 mg/ft^2. Therefore, pass/fail criteria is not applicable (NA).
3. Particulate – $\leq$ 1,000 particle/ft^3 for particles of 5 μ or greater.

b. Performance Test

1. Vulcanized bonds – Within 3 σ (> X -3σ) of witness panel database.
2. Steel-epoxy bonds – If the exposed panel set (five total) has significantly less bond strength at the 95 percent confidence level than the control panel set (five total), then the test has failed.

Pass/fail Criteria 2.B was the only criteria that CTP-0142, Revision B addressed. After the test was repeated, it was discovered the statistical pass/fail criteria was not met because the discriminatory capability of the test was underestimated.

Pass/fail Criteria 2.B was revised as follows (Appendix R):

Pass: If the exposed panels averages are above the systems tunnel witness panel database A-basis lower limit, or if the exposed panel set does not have a significantly lower tensile adhesion bond strength than the control panels at the 95 percent confidence level.

Fail: If any of the exposed panel averages fall below the systems tunnel witness panel database A-basis lower limit, and the exposed panel set has a significantly lower tensile adhesion bond strength than the control panels at the 95 percent confidence level.

The witness panel data that was produced by CTP-0142, Revision B, did meet the revised pass/fail criteria.

1.1 TEST ARTICLE DESCRIPTION

The test article consisted of a stainless steel room, 21 ft wide by 36 ft long with an 11 ft high ceiling. The south wall provided a full wall filter vapor exhaust system. The floor had been encapsulated prior to testing. The spray booth had two doors on the west wall for personnel access, and one large door on the north wall used for items to be painted (Figure 1).

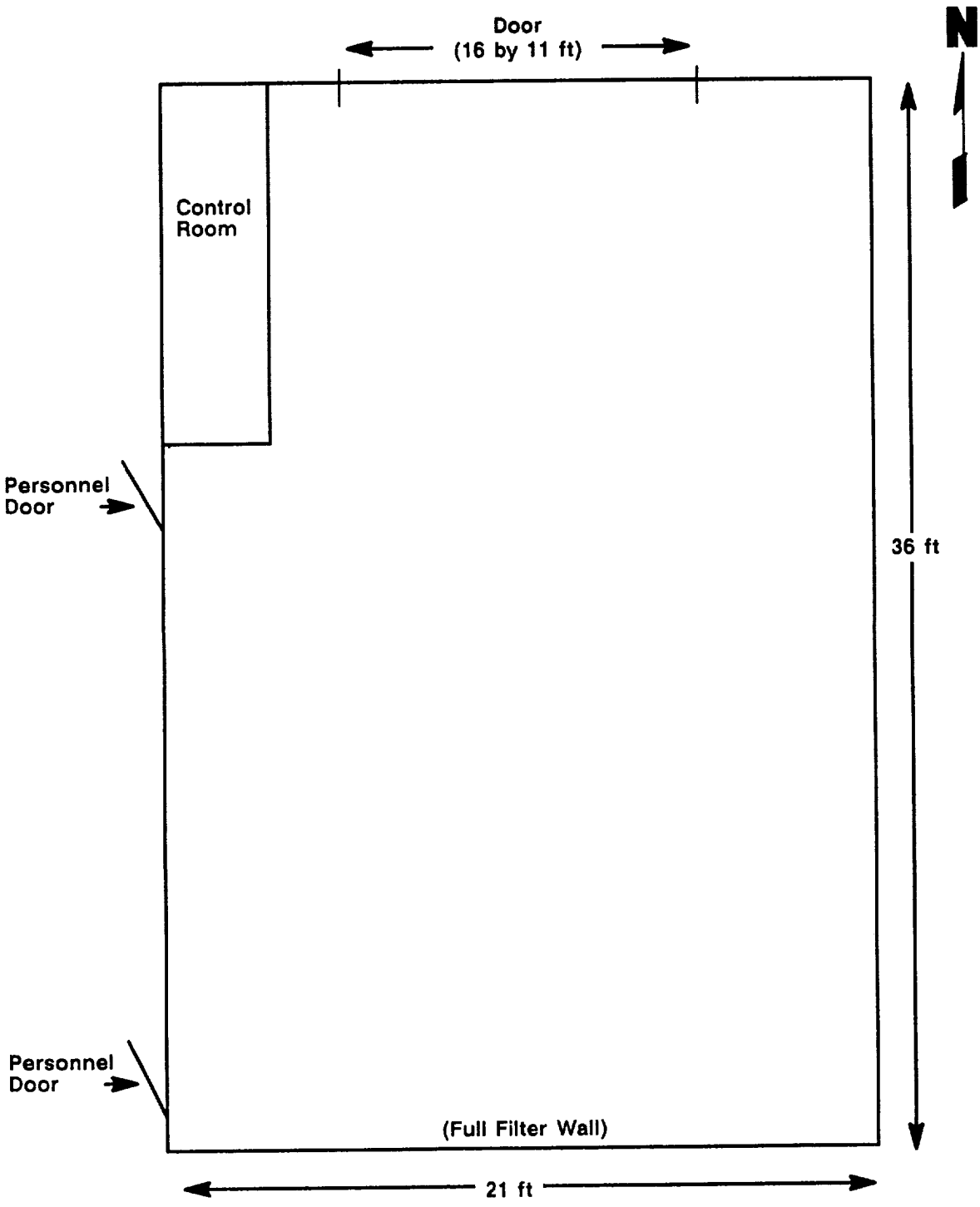


Figure 1. Spray Booth Configuration

A028512a

2

OBJECTIVES

The objectives are taken from Test Plan CTP-0142, Revision B.

a. Verify the M-52 Spray Booth is free of Teflon and all other contamination.

b. Certify the M-52 Spray Booth for painting flight components.

c. Certify that the M-52 Spray Booth contamination/cleanliness level is both adequate for spraying paint and/or adhesives and the contamination/ cleanliness controls placed on the booth will provide the stability required for processing flight hardware through a "critical process".

3

EXECUTIVE SUMMARY

3.1 SUMMARY

The testing sequence was conducted in two series. The first series was conducted under CTP-0142, Revision A. The second series was conducted in accordance with CTP-0142, Revision B.

The test sequence started with CTP-0142, Revision A. The series consisted of the contamination removal test and the performance test. The contamination removal test was used to assess the Teflon level in the spray booth. The performance test consisted painting and Chemloking a forward dome inside the spray booth per flight procedures.

FTIR samples, environmental fallout panels, a NASA test box filter, particulate counts, and NVR data were analyzed during the contamination removal test for the presence of Teflon and found to be acceptable.

The painting/Chemloking procedures were performed on a forward dome inside the spray booth without incident and were found to be acceptable. During the performance test, two sets of witness panels were prepared and pull tested. One set was prepared for case/insulation bond strength testing and one set was prepared for steel/epoxy/steel bond strength testing. The case/insulation witness panels used in CTP-0142, Revision A, had acceptable bond strengths. The steel/epoxy/steel witness panels had predominately adhesive failure and an average bond strength that was not within five standard deviations of the established steel/epoxy/steel witness panel database.

The CTP-0142, Revision B, series of testing consisted of re-testing the steel\epoxy\steel witness panels. A total of ten panels were prepared and tested. The pull tests analysis indicates the results of the tensile tests were comparable to the systems tunnel witness panel database. The exposed panel set and the control panel set average tensile values were above the A-basis lower limits established on the systems tunnel witness panel database.

3.2 CONCLUSIONS

	Objective	Conclusion
a.	Verify the M-52 spray booth is free of Teflon and all other contamination.	Verified. The FTIR wipes proved that the spray booth was free of Teflon contamination.
b.	Certify the M-52 spray booth for painting flight components.	Certified. During the performance portion of the test, a forward dome was moved into the spray booth and processed (primer and top coat sprayed on the outer diameter, Chemlok primer and bonding agent sprayed on the inner diameter) per flight procedures without incident.
c.	Certify that the M-52 Spray Booth contamination/cleanliness level is both adequate for spraying paint and/or adhesives and the contamination/ cleanliness controls placed on the booth will provide the stability required for processing flight hardware through a "critical process".	Certified. The contamination levels in the spray booth are comparable with the bonding facility already in use. The witness panel data per CTP-0142, Revision B, proved the cleanliness of the spray booth.

3.3 RECOMMENDATIONS

It is recommended that the M-52 spray booth be qualified for producing flight hardware.

4

INSTRUMENTATION

The following instruments/measuring devices were used to validate the test:

a. Conscan II unit
b. Atcor Portable Particulate Counter
c. Instron Tensile Machine
d. Analog Diffuse Reflectance FTIR
e. Grant Series Squirrel Meter/Logger
f. NASA Test Box

Calibration system requirements were in accordance with MIL-STD-45662.

5

PHOTOGRAPHY

Still black and white and color photographs of the test article configuration were taken. Copies of the photographs (series Numbers 116023, 116282, 117017, 117716, 117672, and 117654) are available from the Thiokol Corporation Photographic Services department.

6

RESULTS AND DISCUSSION

6.1 TEST ARTICLE ASSEMBLY

The spray booth did not need assembly. The case/insulation witness panels, the epoxy/steel/epoxy witness panels, and the environmental fallout panels were assembled and prepared according to TWR-17123 for the first test series in CTP-0142, Revision A. The epoxy/steel/epoxy witness panels were assembled and prepared according to CTP-0142, Revision B, for the second test series.

6.2 TEST DESCRIPTION

The testing sequence was conducted in two series. The first series was conducted under CTP-0142, Revision A. The second series was conducted in accordance with CTP-0142, Revision B.

6.2.1 CTP-0142, Revision A, Testing Series

The test sequence started with CTP-0142, Revision A. The series consisted of the contamination removal test (Figure 2) and the performance test. The results of these tests are described as follows.

6.2.1.1 Contamination Removal Test Results. The contamination removal test was used to assess the Teflon level in the spray booth. FTIR samples, environmental fallout panels, a NASA Test Box filter, particulate counts, and NVR data were analyzed in this assessment.

6.2.1.1.1 FTIR Sample Analysis. The FTIR analysis of the spray booth walls and ceiling is described in this section. Prior to any testing, the spray booth was cleaned and FTIR wipes were taken from the walls and ceiling. There were 21 samples analyzed. The areas where the wipes were taken are defined in Figure 3. The results of the wipes showed Teflon present in the spray booth (Appendix A).

After the spray booth was cleaned per CTP-0142, Revision A (Figure 4), a second FTIR wipe was conducted. There were 26 samples analyzed. The results of the wipes showed Teflon present in the spray booth (Appendix B).

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N1160233-2

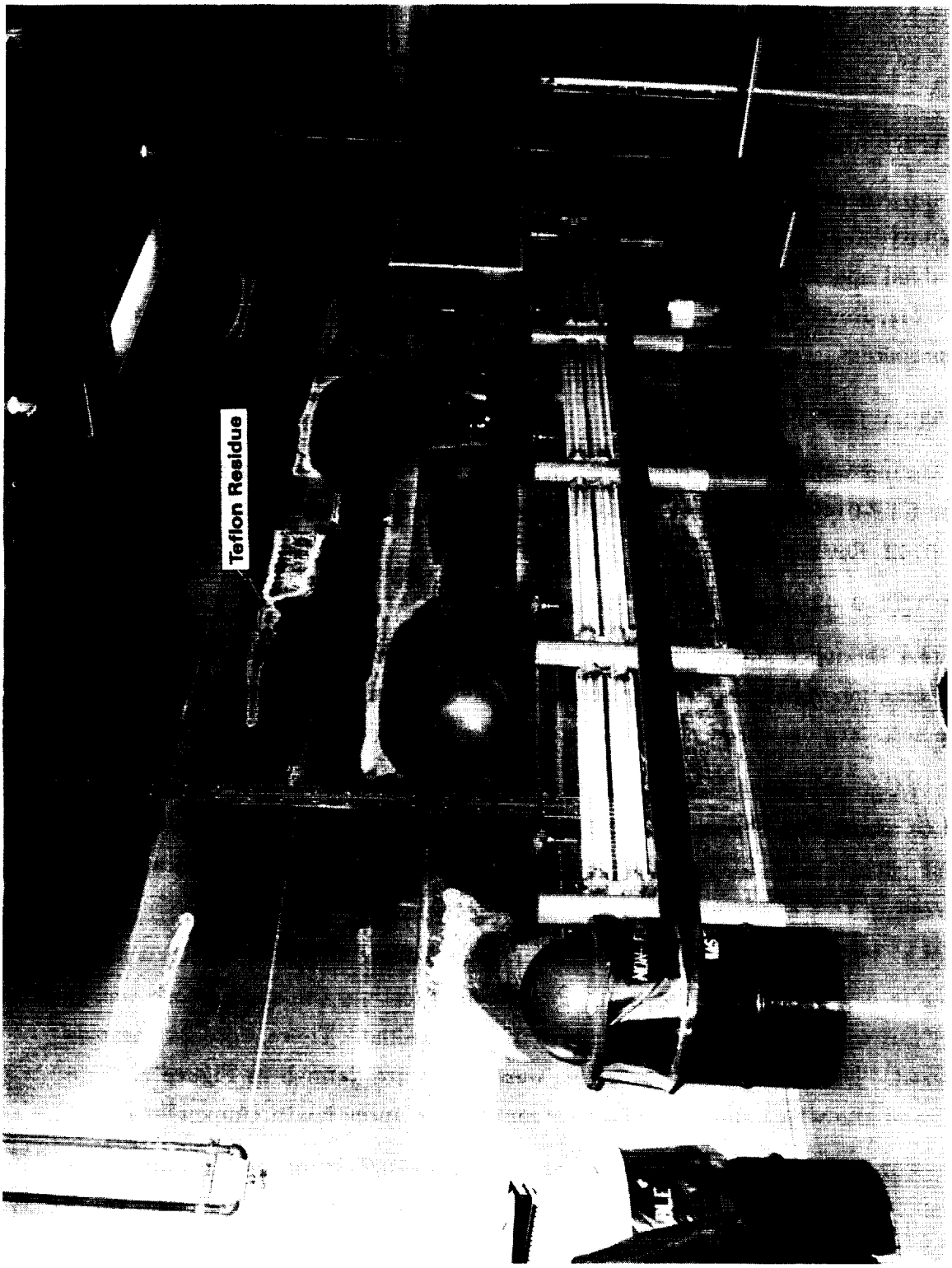


Figure 2. Spray Booth East Wall (before cleaning)

ORIGINAL PAGE IS
OF POOR QUALITY

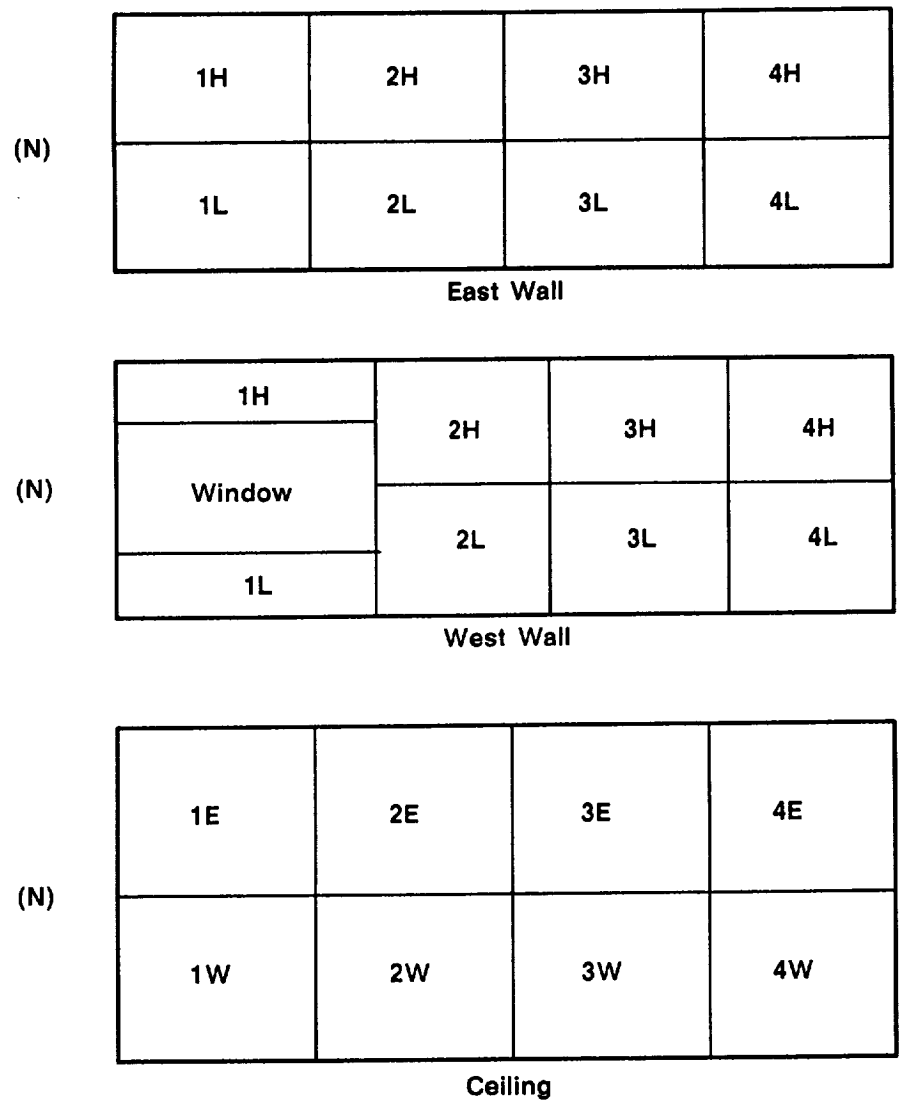


Figure 3. FTIR Wipe Locations

A028513a

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N116282-4

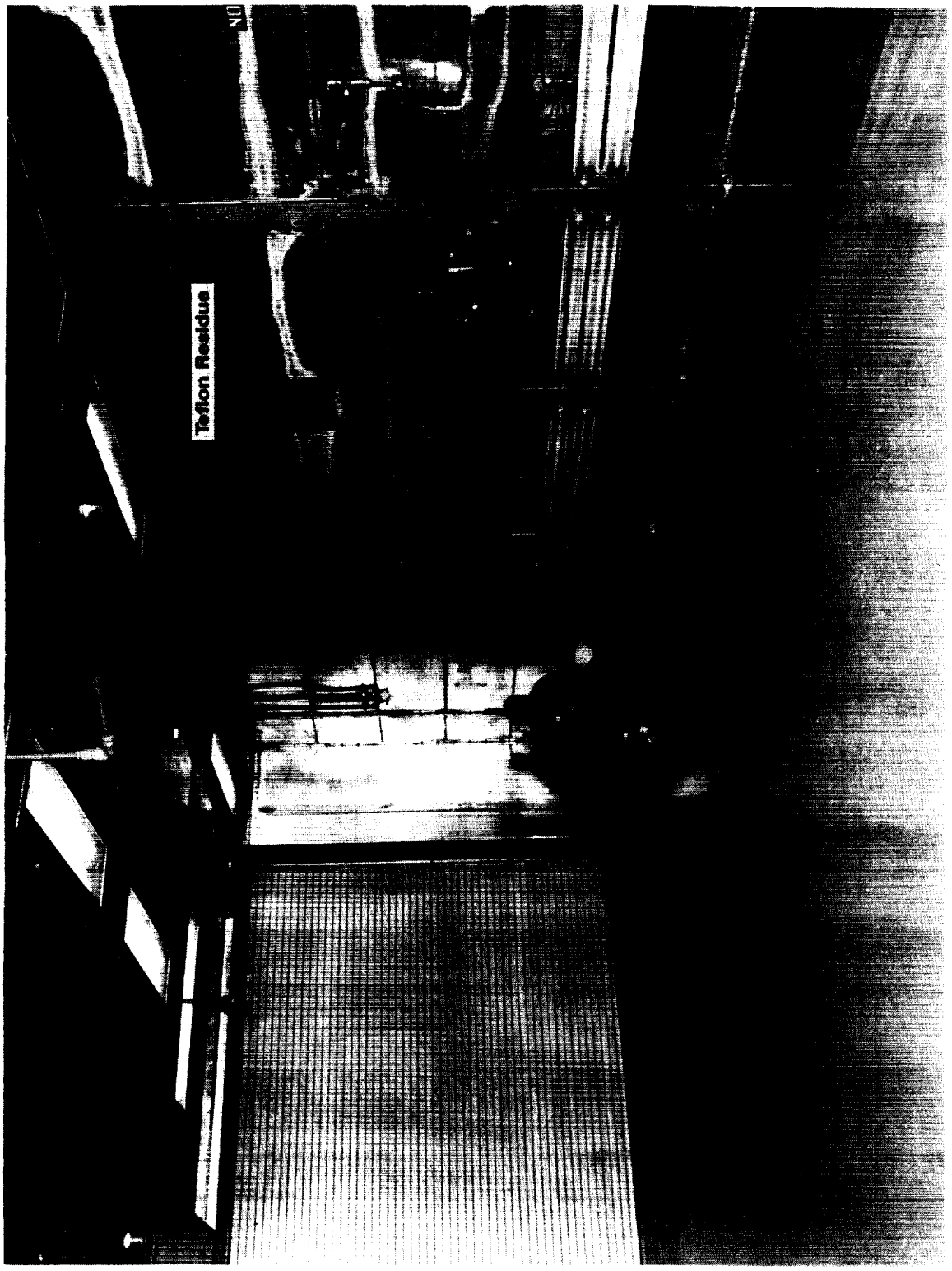


Figure 4. East Wall After First Cleaning

The spray booth was cleaned a second time per CTP-0142, Revision A. A third FTIR wipe was conducted. There were 26 samples analyzed. The results of the wipes showed Teflon present in the spray booth (Appendix C).

Before a third cleaning was done, a fourth FTIR wipe was conducted on the spray booth north door, inside the air ducts in the spray booth ceiling, on the outside blower housing, on the outside blower blades on the spray booth roof, on the outside roof by the blower ducts, on the outside screen of the blower, and on an east wall area that was suspected as having Teflon embedded in/on its surface (Appendix D). It was discovered that the cleaning aids and solvent were not disposed of frequently (Appendix E). The cleaning process was modified to dispose of the cleaning aids/solvent frequently to prevent movement of Teflon from one area to another.

The spray booth was cleaned a third time and a fifth FTIR wipe was conducted. A total of 26 samples were analyzed (Appendix F). Of the 26 samples, two areas (East Wall No. 2 Low, see Figure 3, and the North Door West Side) were identified as having traces of Teflon, the other 24 showed no signs of Teflon. The two areas were re-cleaned and FTIR wipes were analyzed. The two areas showed no presence of Teflon (Appendix G).

6.2.1.1.2 Environmental Fallout Panel Results. The environmental fallout panels (Figure 5) were analyzed for Teflon and NVR contamination. FTIR wipes were taken from the panels before and after the first and second spray booth operational cycles (5 hr at 135°F). The wipes included panel samples and particulate samples taken from the panels. A total of 32 samples (eight before each 5-hr operational cycle and eight after each 5-hr operational cycle) were analyzed. No Teflon was detected on any of the samples (Appendix I).

NVR contamination analysis was conducted before the spray booth cleaning started and after the spray booth was declared clean of Teflon. The detectable limit of NVR was 2.0 mg/ft^2. After the spray booth was cleaned, the northwest environmental fallout panel showed 2.2 mg/ft^2. All of the other environmental fallout panels showed less than 2.0 mg/ft^2 of NVR levels (Appendix J).

6.2.1.1.3 Particle Counter Results. The particle counter (Figure 5) was used before the first cleaning operation per CTP-0142, Revision A, and after the last cleaning

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N116023-5

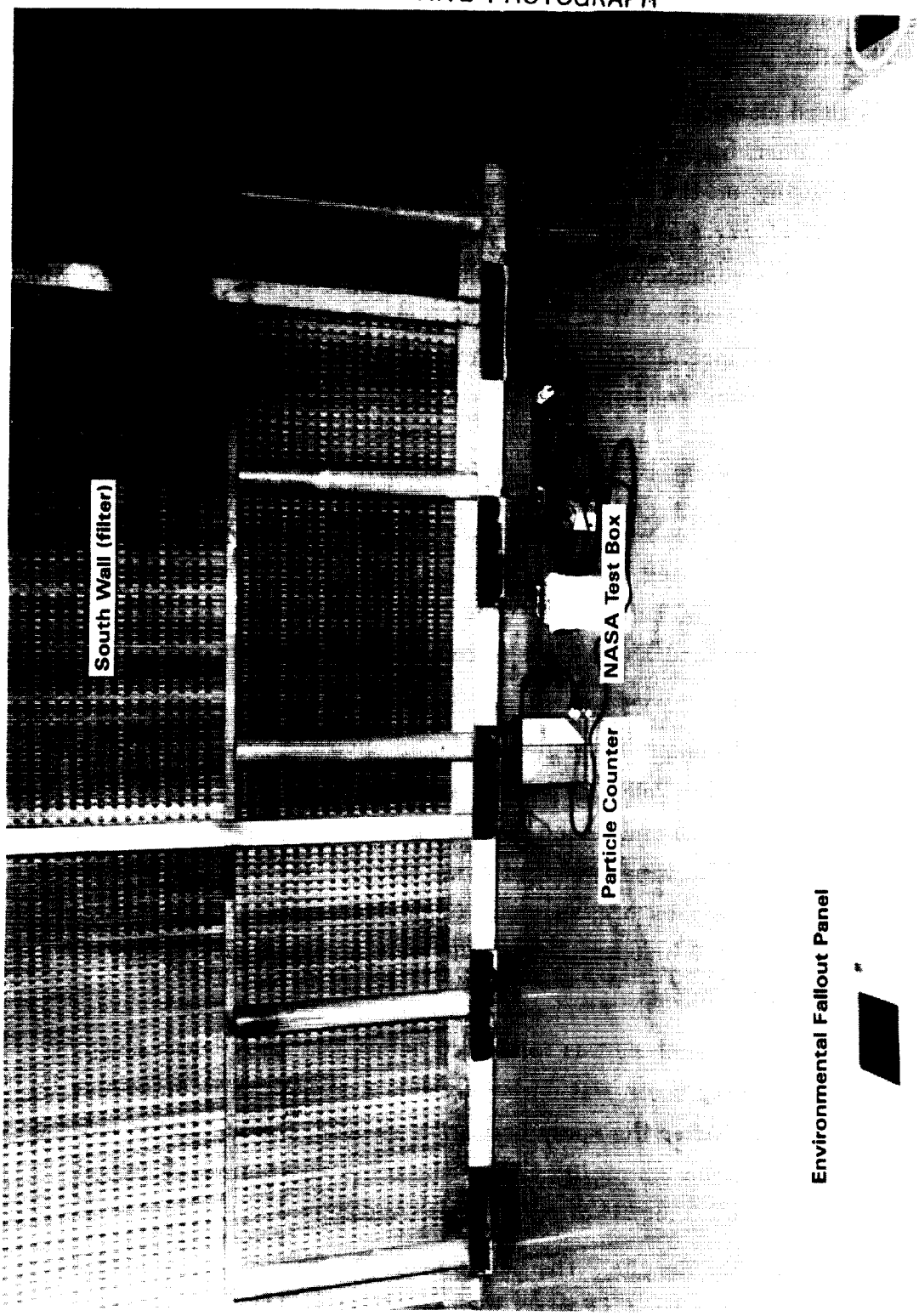


Figure 5. Contamination Removal Test Setup

operation per CTP-0142, Revision A. The particle counter uses lasers to count particulate in the air. It does not trap particulate in a filter. Therefore, no FTIR or NVR analysis were conducted on the particulate counts. Data from the first particle counter usage was lost. The average particulate count after the last spray booth cleaning was 14 particles (5 μ or larger)/ft^3 of air (Appendix J). The pass/fail criteria was established at less than or equal to 1,000 particles/ft^3 for particles of 5 μ or larger. The particulate count was well within the pass/fail criteria.

6.2.1.1.4 NASA Test Box Results. The NASA Test Box (Figure 5) was used to catch airborne particles for FTIR analysis. The Test Box was used before the first spray booth cleaning per CTP-0142, Revision A, and after the last spray booth cleaning. The FTIR analysis showed no Teflon detected on the Test Box filter (Appendix K).

6.2.1.2 Performance Test Results. The performance test consisted of painting and Chemloking a forward dome inside the spray booth per flight procedures. Two sets of witness panels (Figure 6) were prepared per TWR-17123. One set was prepared for case/insulation bond strength testing and one set was prepared for steel/epoxy/steel bond strength testing.

6.2.1.2.1 Witness Panel Results. The case/insulation witness panels (three total) showed average tensile adhesion strengths of 823 psi, 822 psi, and 858 psi. The average peel strengths for the case/insulation witness panels were 179 pli, 162 pli, and 166 pli. The cases/insulation witness panel database mean is 756 psi and 172 pli. The case/insulation witness panels used in CTP-0142, Revision A, had acceptable bond strengths (Appendix L).

The steel/epoxy/steel witness panels did not fare as well. To begin with, only two panels were prepared. CTP-0142, Revision A, required three panels to be tested. The steel/epoxy steel witness panels had average tensile strengths of 2,914 psi and 3,875 psi (Appendix L). The steel/epoxy/steel witness panel database mean is 5,588 psi and that mean at five standard deviations is 3,734 psi. The two steel/epoxy/steel witness panels had predominately adhesive failure and an average bond strength that was not within five standard deviations of the established steel/epoxy/steel witness panel database.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117017-1

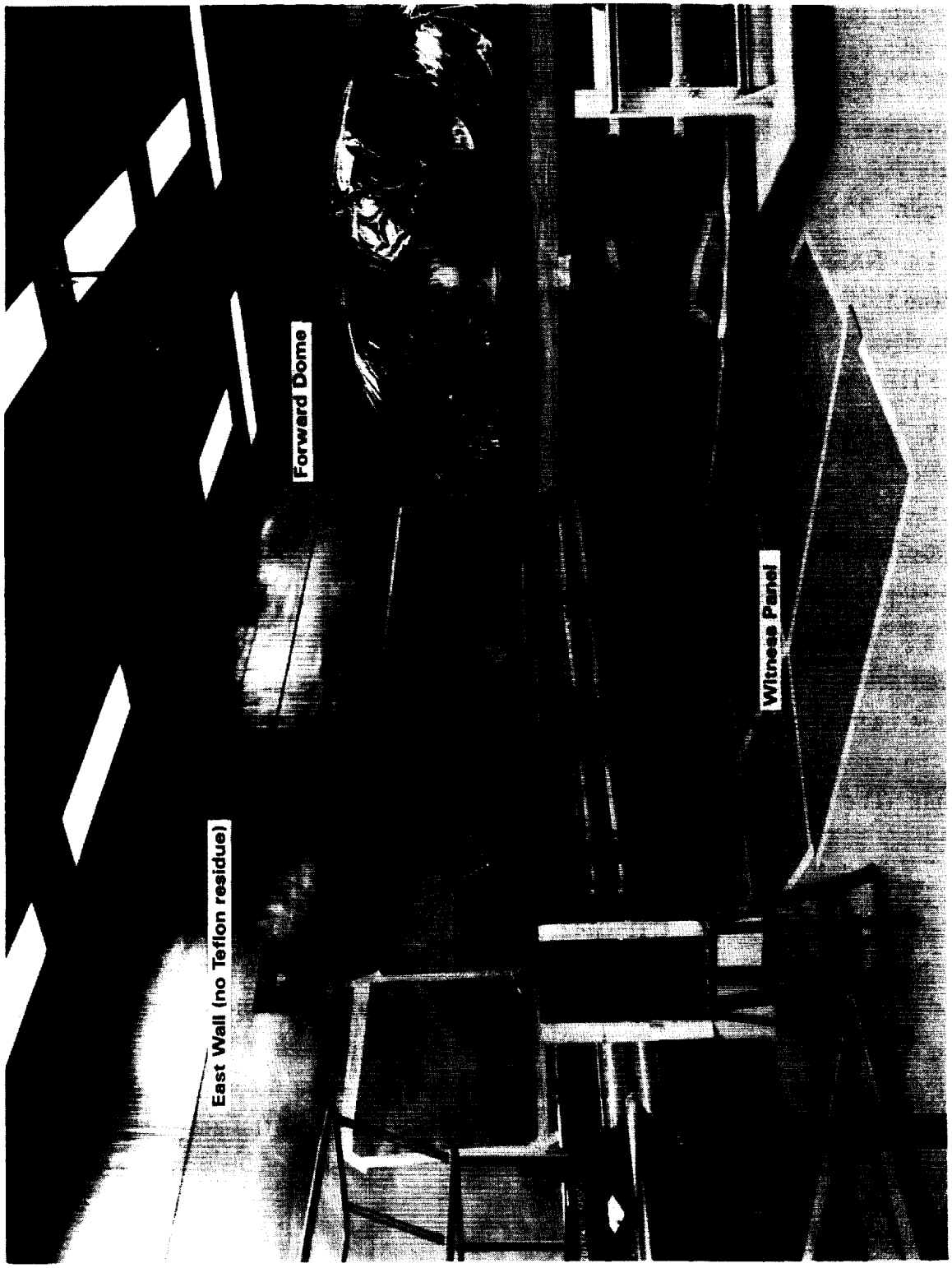


Figure 6. Performance Test Setup

An investigation revealed the following deviations concerning the steel/epoxy/steel bond strength configuration witness panels:

a. The witness panels were not prepared in accordance with Section 8.2.2, subsection A of the test plan. The panels were prepared without silane primer application to the steel bond surface. Silane primer is an adhesion promoter that increases the nominal bond strength approximately 10 percent and precludes possible surface contamination.

b. The environment of the test panels was not adequately controlled prior to epoxy and test button application. The witness panels remained in the spray booth after the forward dome was coated without any contamination controls for approximately 7 days before being sent to the R&D Lab for test assembly.

c. While on the panel holder, the witness panels were covered with 'black poly' plastic covering after the forward dome was coated and prior to epoxy and test button application. The witness panel bond strengths could have adversely affected by transference of contamination from 'black poly' plastic covering.

The results of the steel/epoxy/steel witness panel tests initiated an engineering evaluation test. This test was performed outside the parameters of CTP-0142, Revision A. The test objective was to account for the effects of the test variables introduced during the test performance. The testing sequence and test conclusions are outlined in Appendix M. The analysis of the engineering evaluation initiated CTP-0142, Revision B.

6.2.1.2.2 Dome Procedure Analysis. The performance test consisted of painting (primer and topcoat) and Chemloking (primer and bonding agent) a forward dome (see Figure 6) inside the spray booth per flight procedures. The procedures were performed without incident and were found to be acceptable.

In addition to the painting sequence, Ron Brock, NASA, requested that witness panels be paint adhesion tested. Three witness panels were placed inside the spray booth and painted along with the test dome. Two witness panels were placed in the paint pit and painted with the Flight 17B aft dome. All five panels were then tested per ASTM-D-3359-87, Method B. The panels were all rated '4B'. The paint results can vary from '0B' (worst case) to '5B' (perfect). The '4B' rating is most common for flight component witness panels.

6.2.1.2.3 Conscan Analysis. The test dome was conscanned before the Chemloking process was accomplished. A total of 32 points on the interior of the test dome were conscanned. An acceptable reading had to be above 378. All 32 readings were above 378 (Appendix N).

6.2.1.2.4 Contamination Removal Analysis. After the performance test was conducted, 28 wipes were taken from the walls and ceiling and FTIR analyzed. The analysis showed no Teflon present in the spray booth (Appendix H). The environmental fallout panels were analyzed for the presence of Teflon and NVR contamination. The analysis showed no presence of Teflon (Appendix J and O). The particulate count was 24 particles (5 μ or larger)/ft^3 of air (Appendix J).

6.2.2 CTP-0142, Revision B, Testing Series

This series of testing consisted of re-testing the steel\epoxy\steel witness panels. A total of ten panels (Figures 7 and 8) were prepared and tested per CTP-0142, Revision B.

The steel\epoxy\steel witness panels were grit blasted with new zirconium silicate grit and vapor degreased with methyl chloroform. After the vapor degrease, the witness panels were conscanned (Figure 9). A reading above 433 was acceptable. Each panel was conscanned five times. The lowest reading average was 756. The panels were acceptable after the conscan (Appendix P).

The witness panels were identified "A" through "J". "A" through "E" were designated as the test set of panels and "F" through "J" were designated as the control set of panels. The panels were wrapped in craft paper and placed in the spray booth (Figure 10).

The craft paper was removed from the test set of panels. The spray booth was subjected to an operational cycle (5 hr at 135°F). After the operational cycle, the test set of panels was re-wrapped in craft paper and shipped to the development laboratory.

A total of 120 tensile buttons were prepared with silane primer and dried for 3 hr. On each witness panel, a 24-hole template and 12 bondline spacers (0.03 in.) were installed. EA 934NA epoxy was applied into each locating hole with a bondline spacer. A thin layer of the epoxy was applied to each tensile button to wet the bond surface. The tensile buttons were assembled to the corresponding locator holes

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117654-1

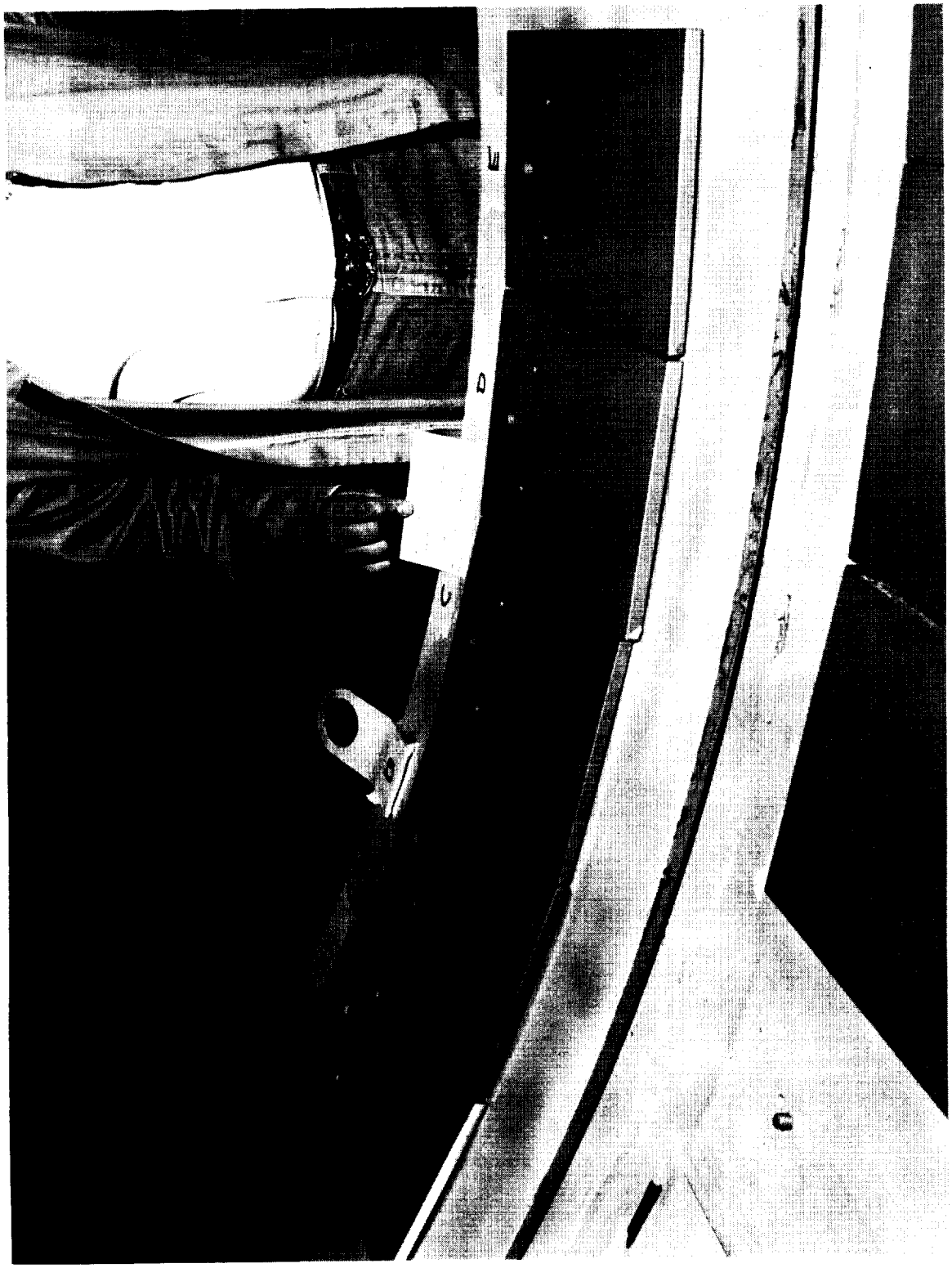


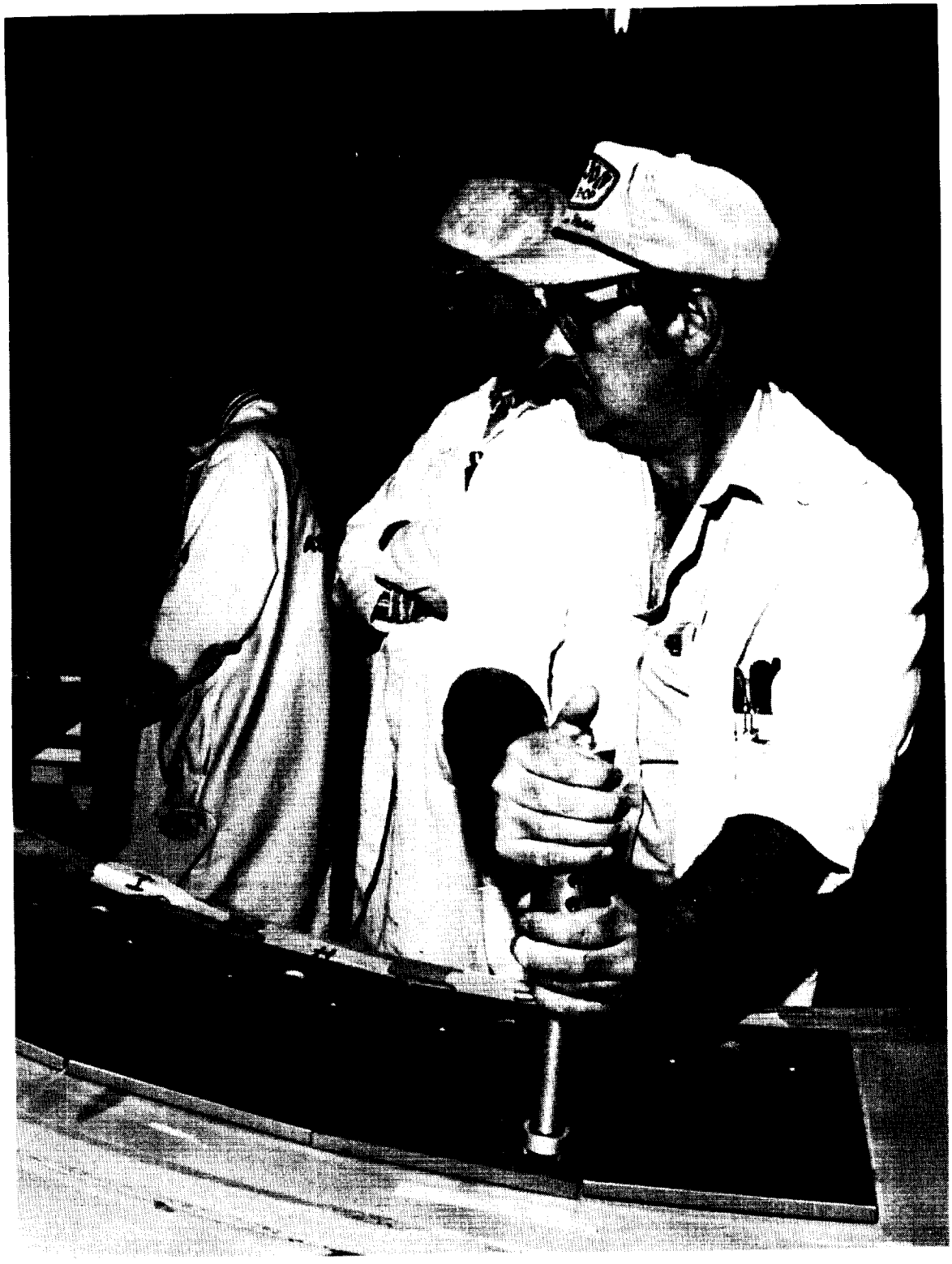
Figure 7. Degreased Witness Panels ("A" through "E")

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117654-2

Figure 8. Degreased Witness Panels ("F" through "J")

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH



N117654-4

Figure 9. Conscan Process

N117654-5

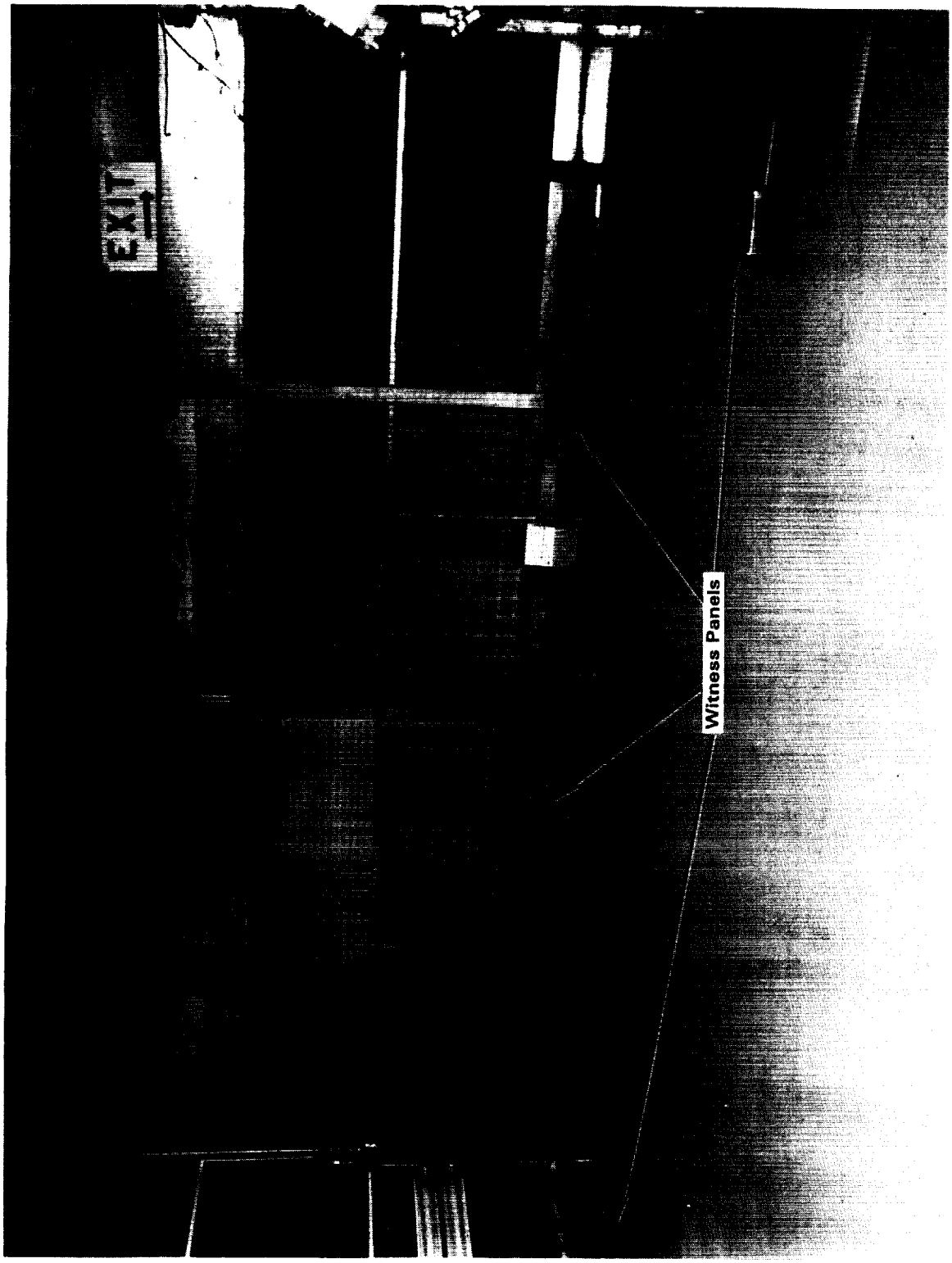


Figure 10. Before Operational Cycle

with bondline spacers and epoxy. The witness panels were installed into pressure holders and allowed to cure for a minimum of 36 hr at ambient temperature (Figure 11).

The pull tests were conducted by the Contamination Control Laboratory (Figures 12 and 13). The pull tests analysis indicates the results of the tensile tests (Appendix Q) are comparable to the systems tunnel witness panel database. The exposed panel set and the control panel set average tensile values were above the A-basis lower limits established on the systems tunnel witness panel database (Figure 14). The statistical pass/fail criteria was not met because the discriminatory capability of the test was underestimated.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117672-1

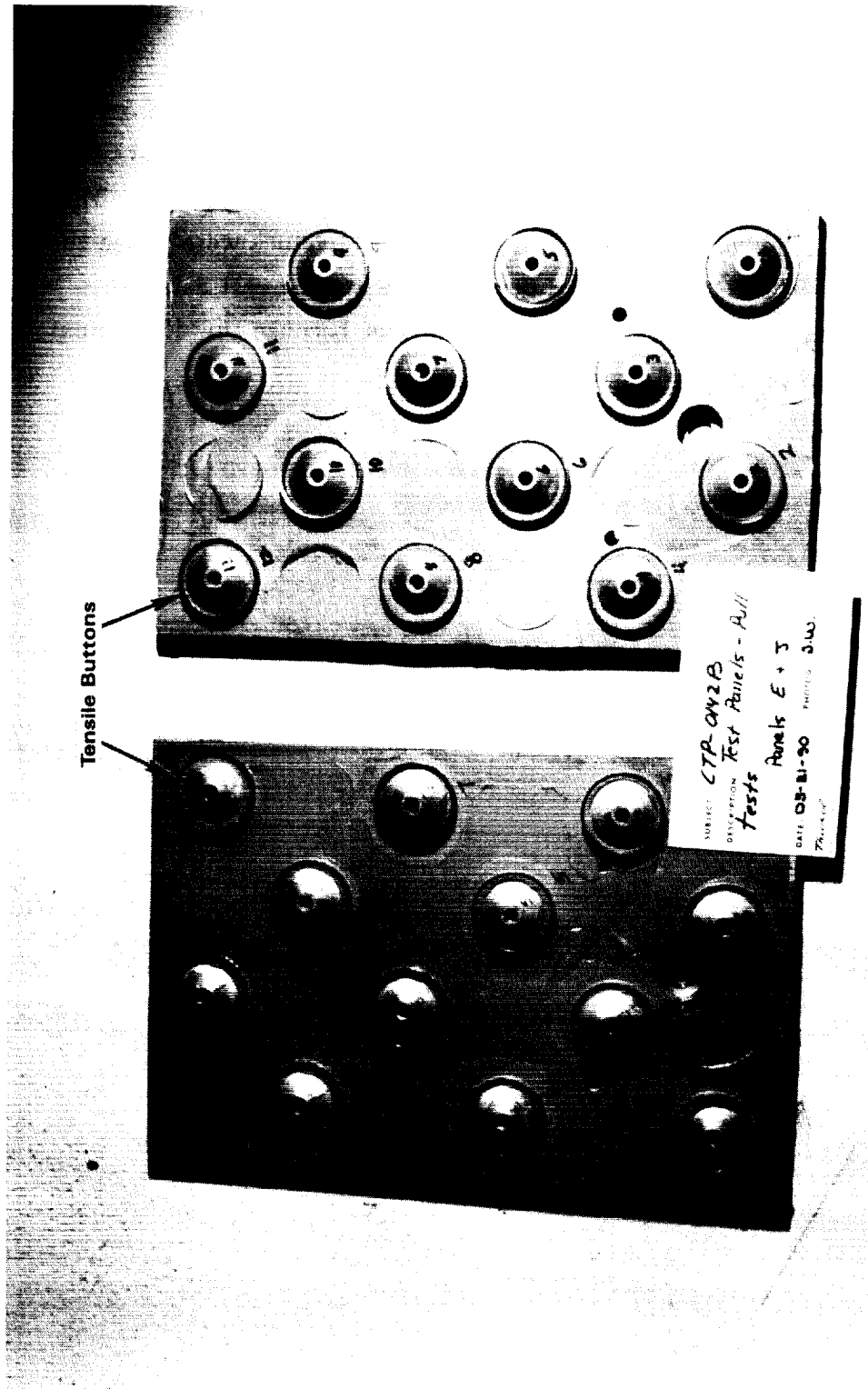


Figure 11. Witness Panels (postcure, prepull)

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117716-9

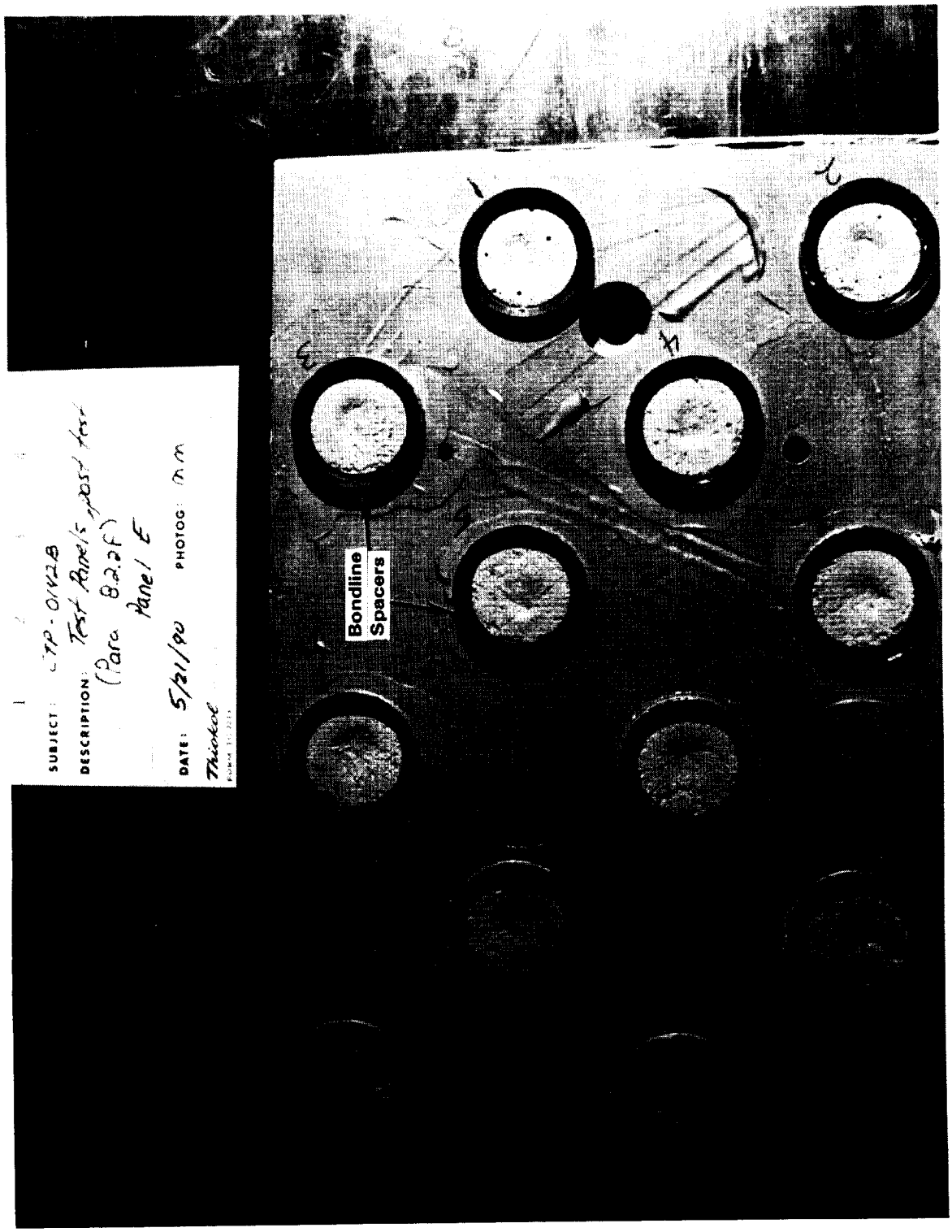


Figure 12. Witness Panel "E" (postpull)

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

N117716-8

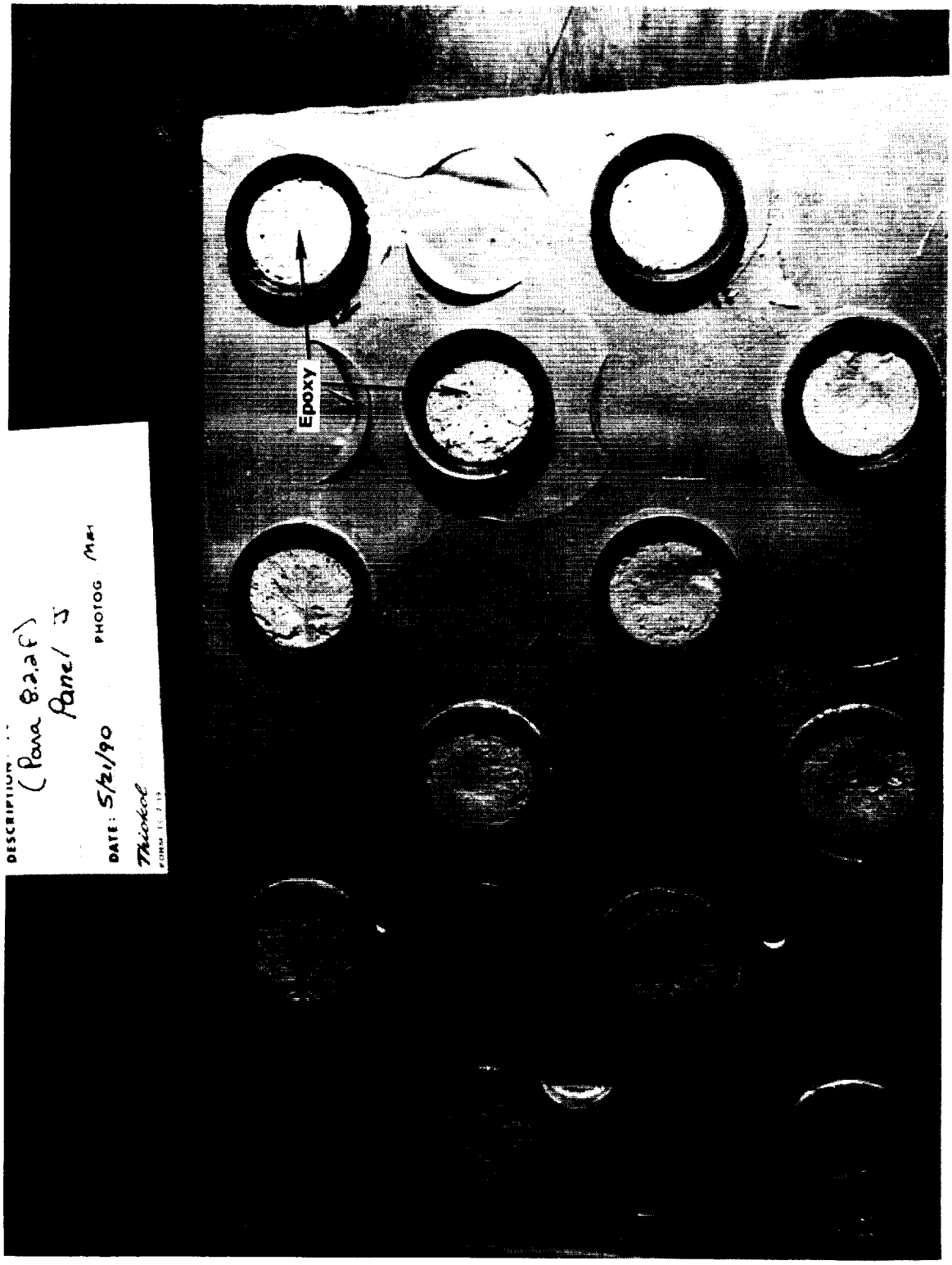


Figure 13. Witness Panel "J" (postpull)

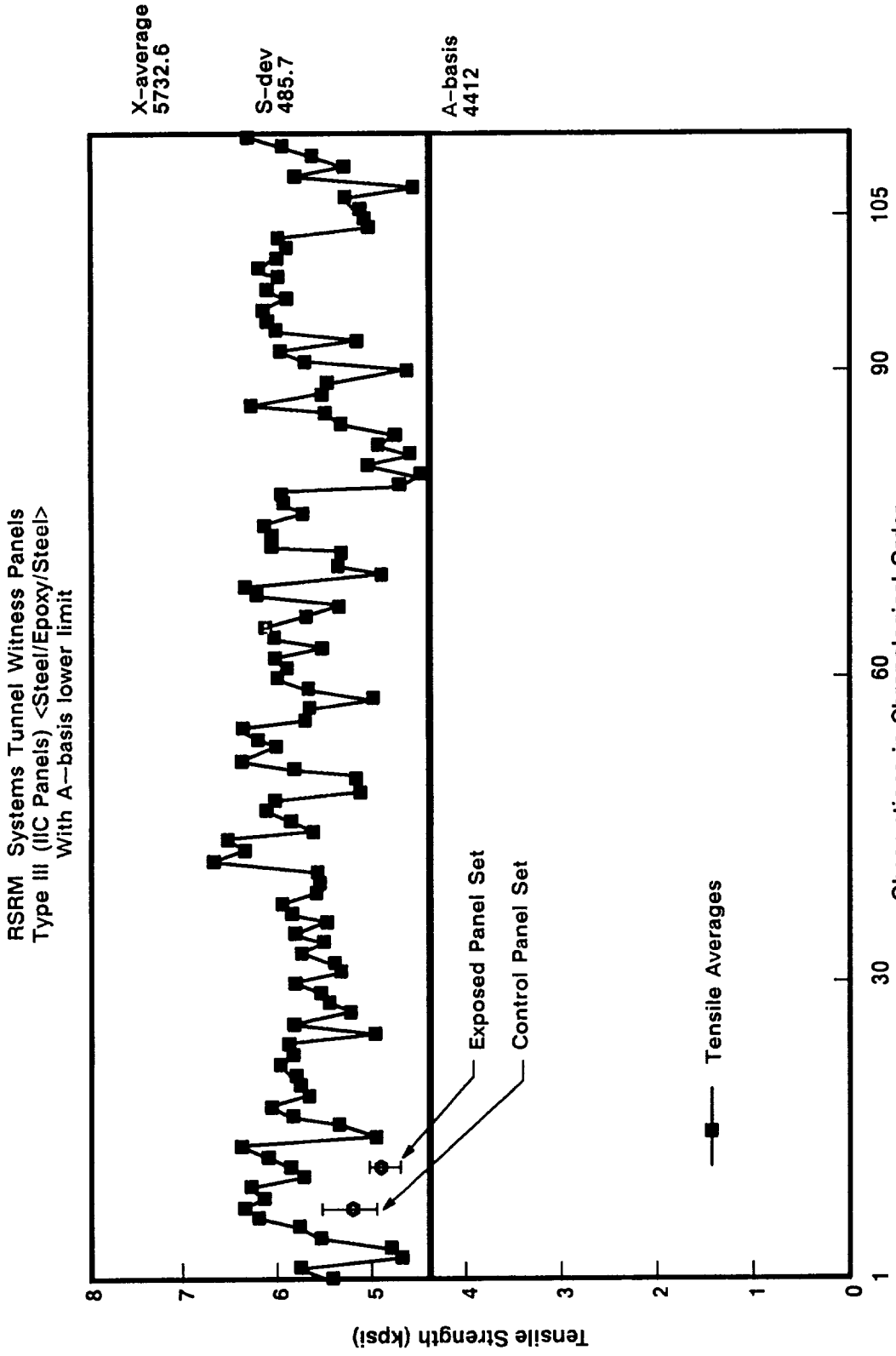


Figure 14. Witness Panel Database Graph

7

APPLICABLE DOCUMENTS

Number	Title
MIL-STD-45662	Calibration System Requirements
TWR-17123	RSRM Space Shuttle Witness Panel Implementation Plan Case/Insulation/Liner/Propellant Weather Seal and Systems Tunnel
CTP-0142A	Qualification Test Plan for the M-52 Spray Booth
CTP-0142B	Qualification Test Plan for the M-52 Spray Booth
TWR-60445	Quick Look Report for the M-52 Spray Booth Qualification under CTP-0142, Revision A
ASTM-D-3359	Standard Test Methods for Measuring Adhesion by Tape Test

Appendix A

Preliminary FTIR Sample Wipes

LABORATORY REPORT

21 Mar. 1990

Originator: Vern Fitch
Ext 6344, M/S L62B

Request: LWR 592584
Laboratory log # 02-21-90-31122

Subject: FTIR Analysis of M-52 Spray Booth Wipe Samples for Teflon Decontamination Testing, CTP-0142-A

FTIR analysis has been carried out on wipe samples taken from the ceiling and walls of the M-52 spray booth. The samples up to the third cleaning were taken by wiping an area about 5" x 5" square with a polypropylene wipe wet with Freon TF. The samples taken after the third cleaning and those from the surfaces outside the booth were obtained by wiping an area approximately 2 feet by 1 foot with a methylchloroform wet wipe. The presence of Teflon was detected by the appearance of the C-F absorbance peaks at about 1160 and about 1230 wavenumbers.

	Occurrence of Teflon After Cleaning				
Sample Location	Before	First	Second	Third	Fourth
South Wall #1 (High) (East)	Present	Present	None	----	None
South Wall #1 (Low) (East)	----	----	----	None*	----
South Wall #2 (High) (West)	Present	Trace	None	----	None
South Wall #2 (Low) (West)	----	----	----	None*	----
North Door East Side	----	----	----	Present*	None
North Door West Side	----	----	----	Present*	Trace**
East Ceiling #1 (North)	Trace	Present	None	----	None
East Ceiling #2	Trace	Present	None	----	----
East Ceiling #3	None	Trace	None	----	None

Sample Location	Occurrence of Teflon After Cleaning				
	Before	First	Second	Third	Fourth
East Ceiling #4 (South)	Present	Present	Trace	----	None
West Ceiling #1 (North)	None	None	None	----	None
West Ceiling #2	Trace	None	Trace	----	None
West Ceiling #3	Trace	None	None	----	----
West Ceiling #4 (South)	None	None	None	----	None
East Wall #1 (High) (North)	Present	None	Trace	----	None
East Wall #1 (Low) (North)	Trace	Trace	Trace	None	None
East Wall #2 (High)	Present	Present	Trace	----	None
East Wall #2 (Low)	Present	Trace	Present	Trace	Trace**
East Wall #3 (High)	Present	Present	Present	----	None
East Wall #3 (Low)	Present	Present	Trace	----	None
East Wall #4 (High) (South)	Present	Present	Trace	----	None
East Wall #4 (Low) (South)	Present	Trace	Trace	None	None
West Wall #1 (High) (North)	Trace	Trace	Trace	----	None
West Wall #1 (Low) (North)	None	Trace	Trace	None	None
West Wall #2 (High)	None	Trace	None	----	None
West Wall #2 (Low)	----	None	None	----	None
West Wall #3 (High)	----	None	Trace	----	None
West Wall #3 (Low)	----	Present	Trace	Trace	None
West Wall #4 (High) (South)	----	Present	None	----	None
West Wall #4 (Low)	Trace	Present	Trace	None	None

* The low south wall and north door samples were only taken after the 3rd cleaning.

** These areas were cleaned a fifth time. No Teflon was detected after the fifth cleaning.

In addition to the above test locations, an embedded surface on the east wall was sampled before and after sanding with the following results:

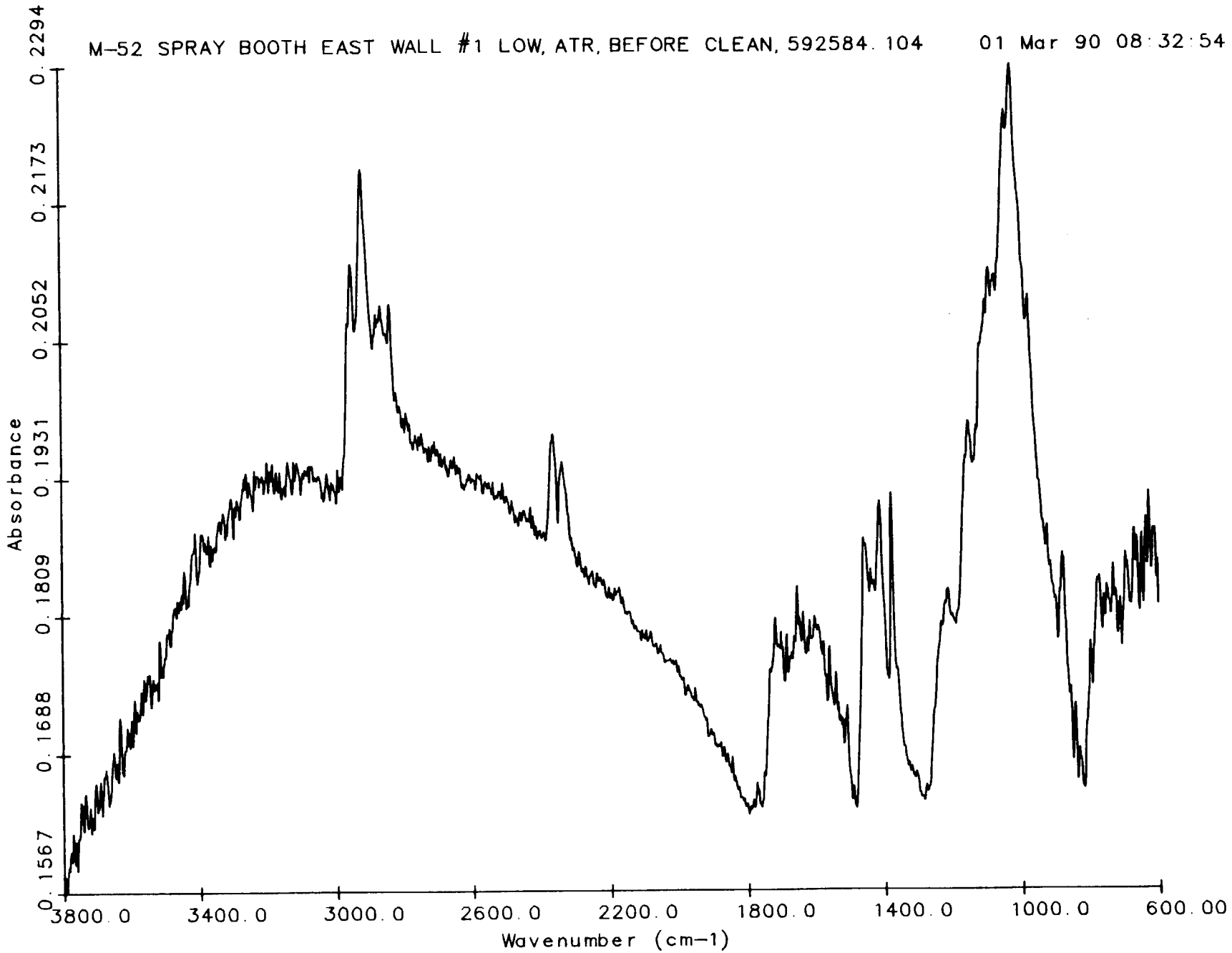
Sample Location	Occurrence of Teflon
East Wall Embedded Surface	
Before Sanding	Trace
After First Sanding	Trace (less than before sanding)
After Second Sanding	None

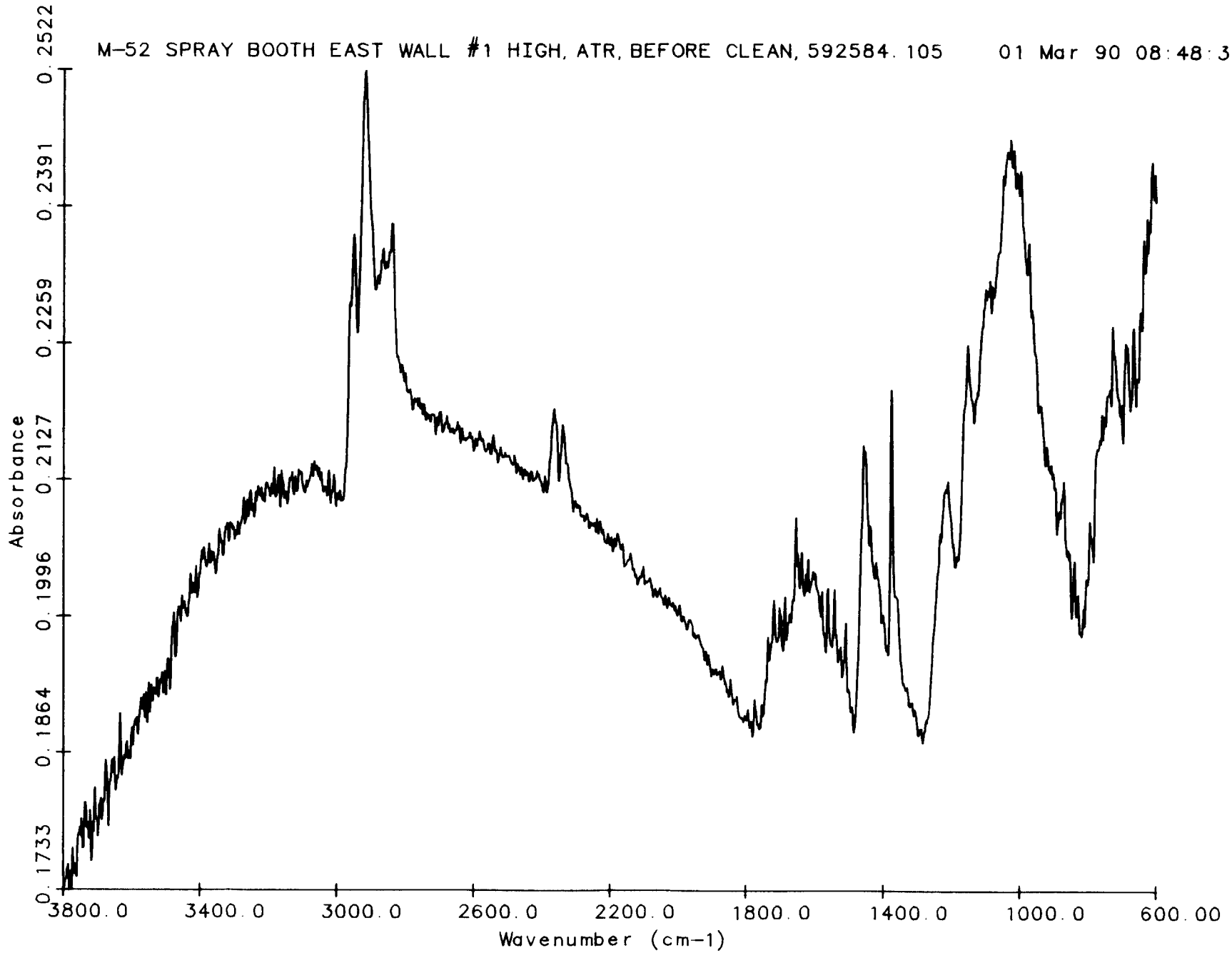
Also, a number of samples were taken outside of the spray booth with the following results:

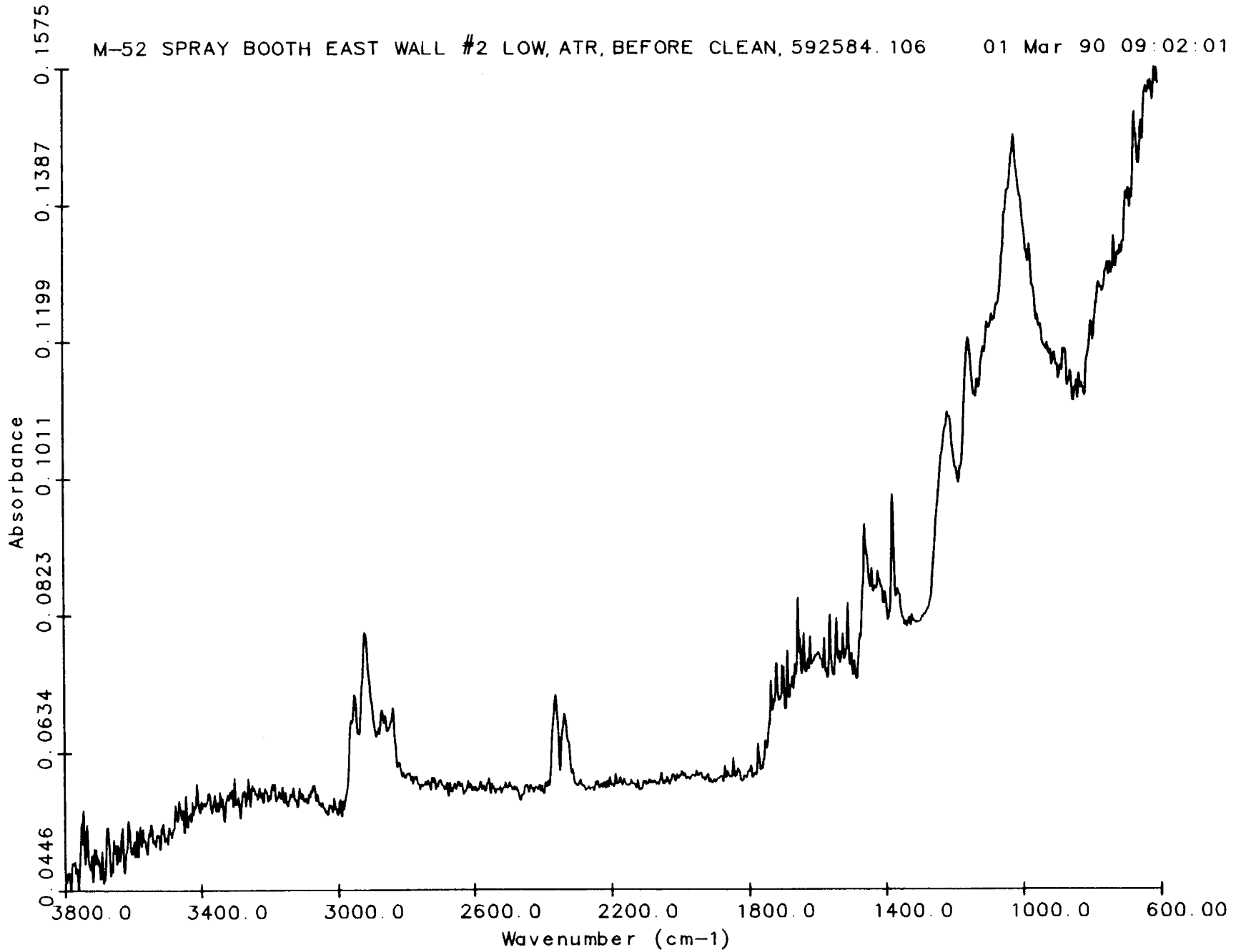
Sample Location	Occurrence of Teflon
Spray Booth Ceiling Inside Air Ducts #1	None
Spray Booth Ceiling Inside Air Ducts #2	None
Outside Blower Housing	None
Outside Blower Blades on Roof	None
Outside Roof by Blower Blades to Spray Booth	None
Outside Screen of Blower	None
Control Sample #1	None
Control Sample #2	None
Control Sample #3	None

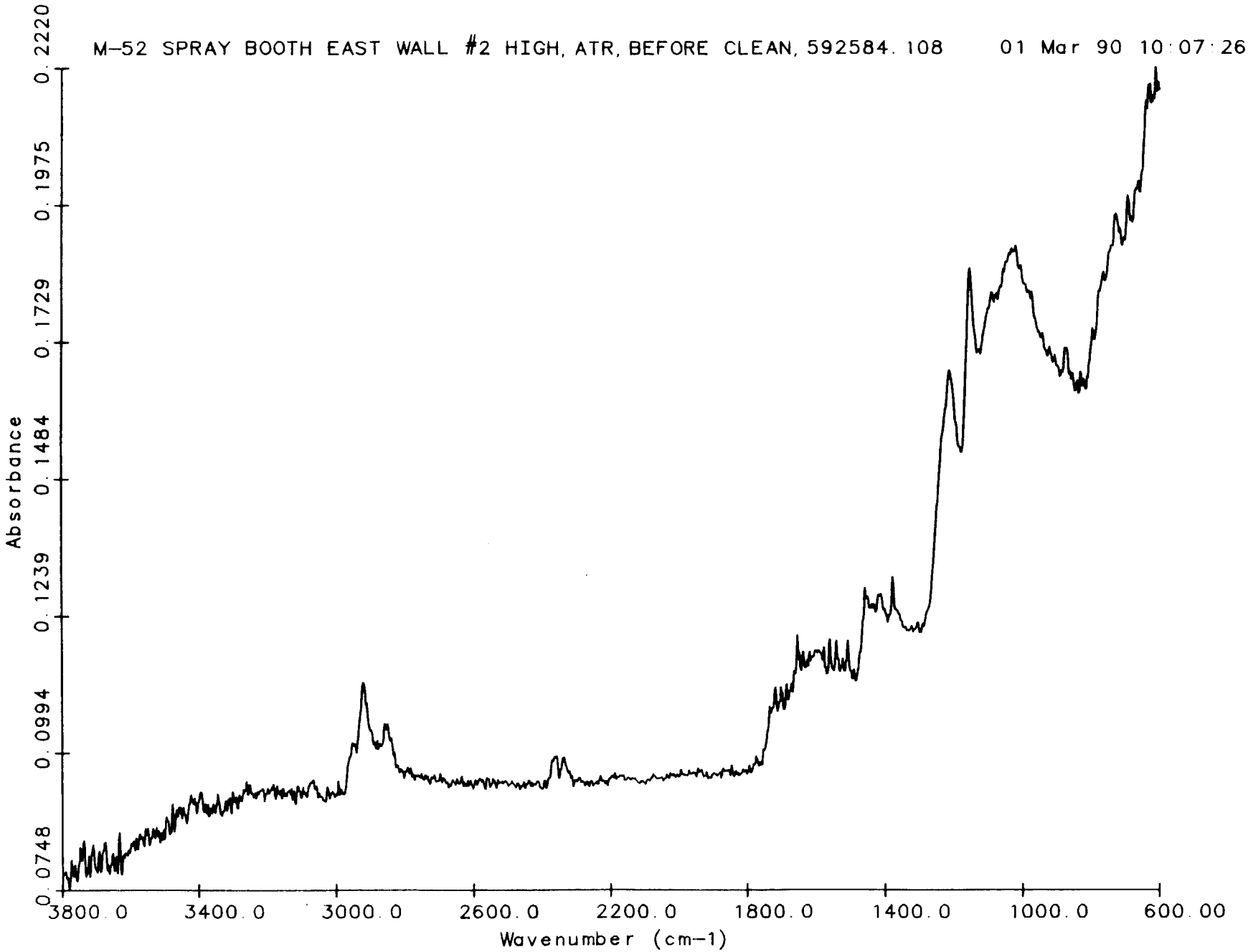
Copies of the FTIR spectra are attached.

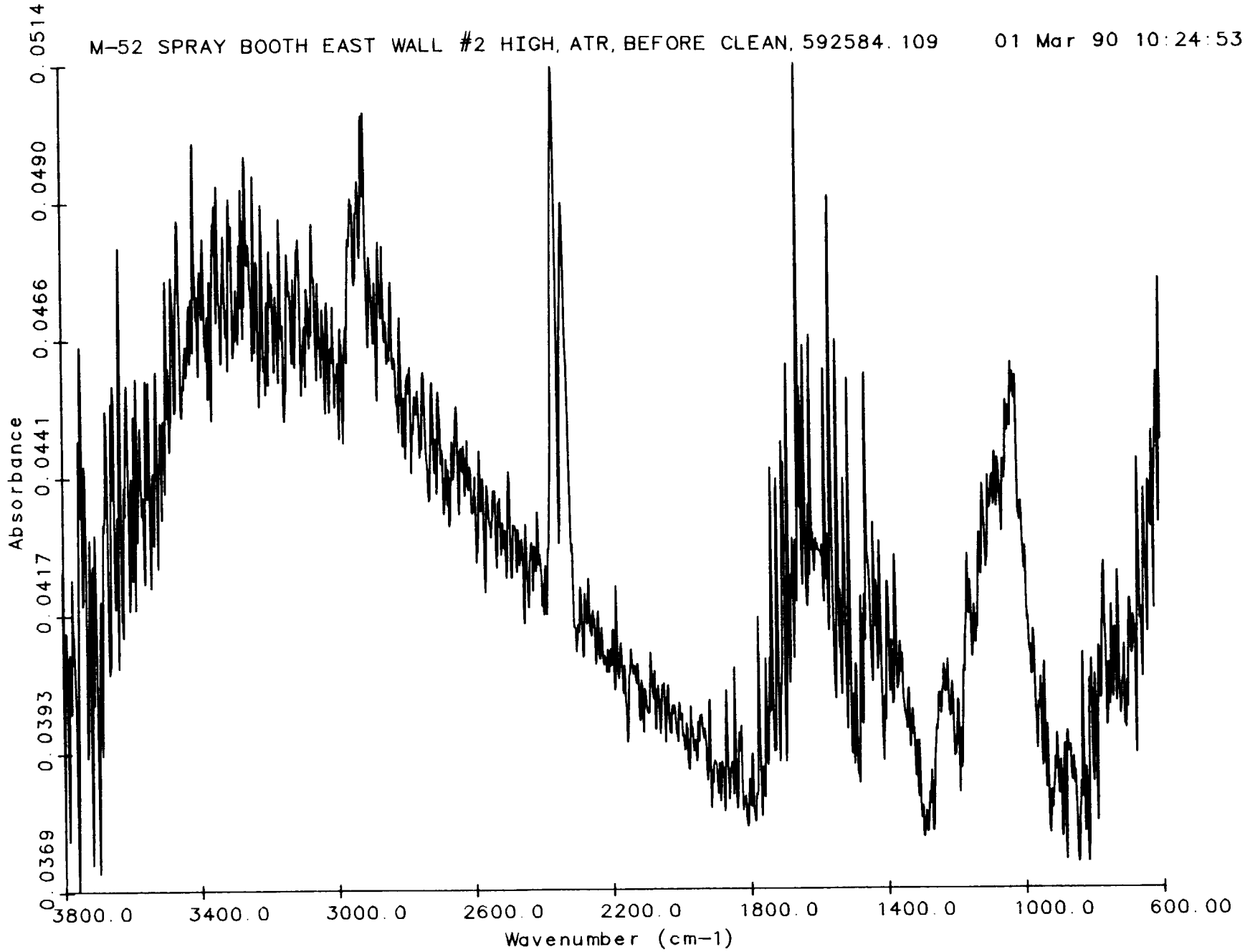
R. C. Raisor, Spectrochemical Analysis
LAB90061
B1222

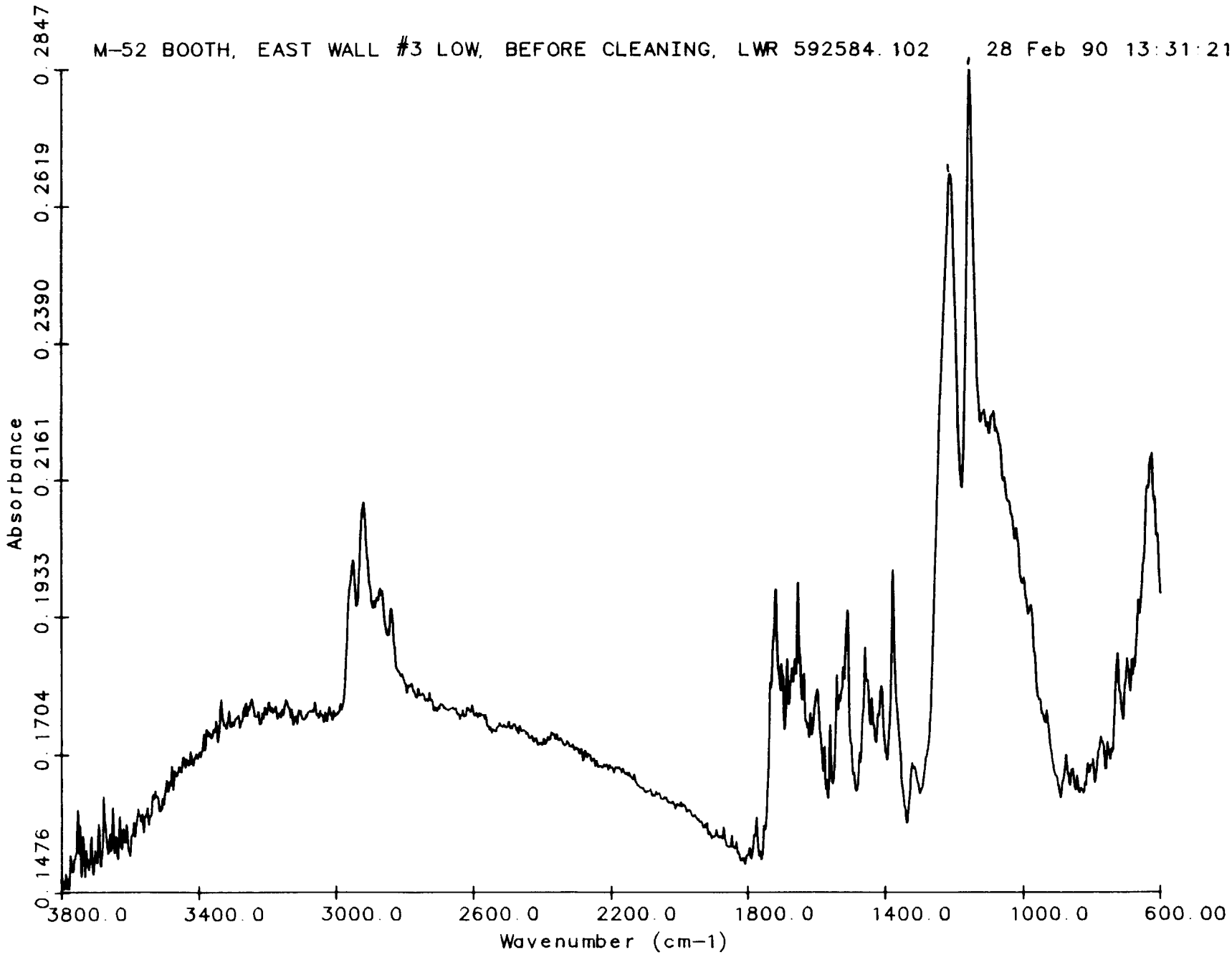

M-52 SPRAY BOOTH EAST WALL #1 LOW, ATR, BEFORE CLEAN, 592584.104
01 Mar 90 08:32:54
Absorbance
0.2294
0.2173
0.2052
0.1931
0.1809
0.1688
0.1567
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

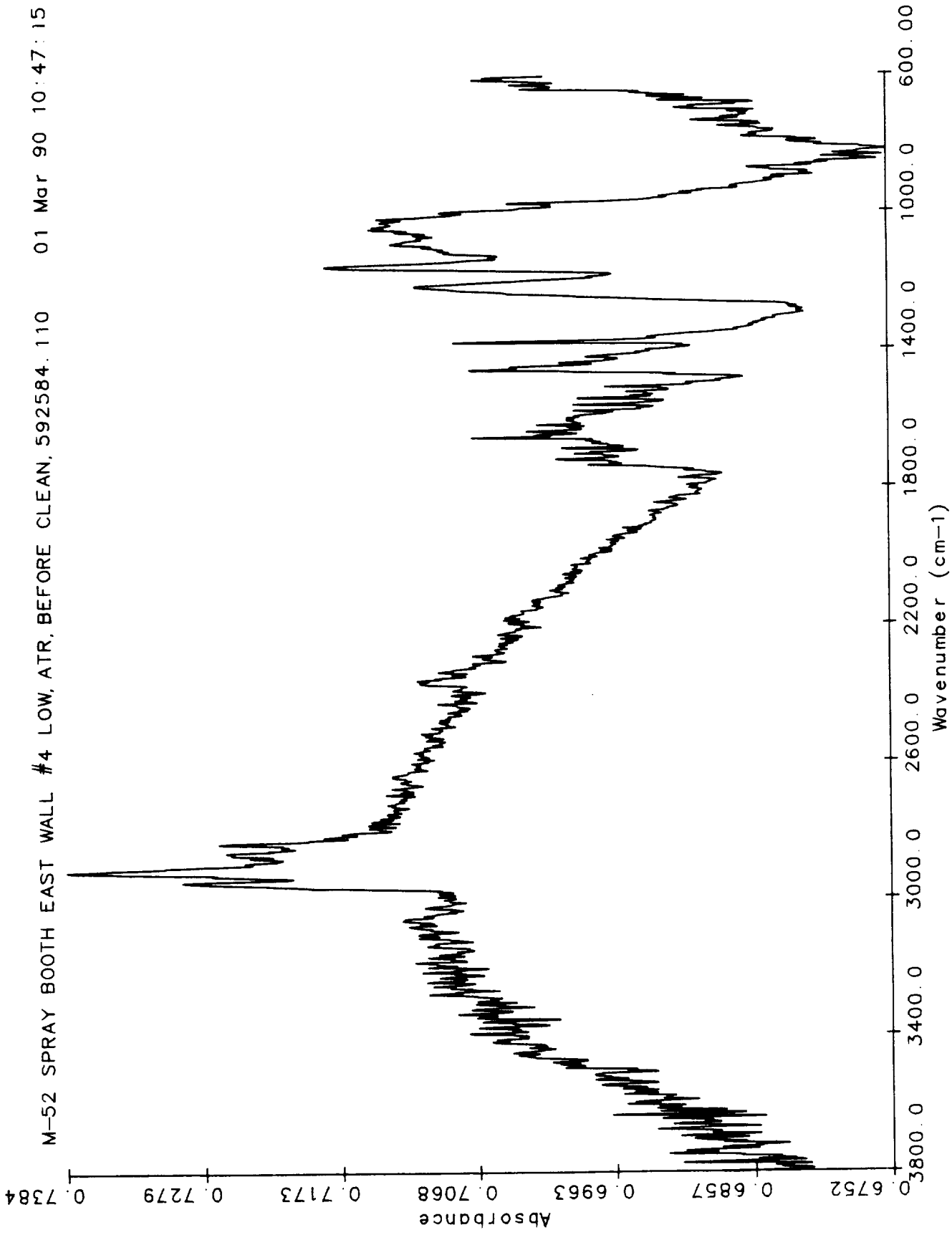

M-52 SPRAY BOOTH EAST WALL #1 HIGH, ATR, BEFORE CLEAN, 592584.105
01 Mar 90 08:48:34
Absorbance
0.2522
0.2391
0.2259
0.2127
0.1996
0.1864
0.1733
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

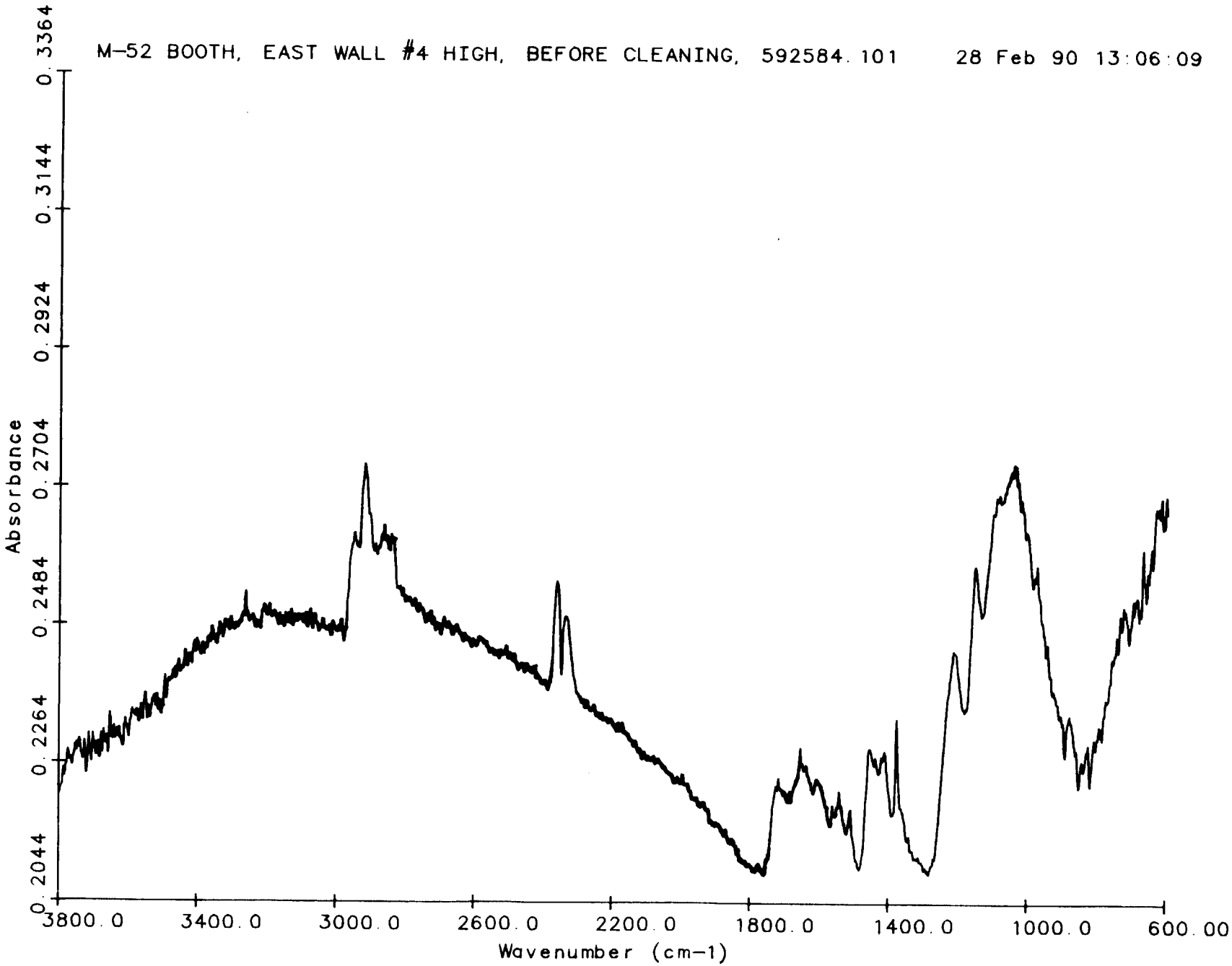

M-52 SPRAY BOOTH EAST WALL #2 LOW, ATR, BEFORE CLEAN, 592584.106
01 Mar 90 09:02:01
Absorbance
0.1575
0.1387
0.1199
0.1011
0.0823
0.0634
0.0446
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

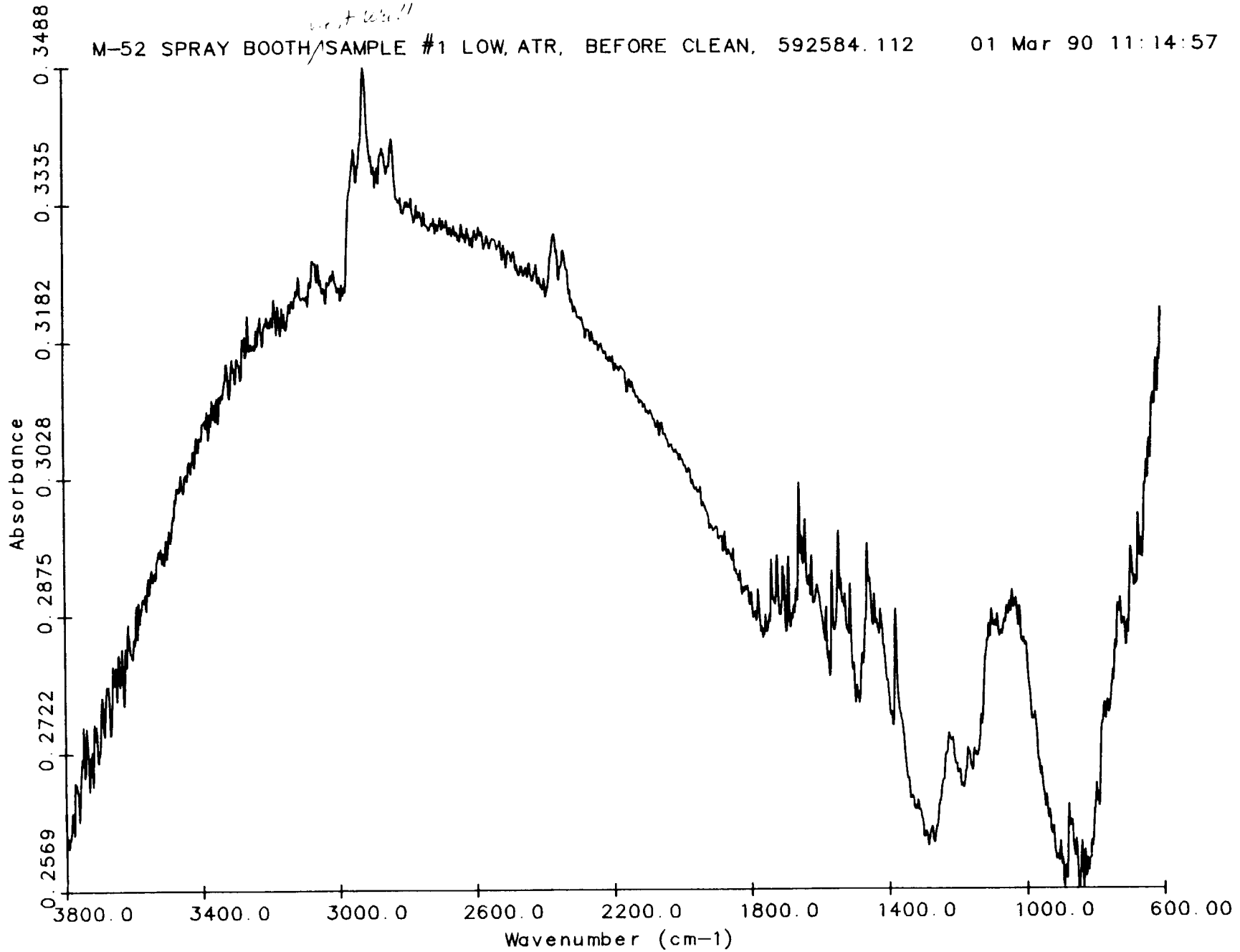

M-52 SPRAY BOOTH EAST WALL #2 HIGH, ATR, BEFORE CLEAN, 592584.108
01 Mar 90 10:07:26
Absorbance
0.2220
0.1975
0.1729
0.1484
0.1239
0.0994
0.0748
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

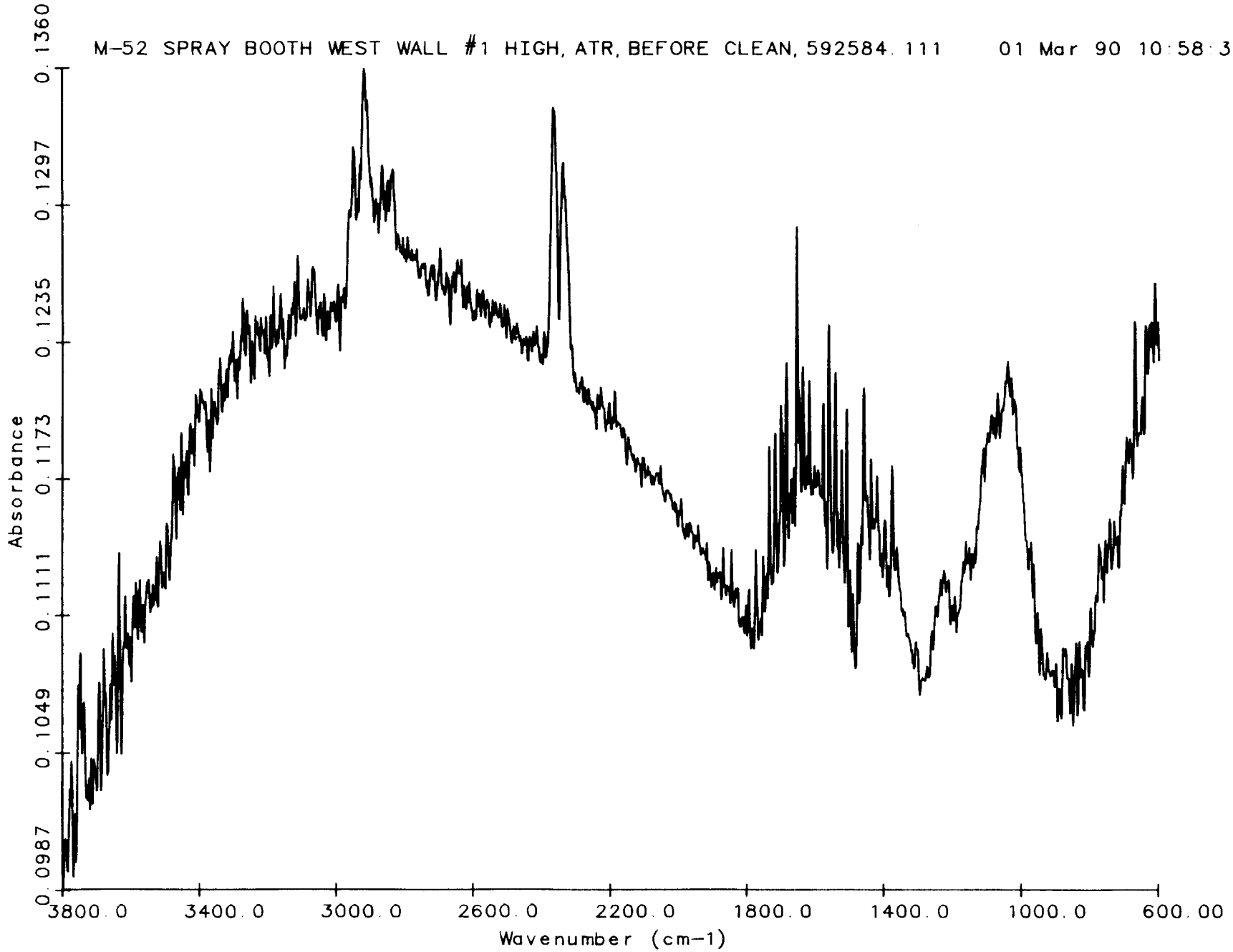

M-52 SPRAY BOOTH EAST WALL #2 HIGH, ATR, BEFORE CLEAN, 592584.109
01 Mar 90 10:24:53
Absorbance
0.0514
0.0490
0.0466
0.0441
0.0417
0.0393
0.0369
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

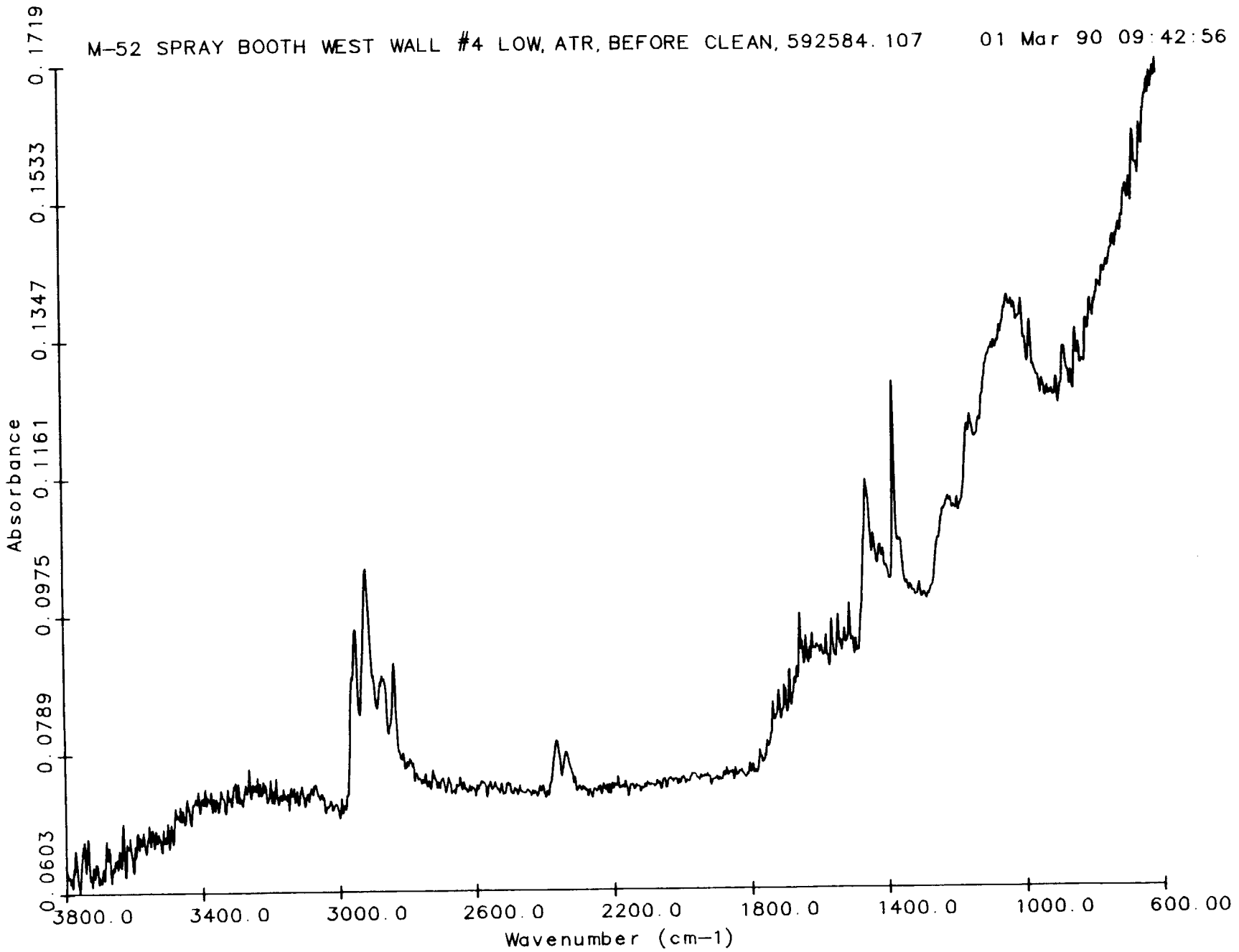

M-52 BOOTH, EAST WALL #3 LOW, BEFORE CLEANING, LWR 592584.102
28 Feb 90 13:31:21
Absorbance
0.2847
0.2619
0.2390
0.2161
0.1933
0.1704
0.1476
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

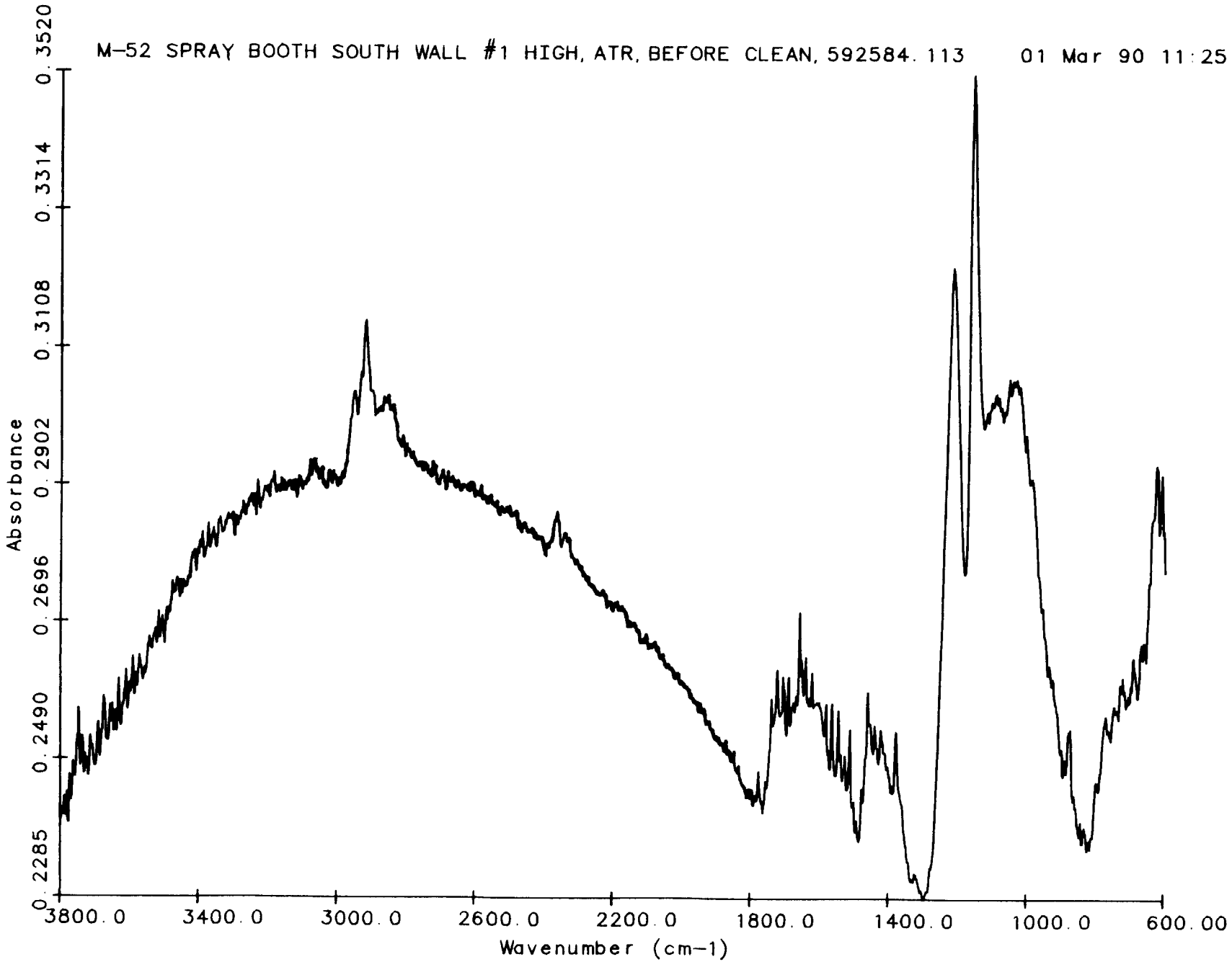

M-52 SPRAY BOOTH EAST WALL #4 LOW, ATR, BEFORE CLEAN, 592584.110 01 Mar 90 10:47:15
Absorbance
0.6752
0.6857
0.6963
0.7068
0.7173
0.7279
0.7384
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

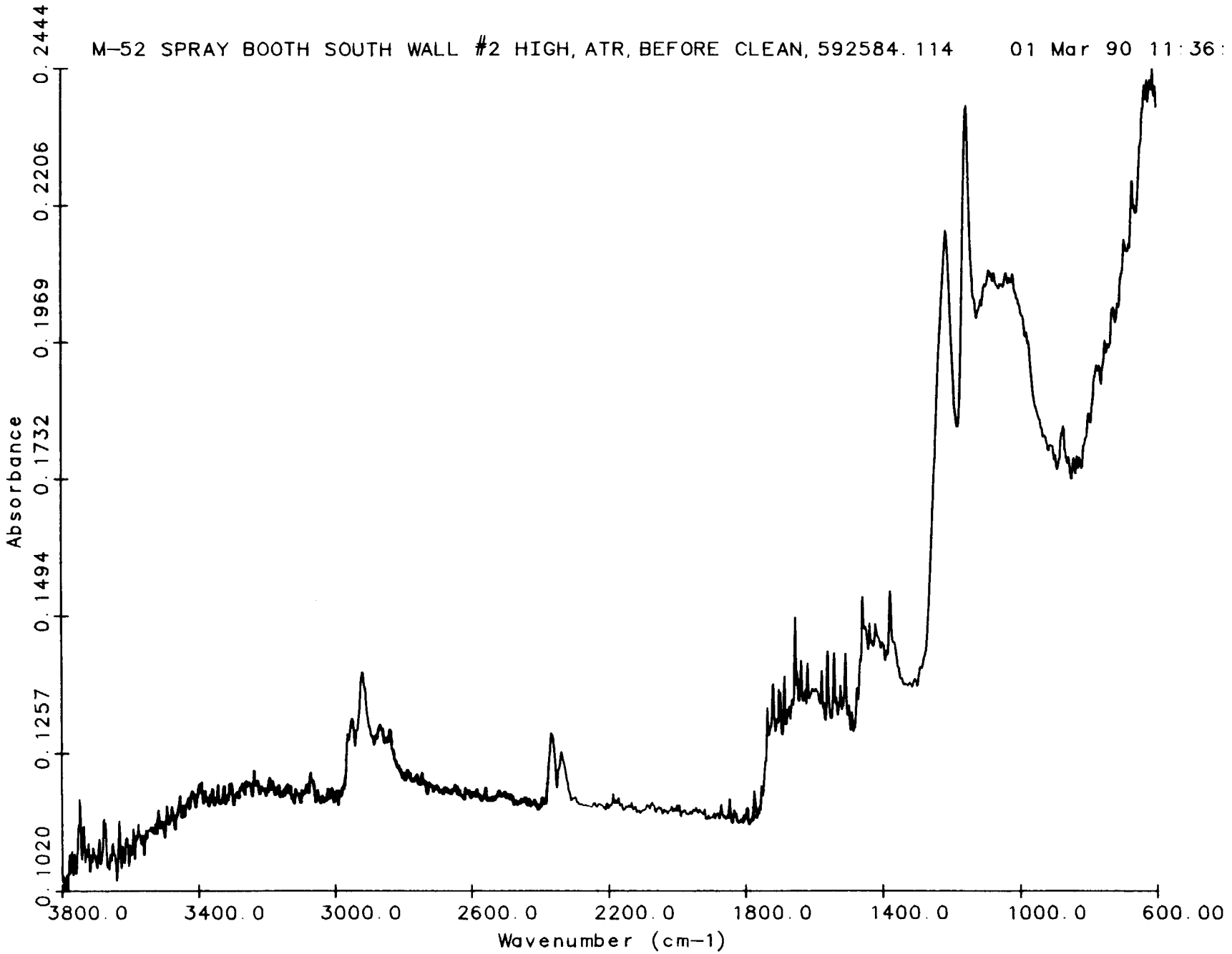

M-52 BOOTH, EAST WALL #4 HIGH, BEFORE CLEANING, 592584.101 28 Feb 90 13:06:09
Absorbance
0.3364
0.3144
0.2924
0.2704
0.2484
0.2264
0.2044
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

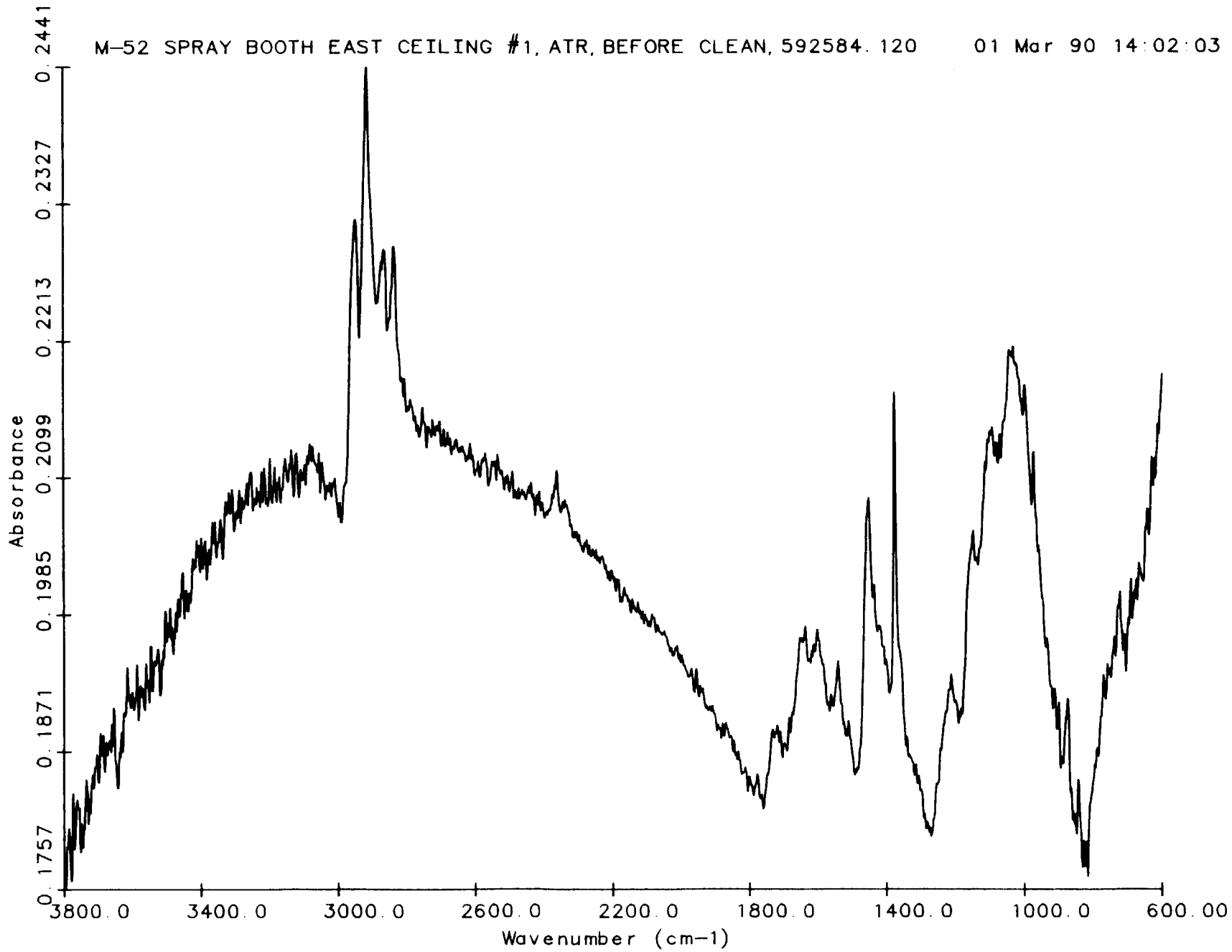

M-52 SPRAY BOOTH/SAMPLE #1 LOW, ATR, BEFORE CLEAN, 592584.112 01 Mar 90 11:14:57
Absorbance
0.3488
0.3335
0.3182
0.3028
0.2875
0.2722
0.2569
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

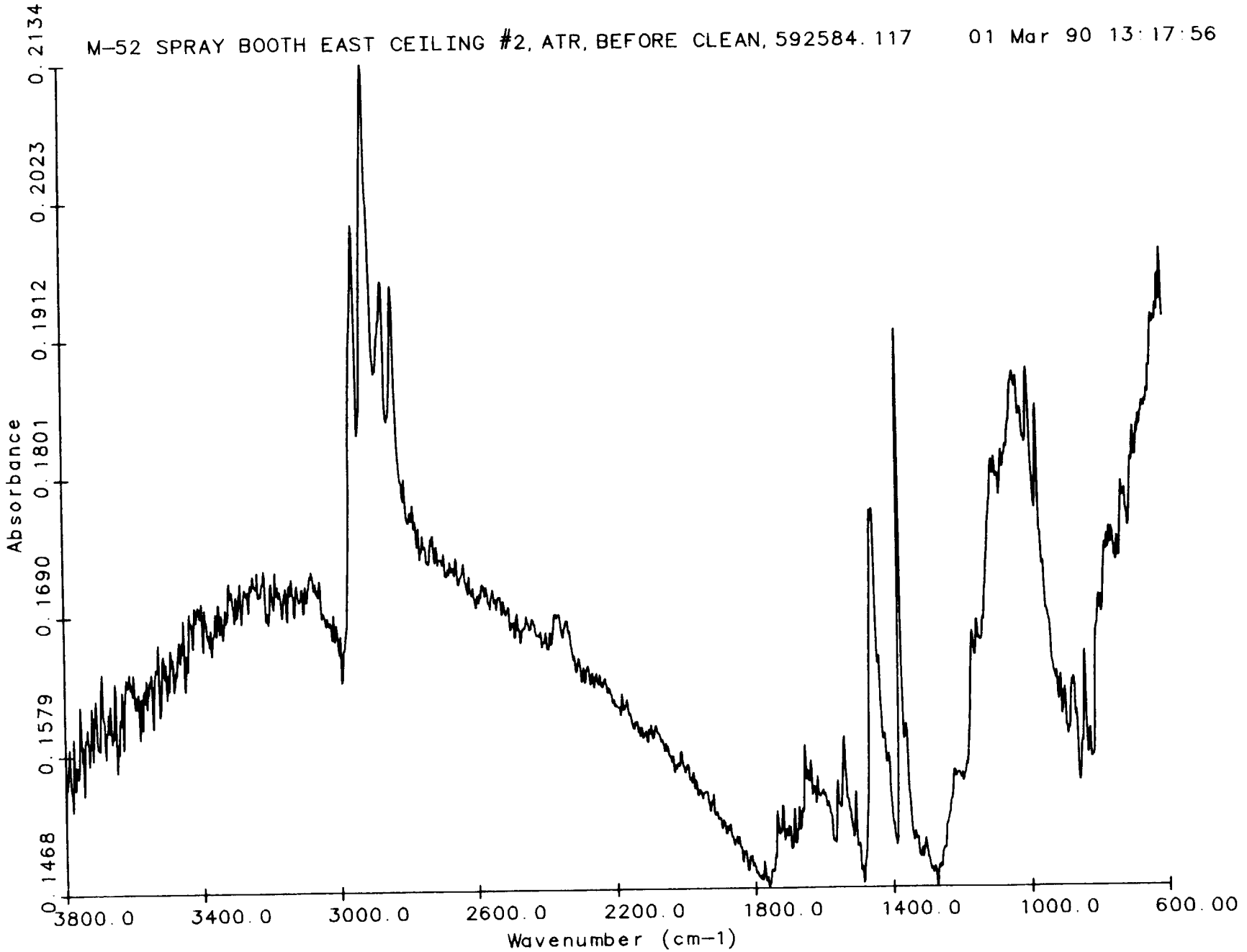

M-52 SPRAY BOOTH WEST WALL #1 HIGH, ATR, BEFORE CLEAN, 592584.111
01 Mar 90 10:58:33
Absorbance
0.1360
0.1297
0.1235
0.1173
0.1111
0.1049
0.0987
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

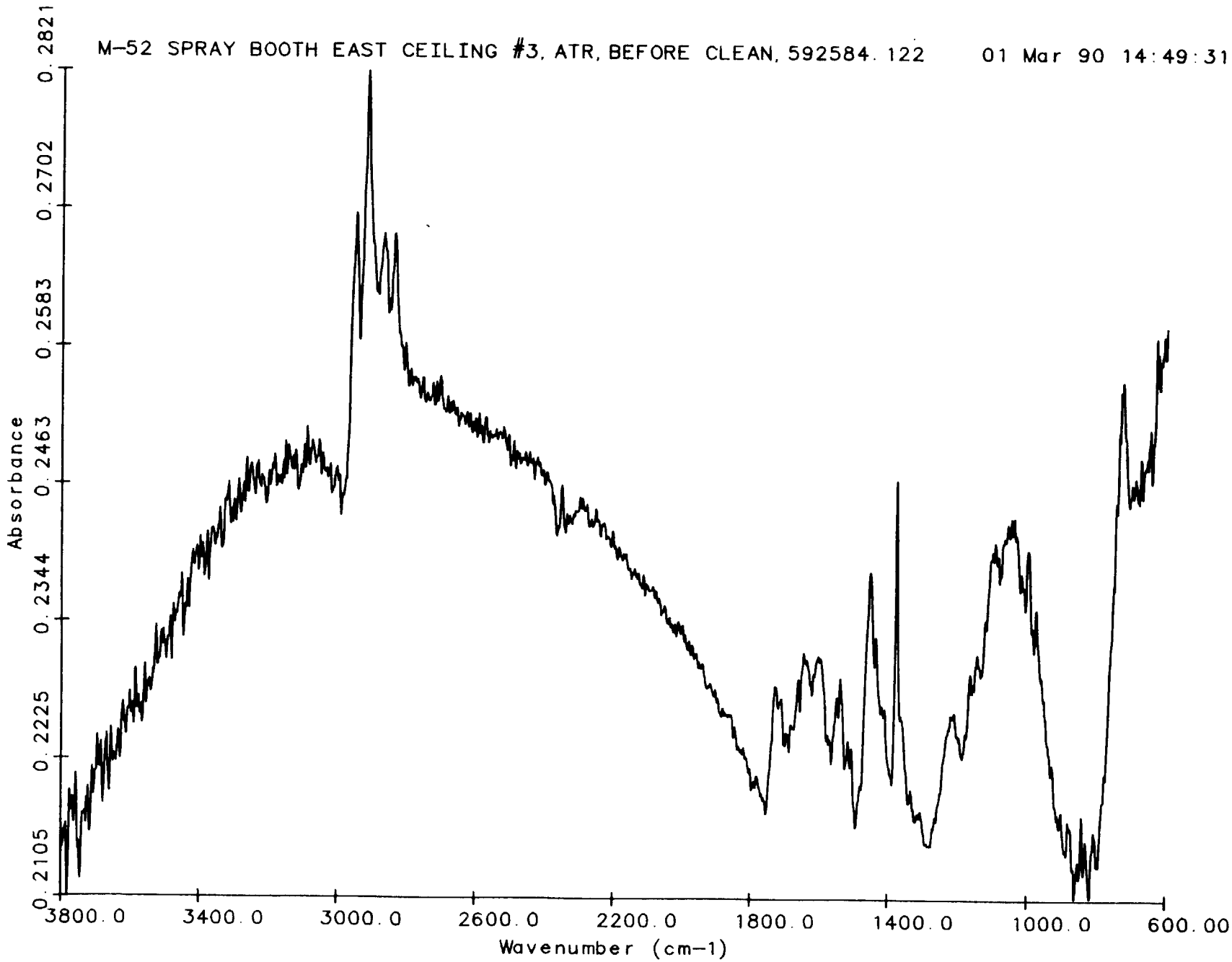

M-52 SPRAY BOOTH WEST WALL #4 LOW, ATR, BEFORE CLEAN, 592584.107
01 Mar 90 09:42:56
Absorbance
0.1719
0.1533
0.1347
0.1161
0.0975
0.0789
0.0603
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

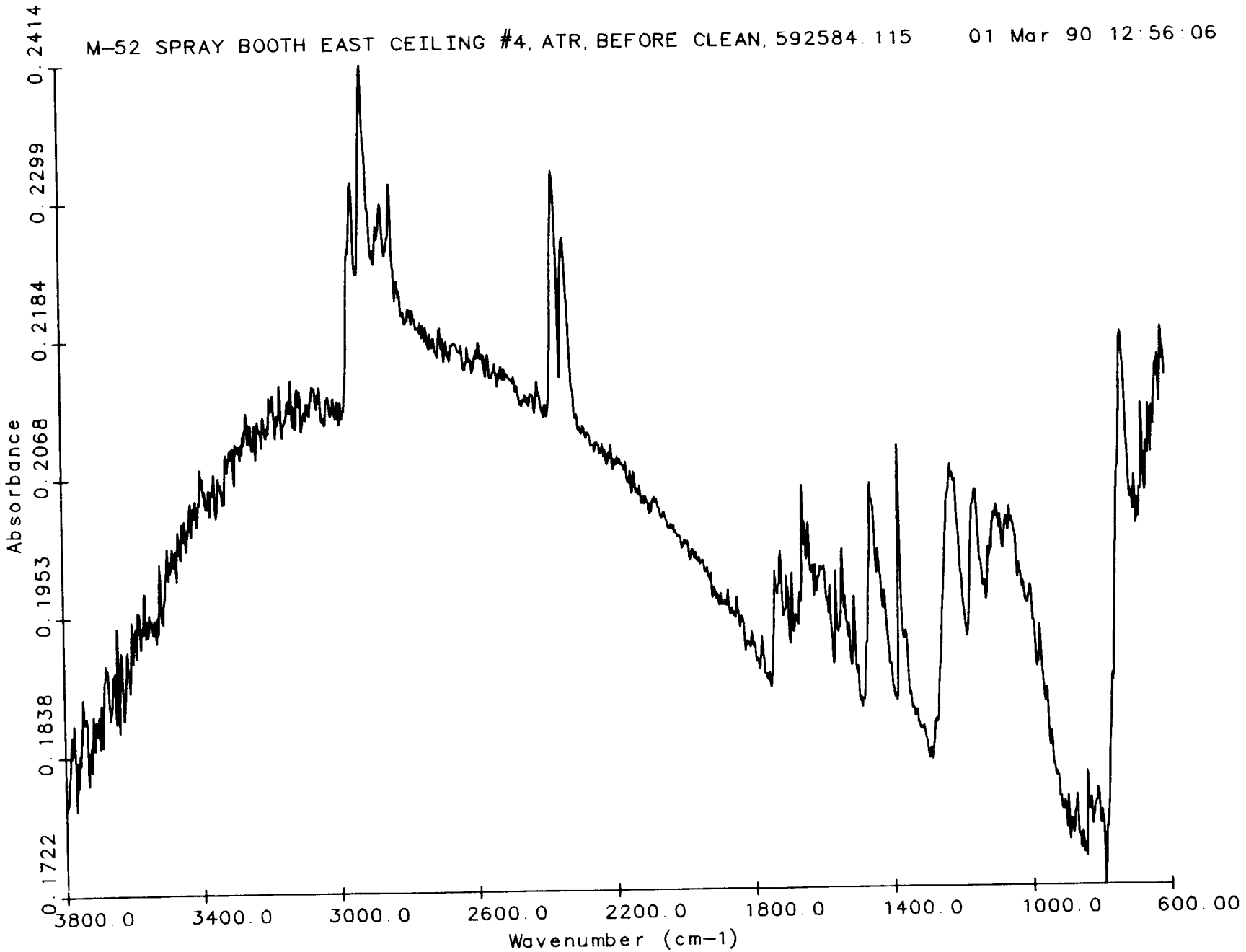

M-52 SPRAY BOOTH SOUTH WALL #1 HIGH, ATR, BEFORE CLEAN, 592584.113
01 Mar 90 11:25:00
Absorbance
0.3520
0.3314
0.3108
0.2902
0.2696
0.2490
0.2285
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

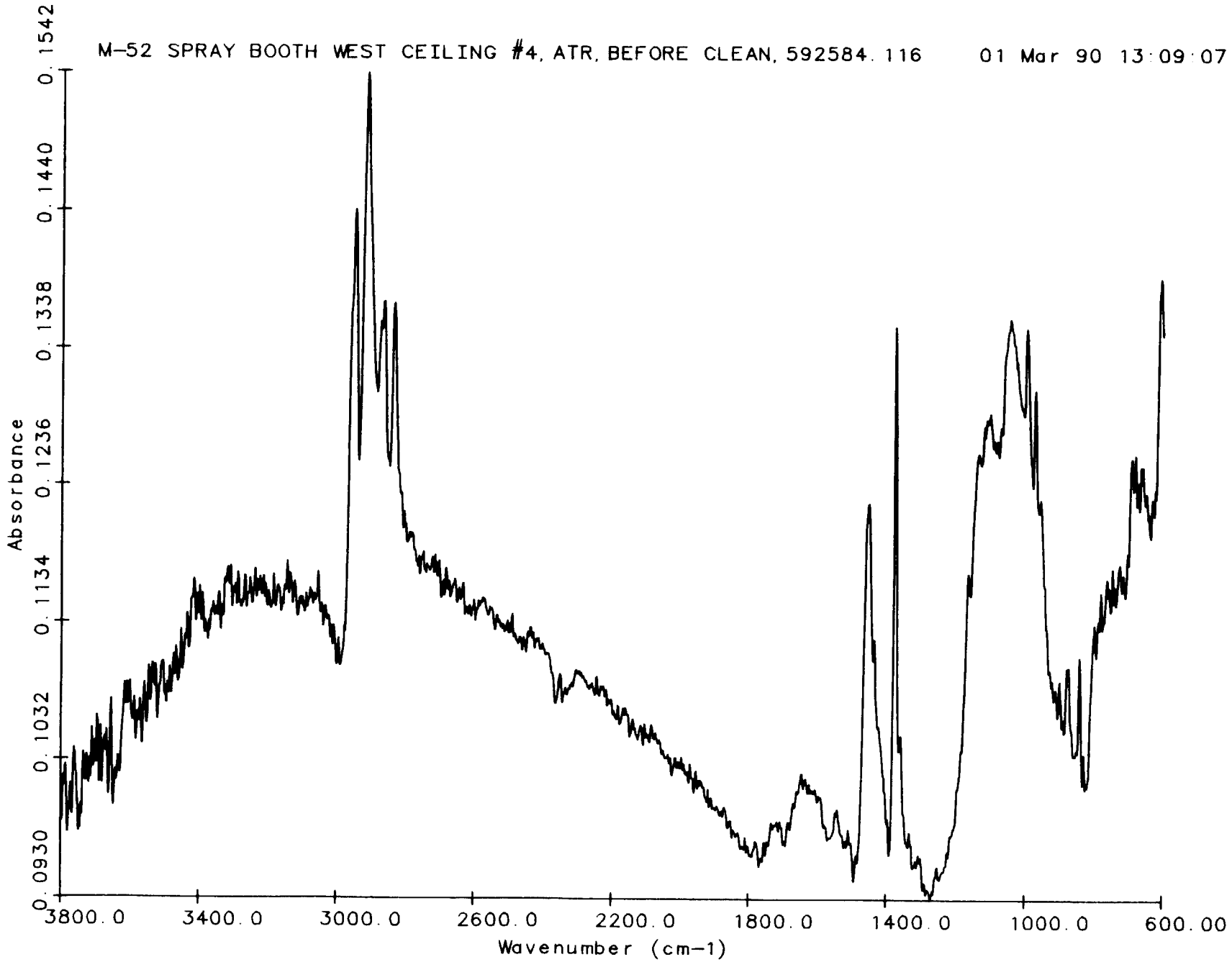

M-52 SPRAY BOOTH SOUTH WALL #2 HIGH, ATR, BEFORE CLEAN, 592584.114
01 Mar 90 11:36:12
Absorbance
0.2444
0.2206
0.1969
0.1732
0.1494
0.1257
0.1020
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

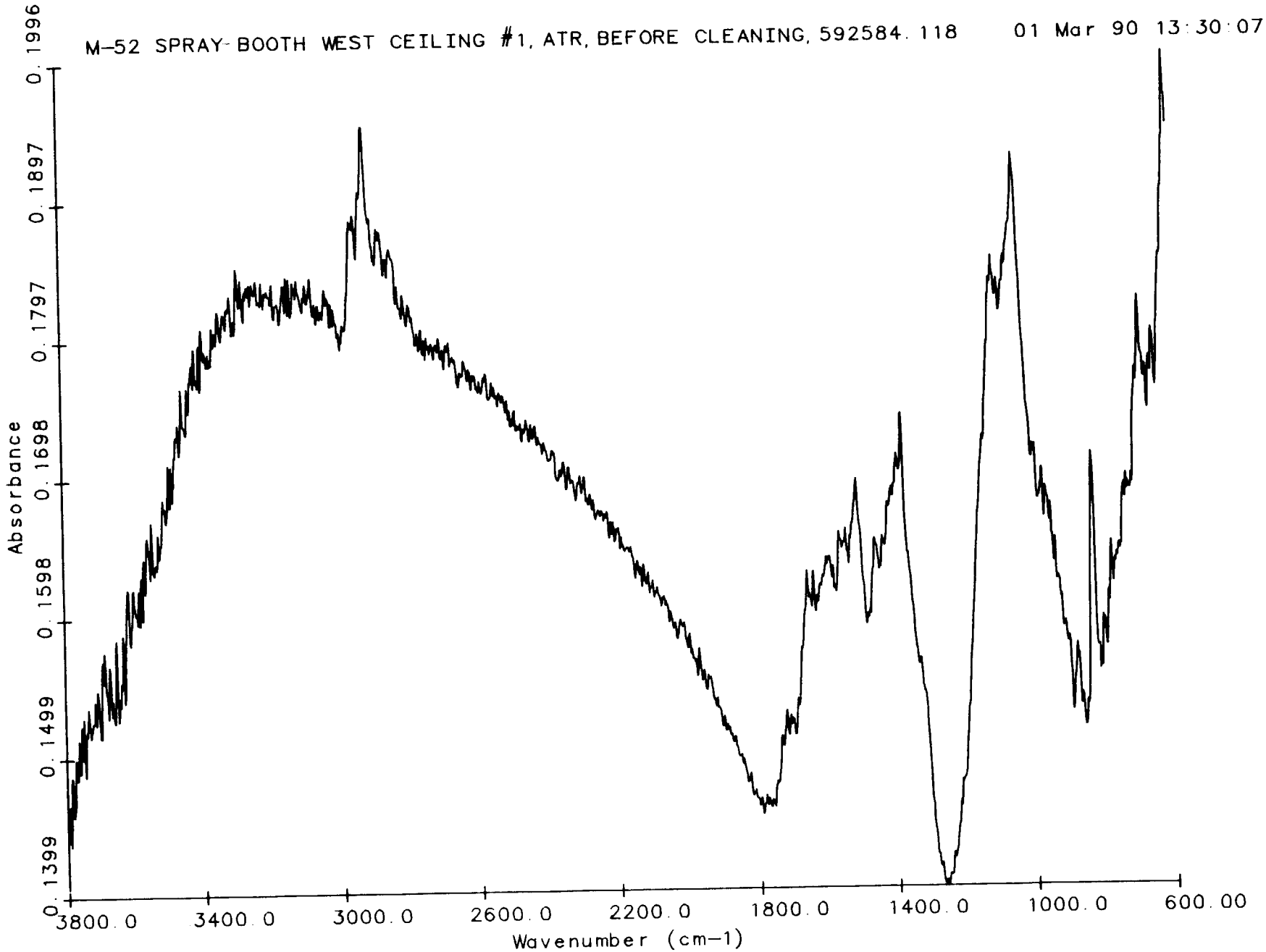

M-52 SPRAY BOOTH EAST CEILING #1, ATR, BEFORE CLEAN, 592584.120
01 Mar 90 14:02:03
Absorbance
0.2441
0.2327
0.2213
0.2099
0.1985
0.1871
0.1757
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

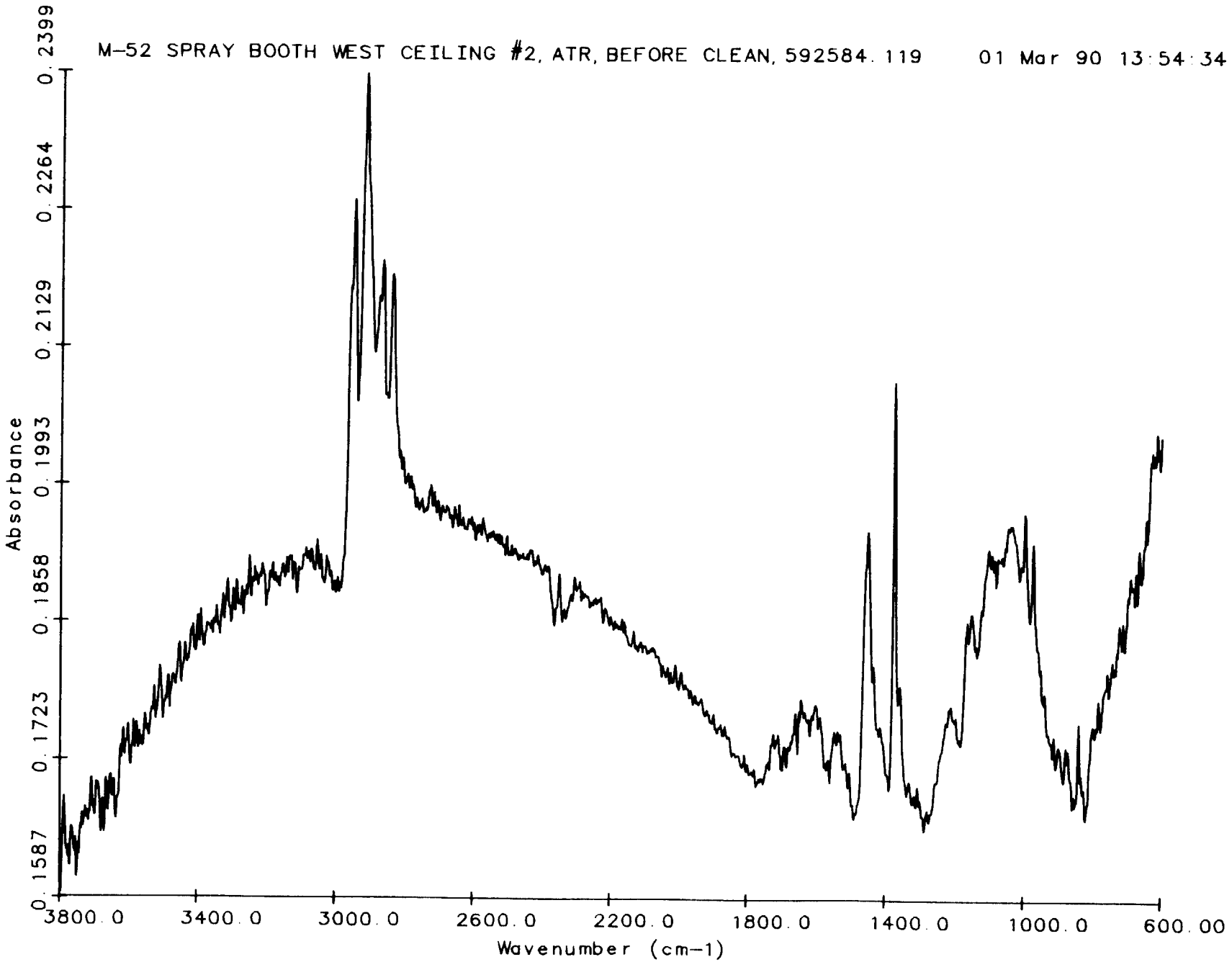

M-52 SPRAY BOOTH EAST CEILING #2, ATR, BEFORE CLEAN, 592584.117
01 Mar 90 13:17:56
Absorbance
0.2134
0.2023
0.1912
0.1801
0.1690
0.1579
0.1468
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

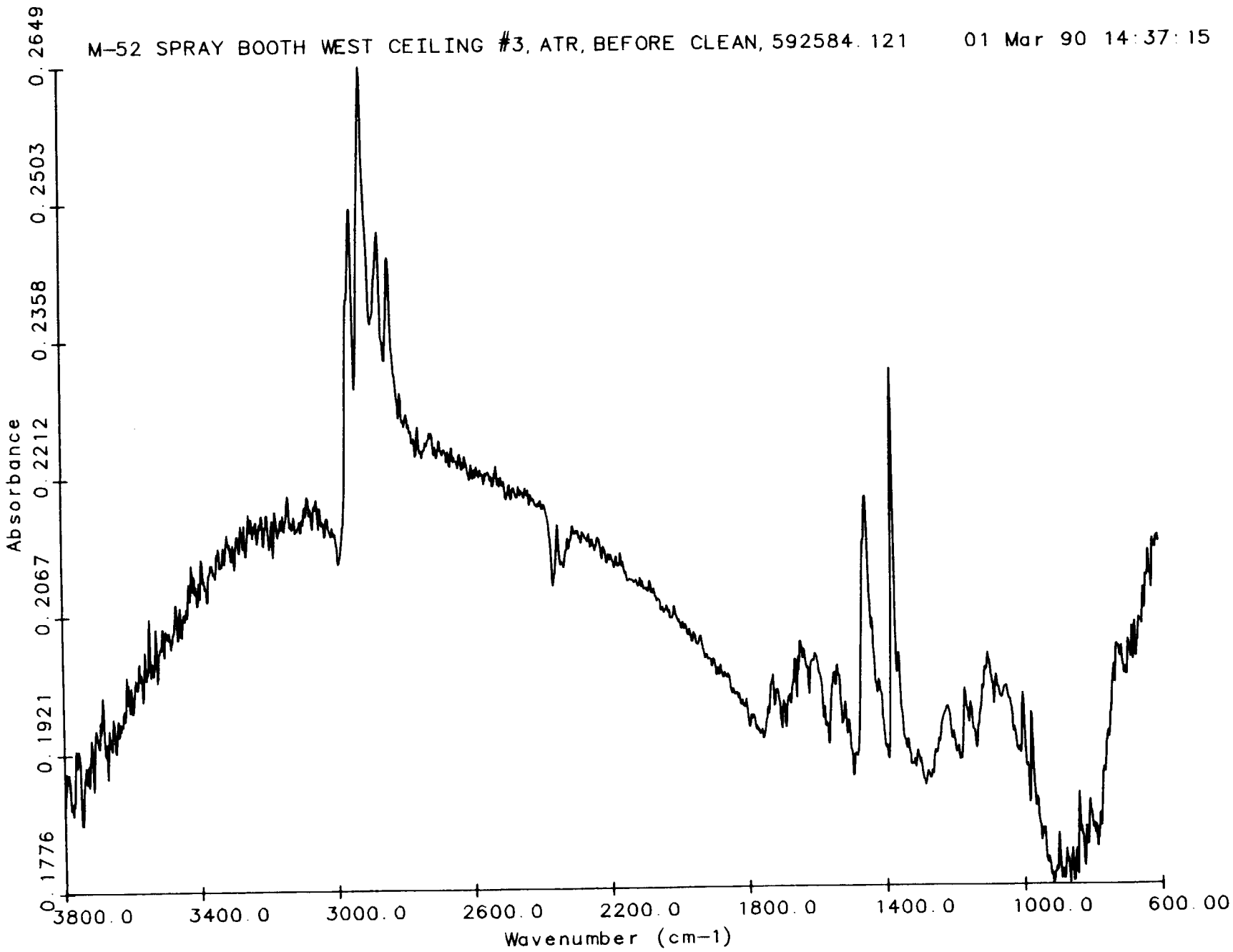

M-52 SPRAY BOOTH EAST CEILING #3, ATR, BEFORE CLEAN, 592584.122
01 Mar 90 14:49:31
Absorbance
0.2821
0.2702
0.2583
0.2463
0.2344
0.2225
0.2105
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH EAST CEILING #4, ATR, BEFORE CLEAN, 592584.115
01 Mar 90 12:56:06
Absorbance
0.2414
0.2299
0.2184
0.2068
0.1953
0.1838
0.1722
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH WEST CEILING #4, ATR, BEFORE CLEAN, 592584.116
01 Mar 90 13:09:07
Absorbance
0.1542
0.1440
0.1338
0.1236
0.1134
0.1032
0.0930
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

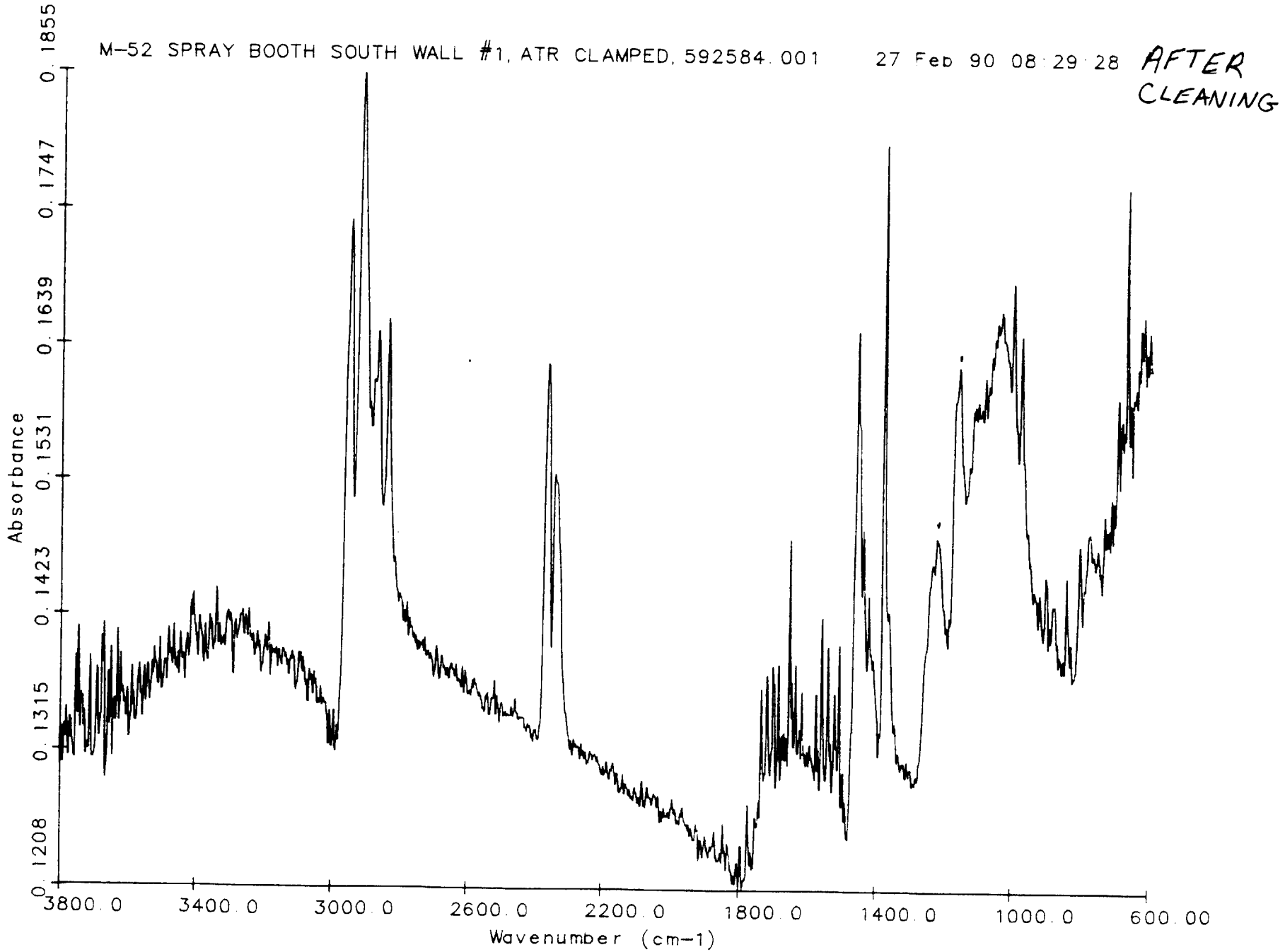

M-52 SPRAY-BOOTH WEST CEILING #1, ATR, BEFORE CLEANING, 592584.118
01 Mar 90 13:30:07
Absorbance
0.1996
0.1897
0.1797
0.1698
0.1598
0.1499
0.1399
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

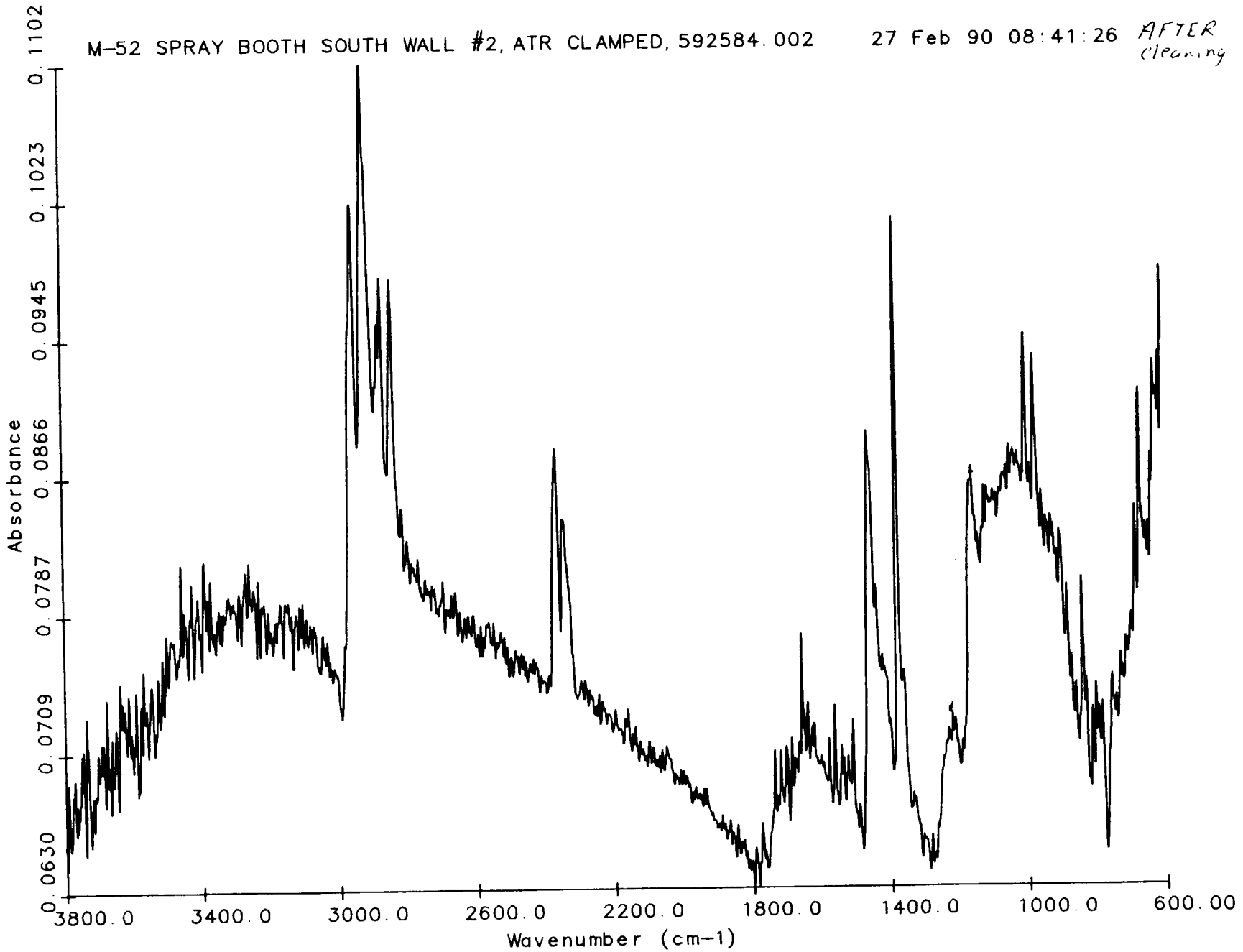

M-52 SPRAY BOOTH WEST CEILING #2, ATR, BEFORE CLEAN, 592584.119
01 Mar 90 13:54:34
Absorbance
0.2399
0.2264
0.2129
0.1993
0.1858
0.1723
0.1587
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

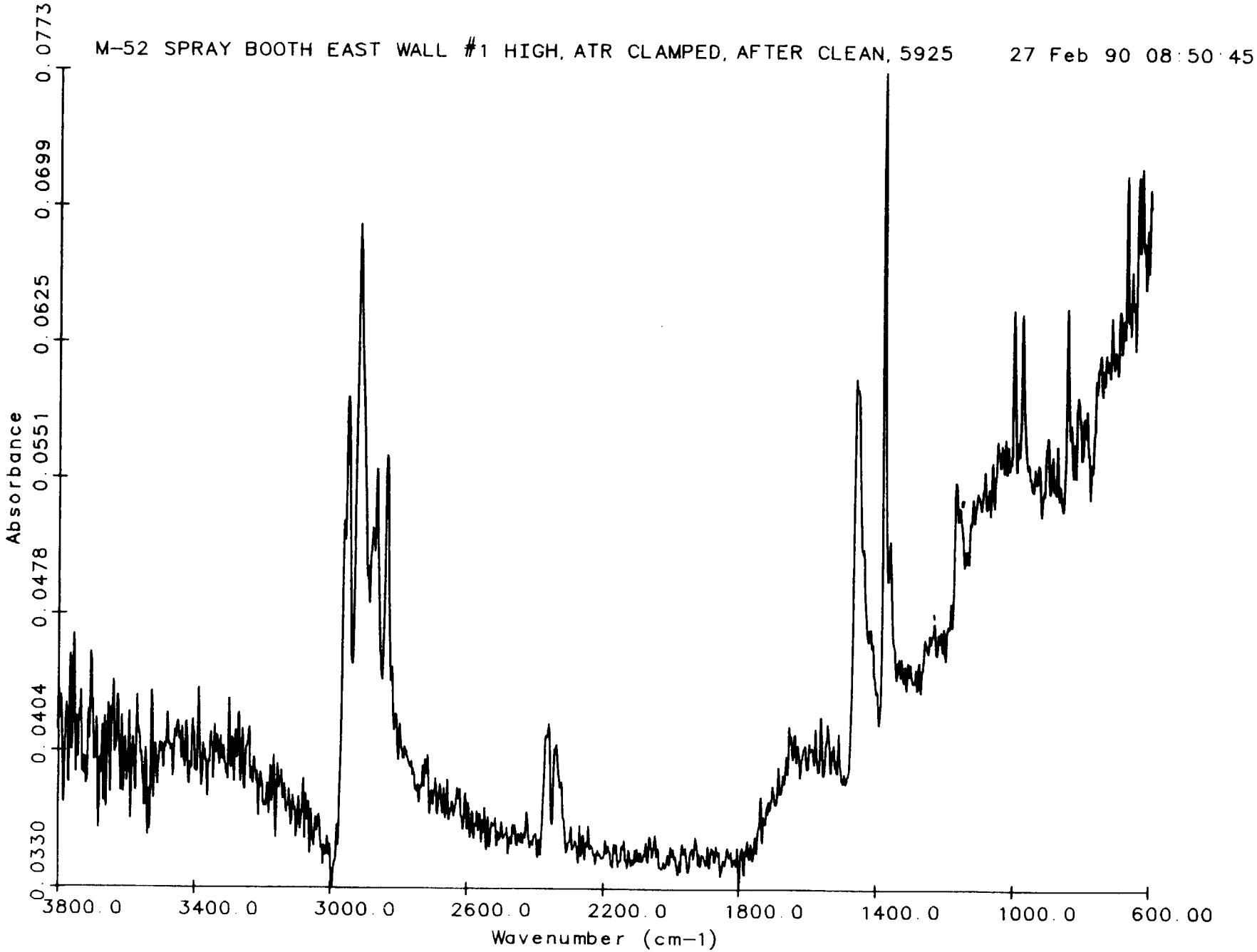

M-52 SPRAY BOOTH WEST CEILING #3, ATR, BEFORE CLEAN, 592584.121
01 Mar 90 14:37:15
Absorbance
0.2649
0.2503
0.2358
0.2212
0.2067
0.1921
0.1776
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

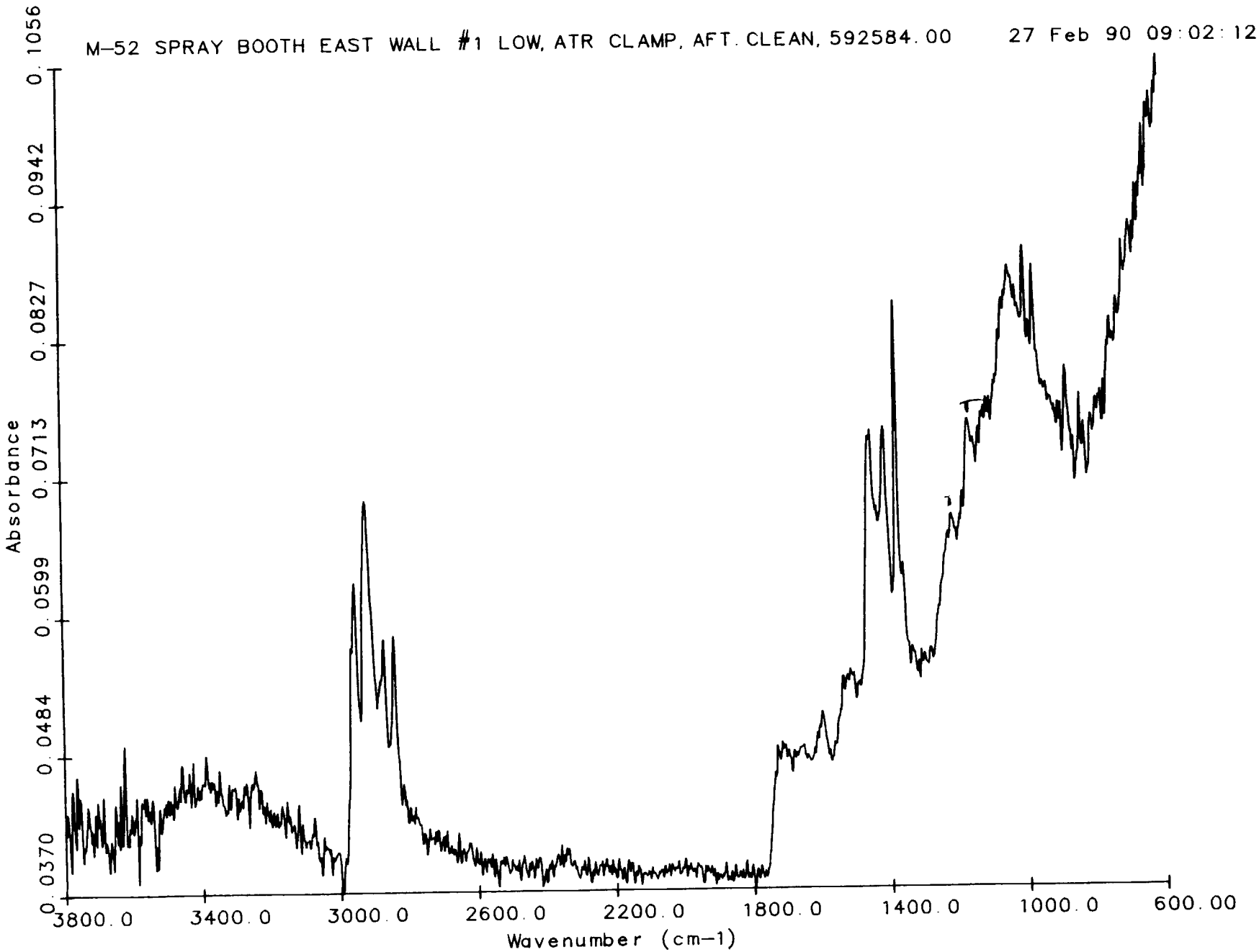
Appendix B

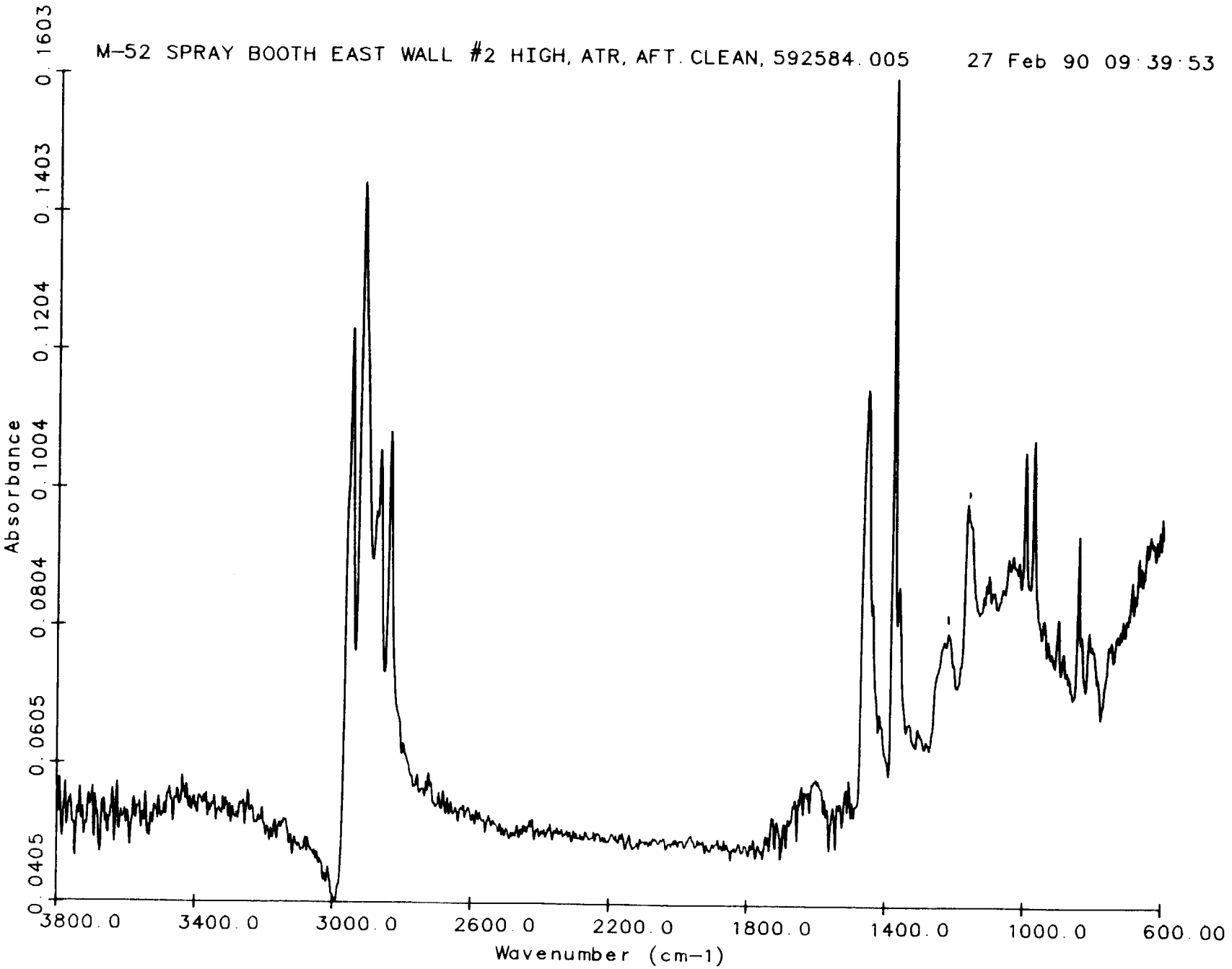
Second FTIR Sample Wipes

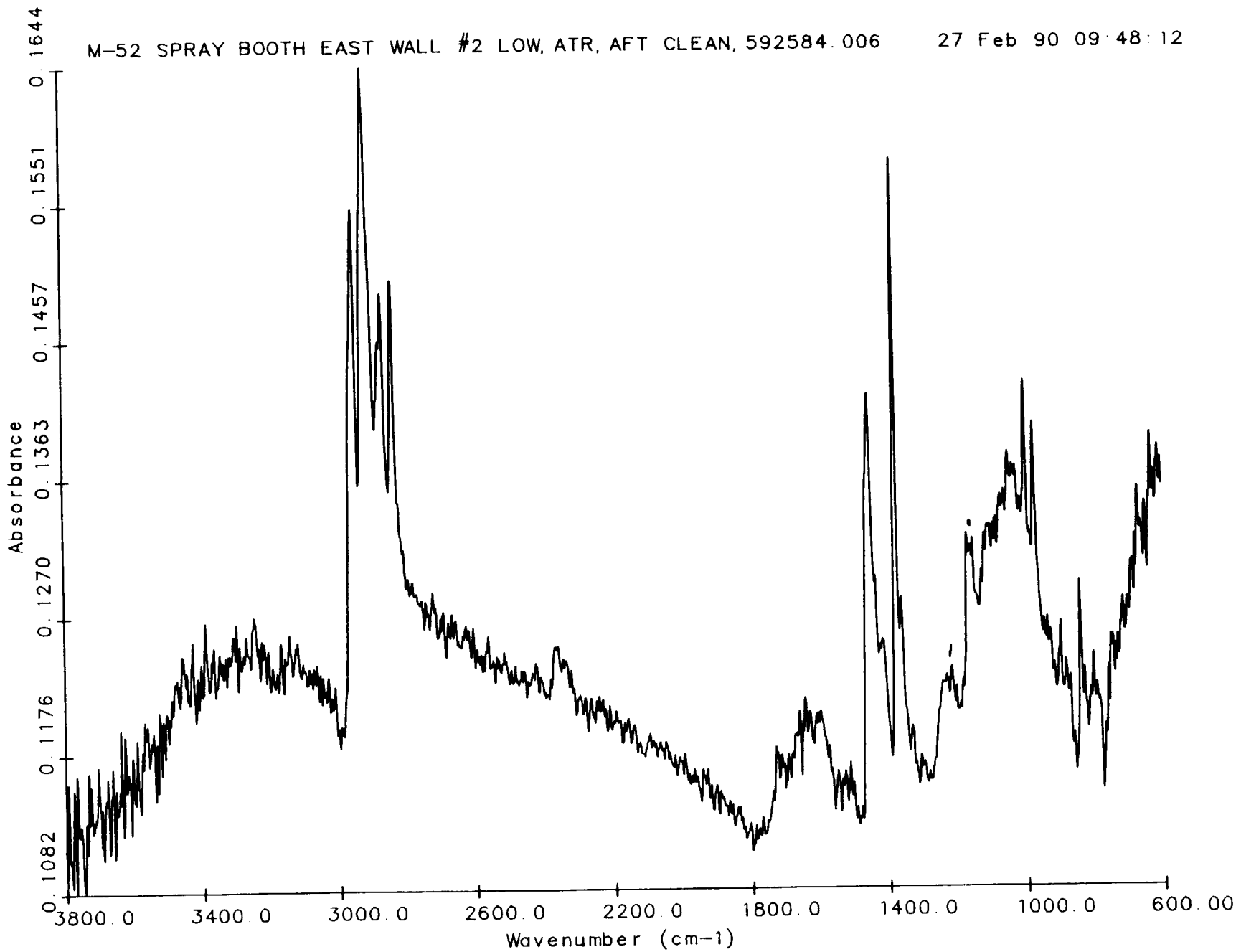

M-52 SPRAY BOOTH SOUTH WALL #1, ATR CLAMPED, 592584.001
27 Feb 90 08:29:28
AFTER CLEANING
Absorbance
0.1855
0.1747
0.1639
0.1531
0.1423
0.1315
0.1208
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

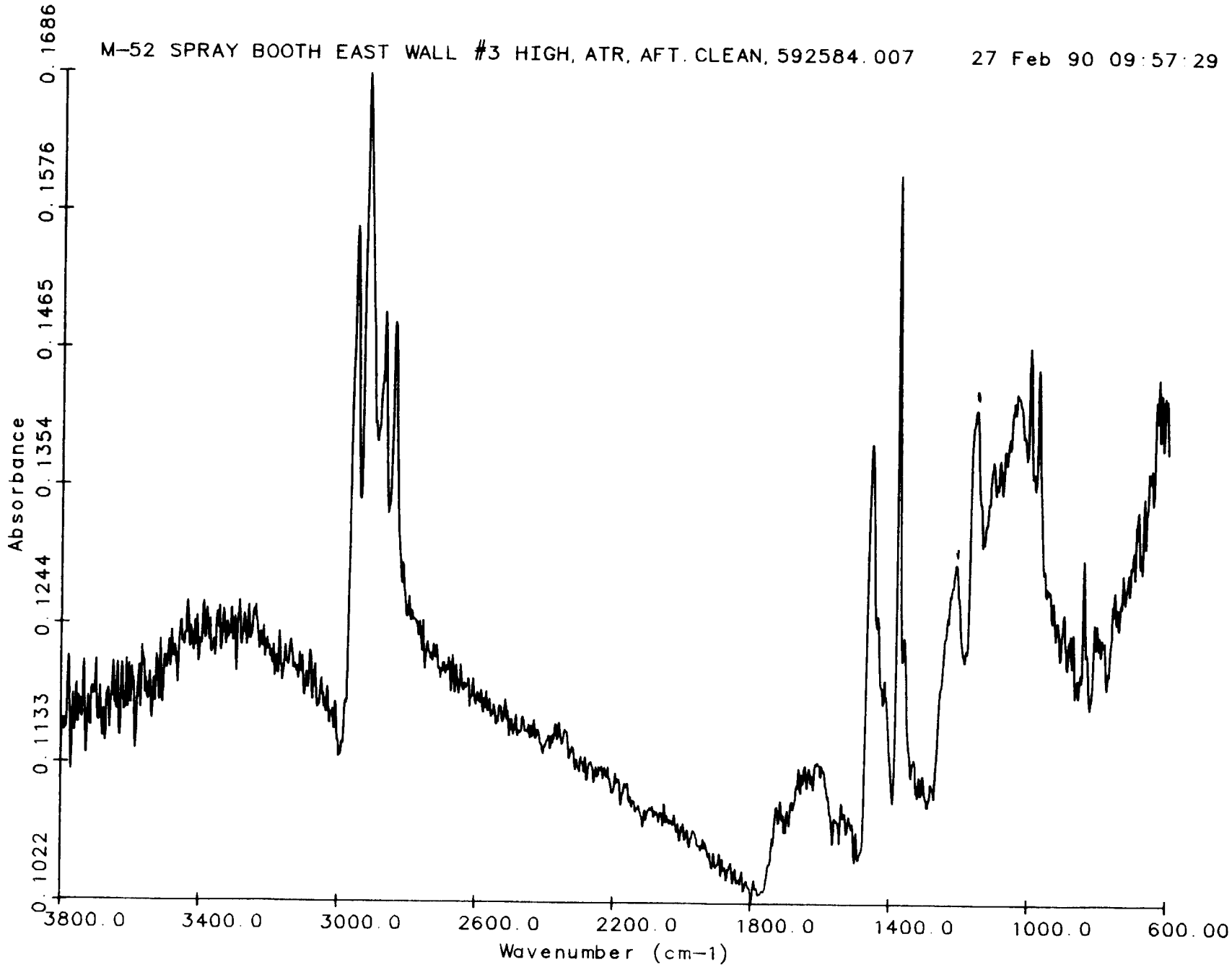

M-52 SPRAY BOOTH SOUTH WALL #2, ATR CLAMPED, 592584.002
27 Feb 90 08:41:26
AFTER cleaning
Absorbance
0.1102
0.1023
0.0945
0.0866
0.0787
0.0709
0.0630
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

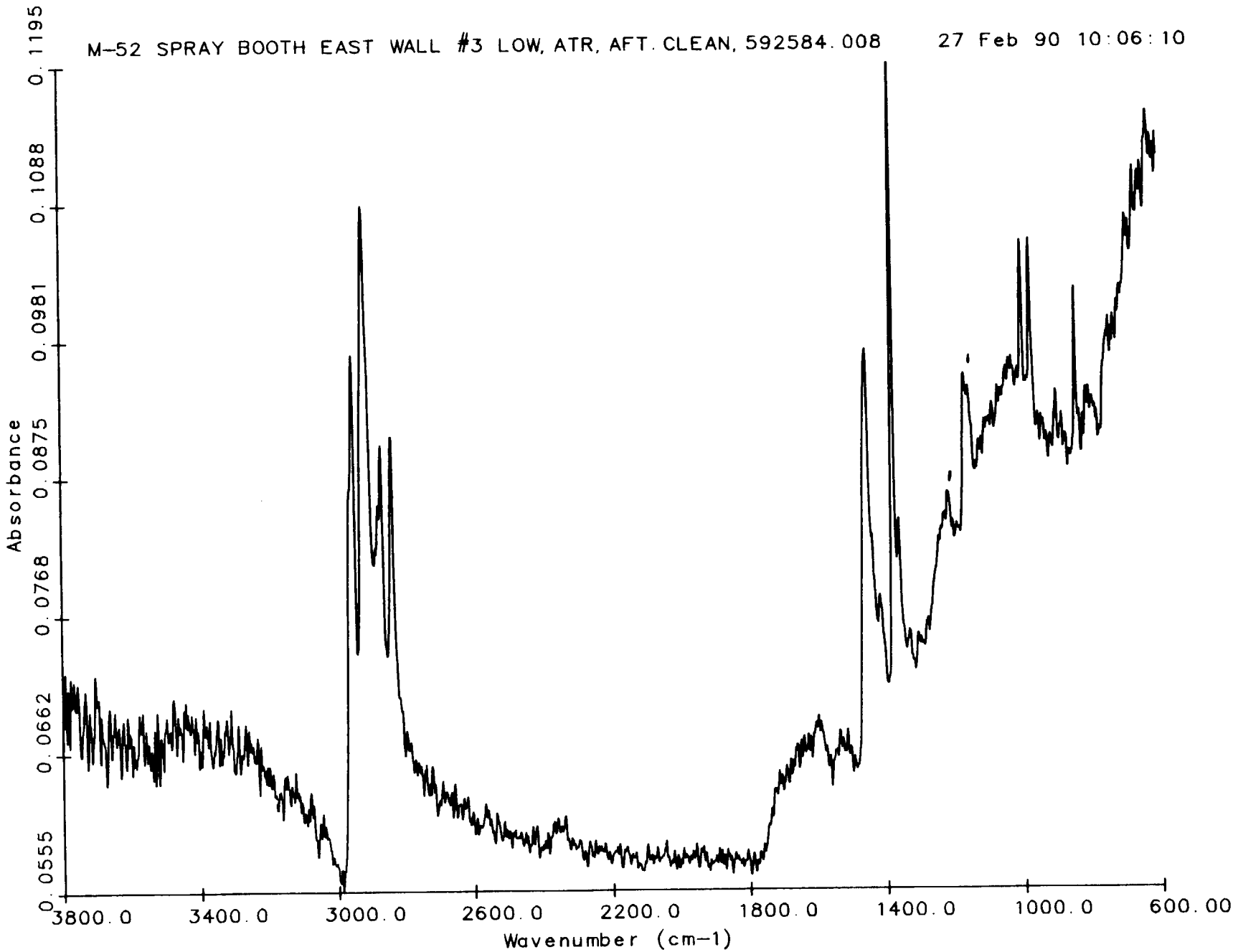

M-52 SPRAY BOOTH EAST WALL #1 HIGH, ATR CLAMPED, AFTER CLEAN, 5925
27 Feb 90 08:50:45
Absorbance
0.0773
0.0699
0.0625
0.0551
0.0478
0.0404
0.0330
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

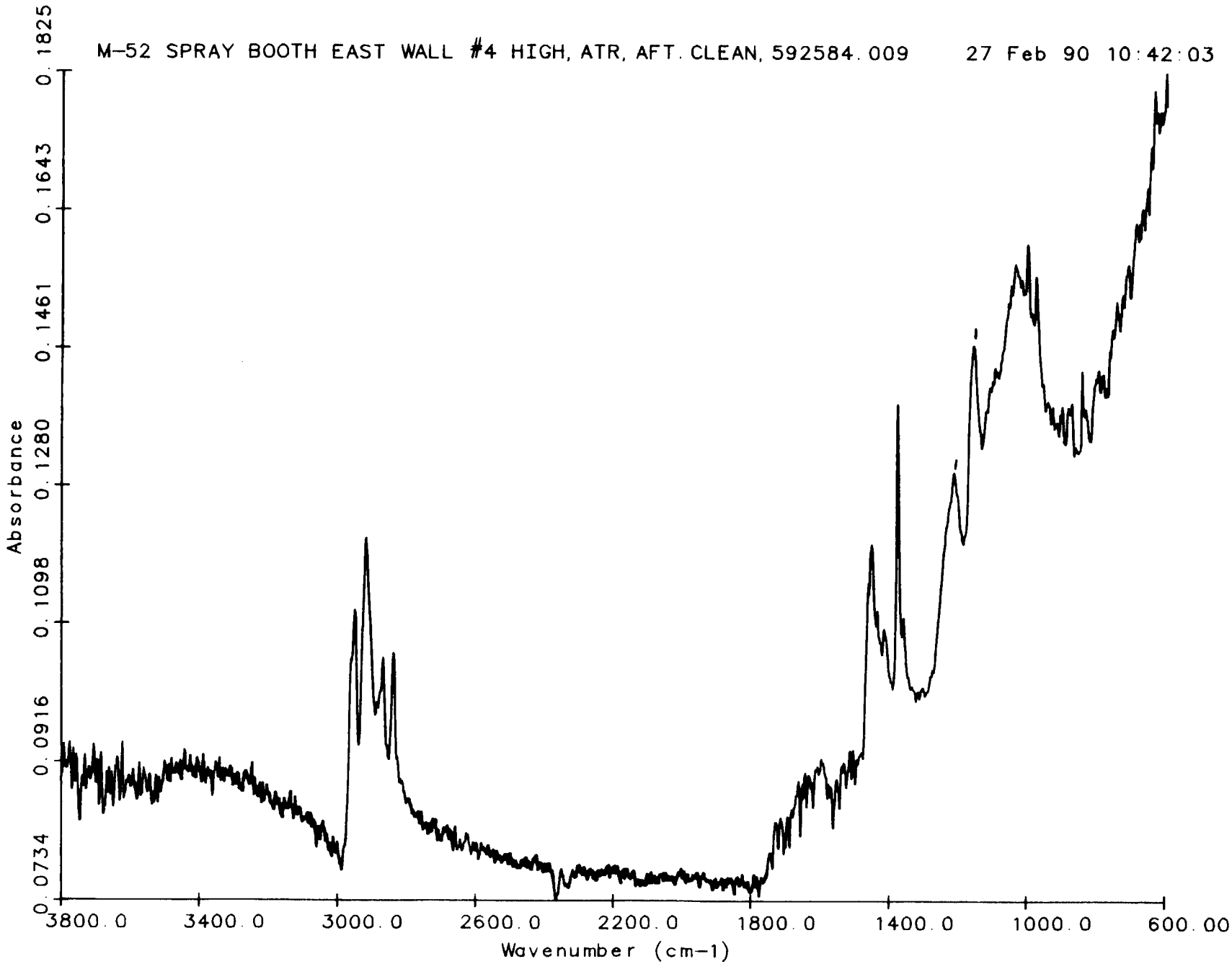

M-52 SPRAY BOOTH EAST WALL #1 LOW, ATR CLAMP, AFT. CLEAN, 592584.00
27 Feb 90 09:02:12
Absorbance
0.1056
0.0942
0.0827
0.0713
0.0599
0.0484
0.0370
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

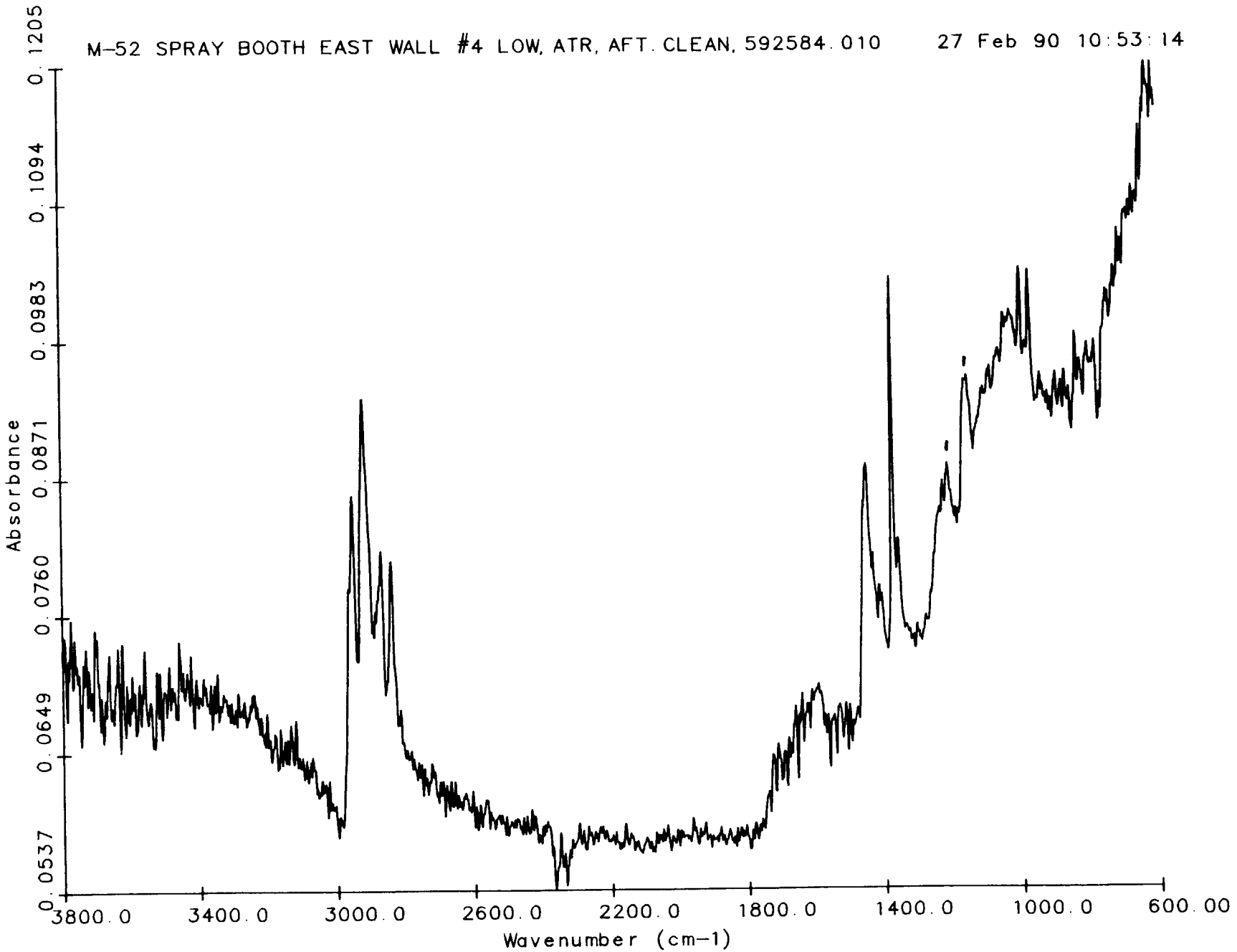

M-52 SPRAY BOOTH EAST WALL #2 HIGH, ATR, AFT. CLEAN, 592584.005
27 Feb 90 09:39:53
Absorbance
0.1603
0.1403
0.1204
0.1004
0.0804
0.0605
0.0405
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

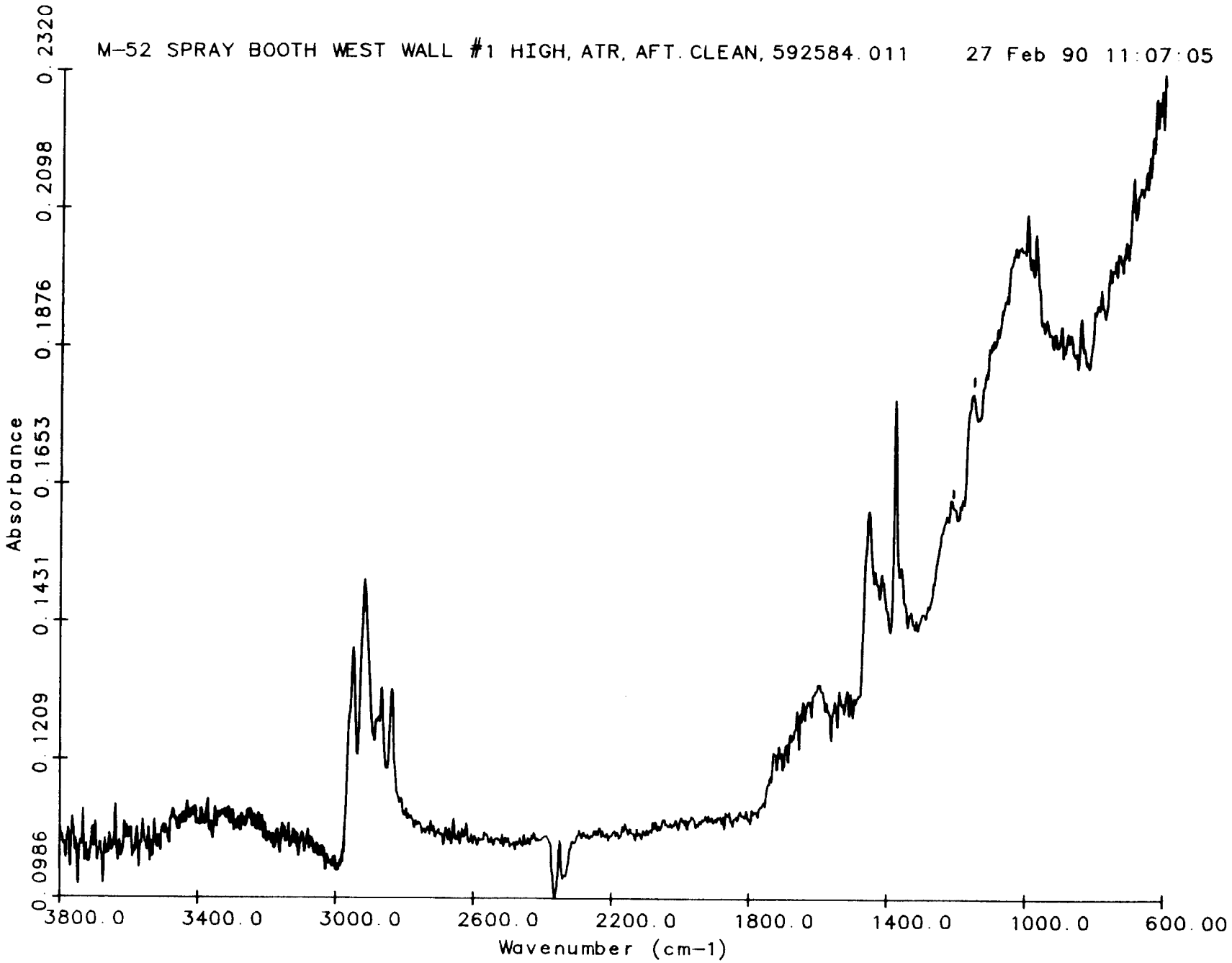

M-52 SPRAY BOOTH EAST WALL #2 LOW, ATR, AFT CLEAN, 592584.006
27 Feb 90 09:48:12
Absorbance
0.1644
0.1551
0.1457
0.1363
0.1270
0.1176
0.1082
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

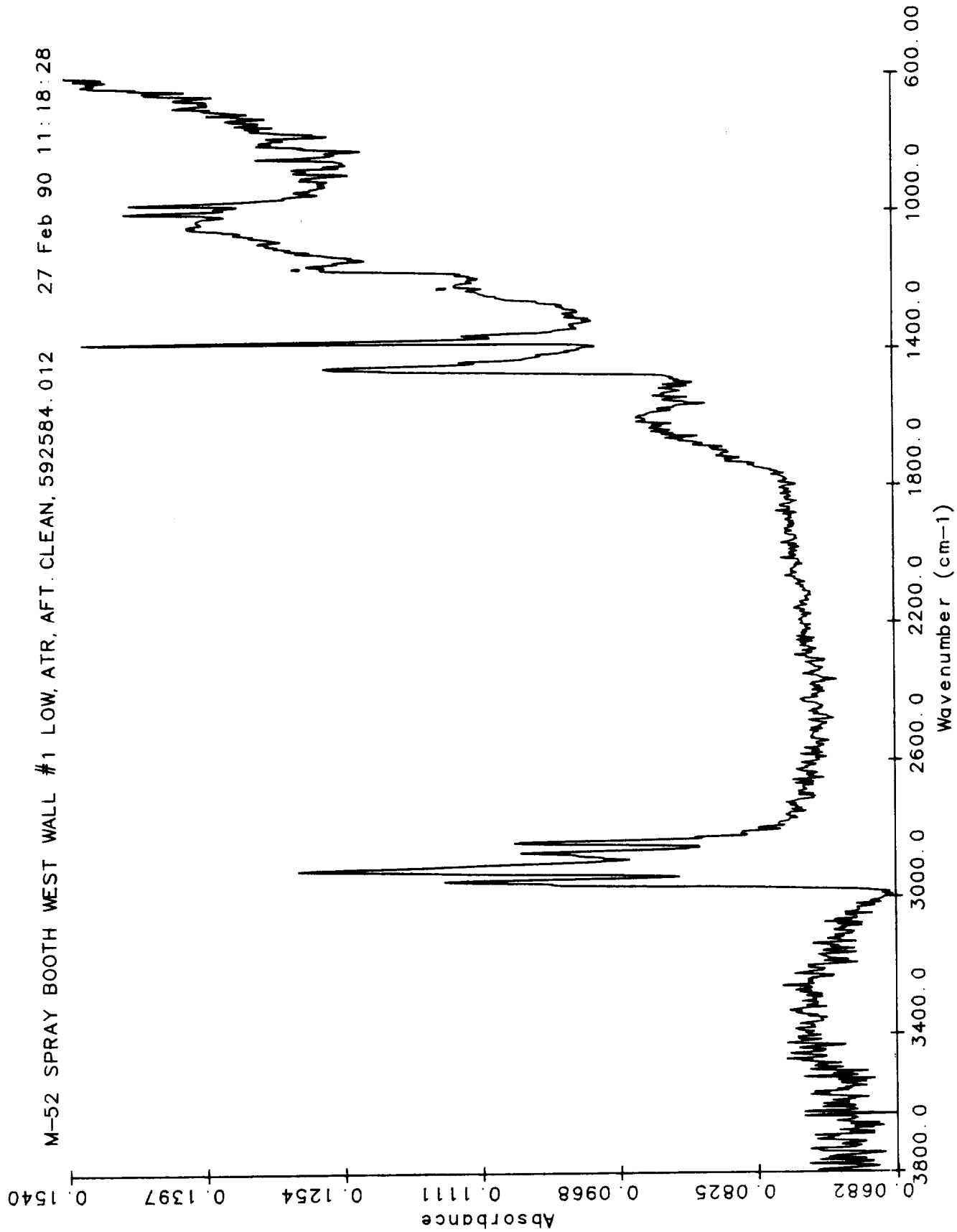

M-52 SPRAY BOOTH EAST WALL #3 HIGH, ATR, AFT. CLEAN, 592584.007
27 Feb 90 09:57:29
Absorbance
0.1686
0.1576
0.1465
0.1354
0.1244
0.1133
0.1022
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

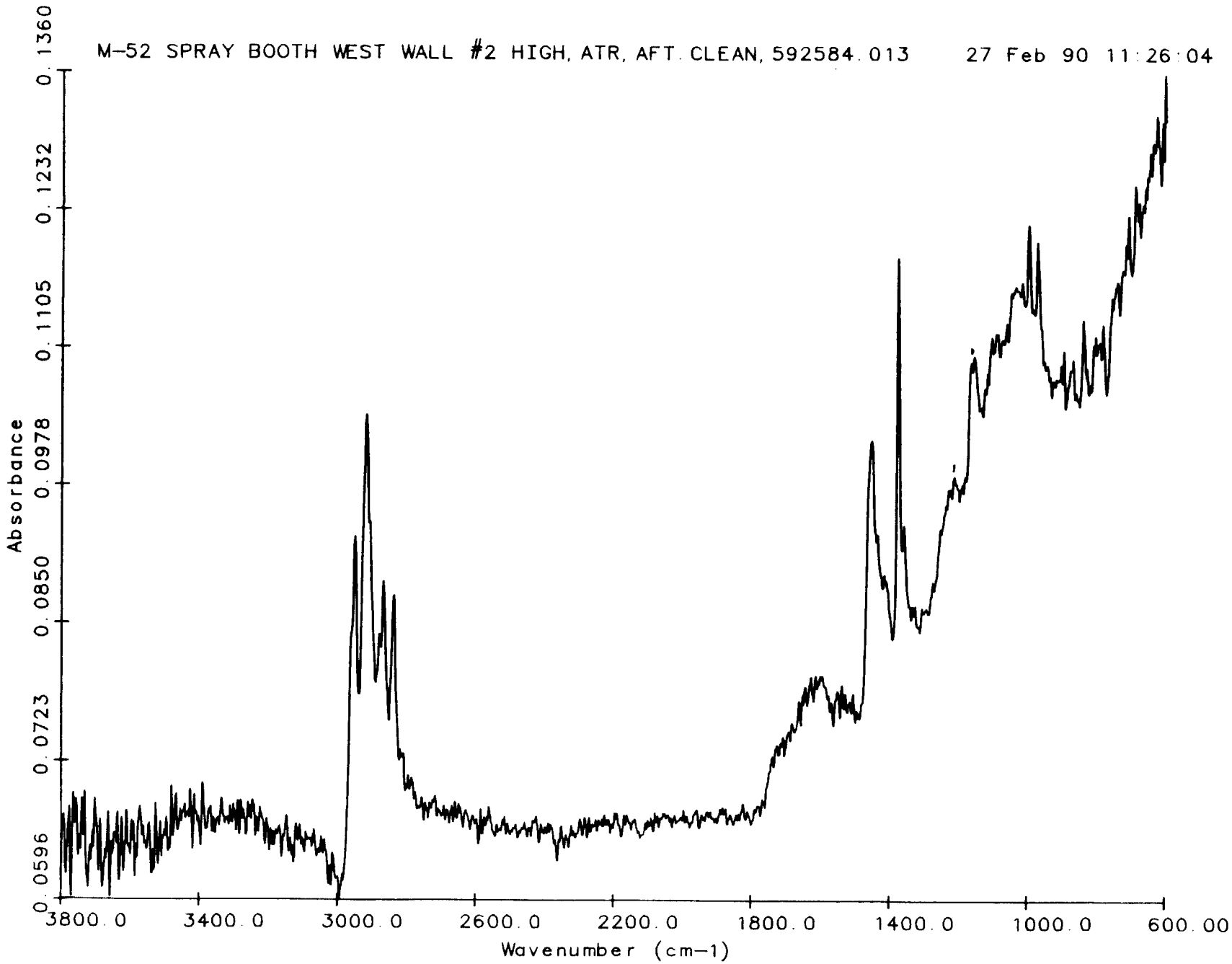

M-52 SPRAY BOOTH EAST WALL #3 LOW, ATR, AFT. CLEAN, 592584.008
27 Feb 90 10:06:10
Absorbance
0.1195
0.1088
0.0981
0.0875
0.0768
0.0662
0.0555
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

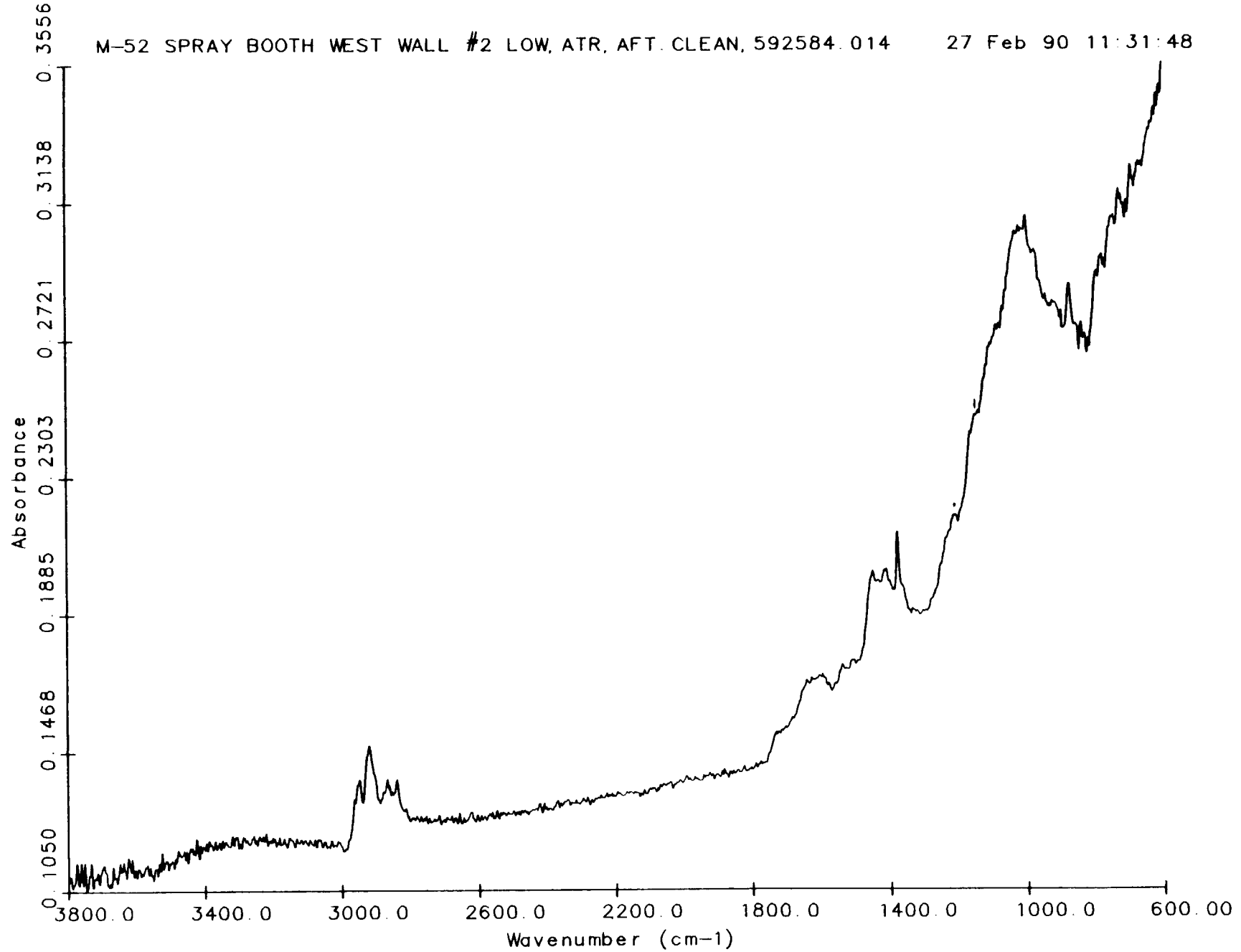

M-52 SPRAY BOOTH EAST WALL #4 HIGH, ATR, AFT. CLEAN, 592584.009
27 Feb 90 10:42:03
Absorbance
0.1825
0.1643
0.1461
0.1280
0.1098
0.0916
0.0734
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

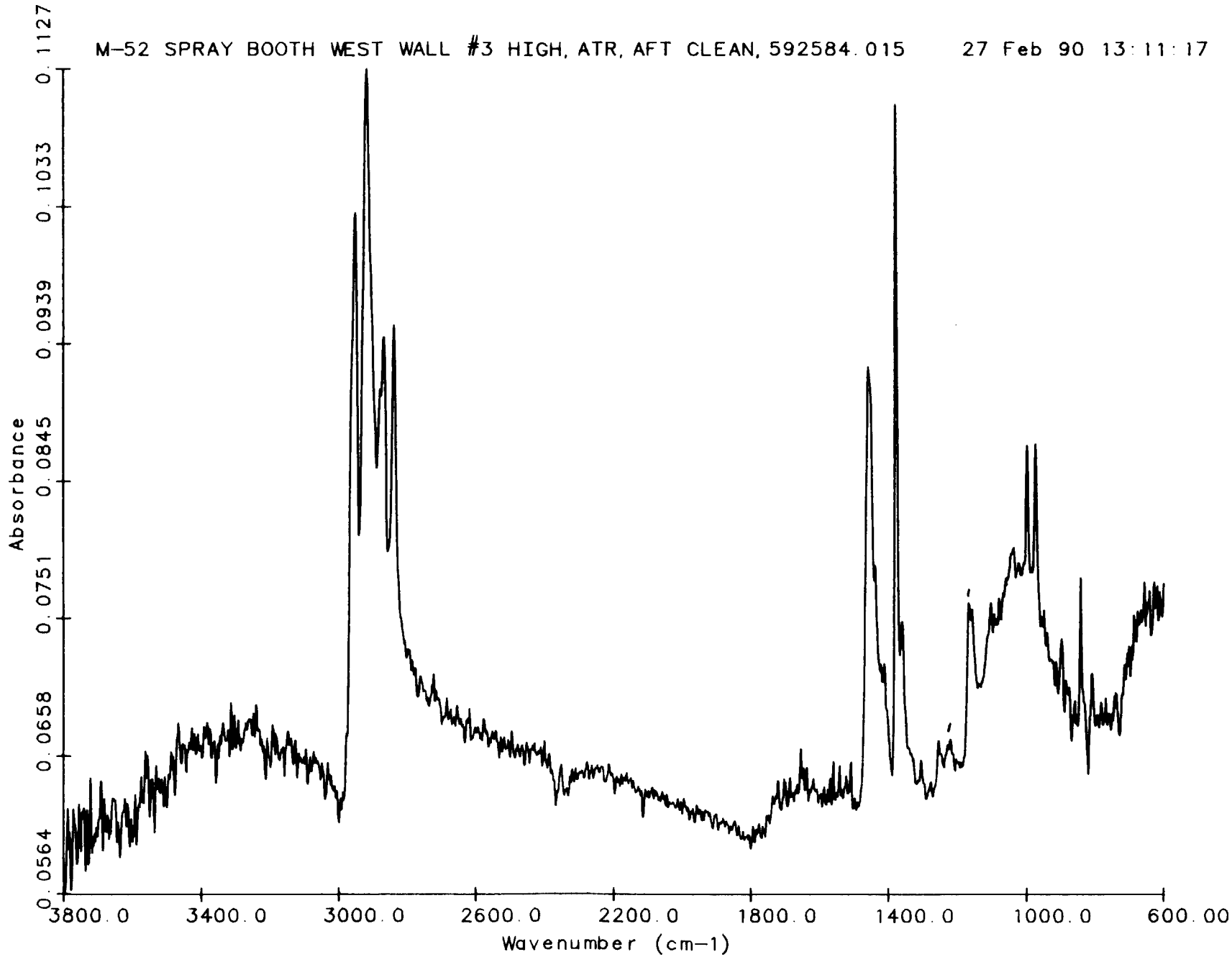

M-52 SPRAY BOOTH EAST WALL #4 LOW, ATR, AFT. CLEAN, 592584.010
27 Feb 90 10:53:14
Absorbance
0.1205
0.1094
0.0983
0.0871
0.0760
0.0649
0.0537
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

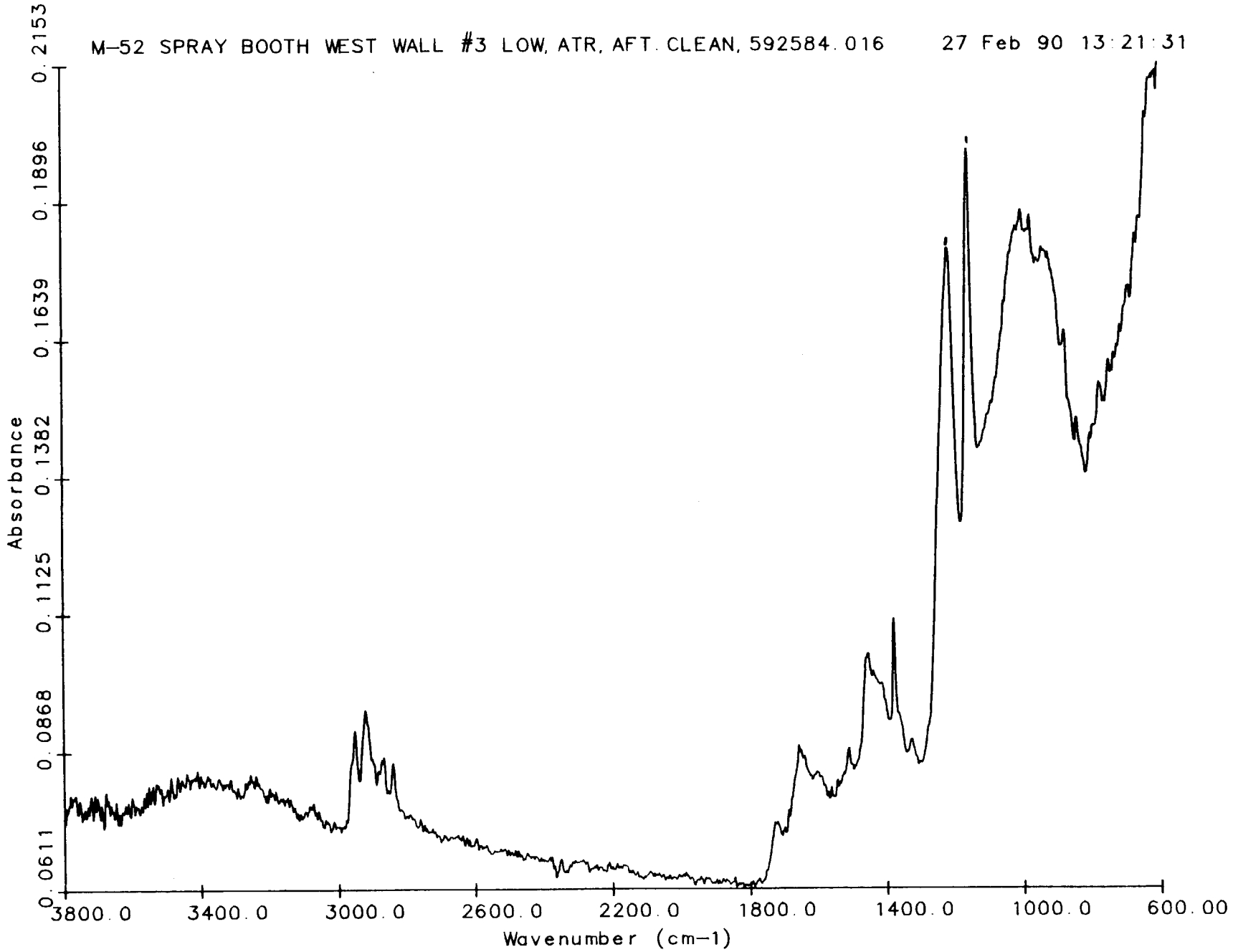

M-52 SPRAY BOOTH WEST WALL #1 HIGH, ATR, AFT. CLEAN, 592584.011
27 Feb 90 11:07:05
Absorbance
0.2320
0.2098
0.1876
0.1653
0.1431
0.1209
0.0986
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

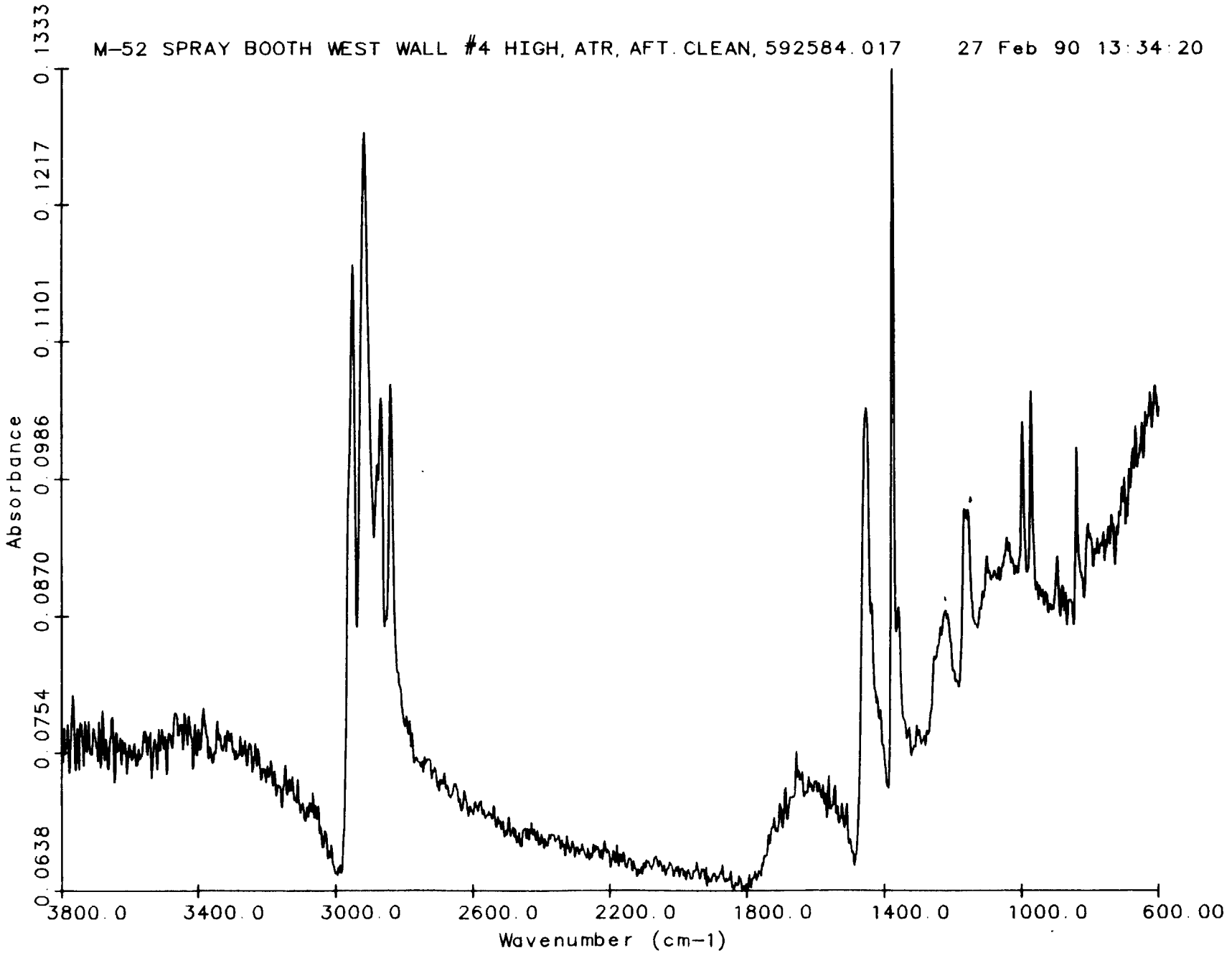

M-52 SPRAY BOOTH WEST WALL #1 LOW, ATR, AFT. CLEAN, 592584.012 27 Feb 90 11:18:28
Absorbance
0.0682
0.0825
0.0968
0.1111
0.1254
0.1397
0.1540
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

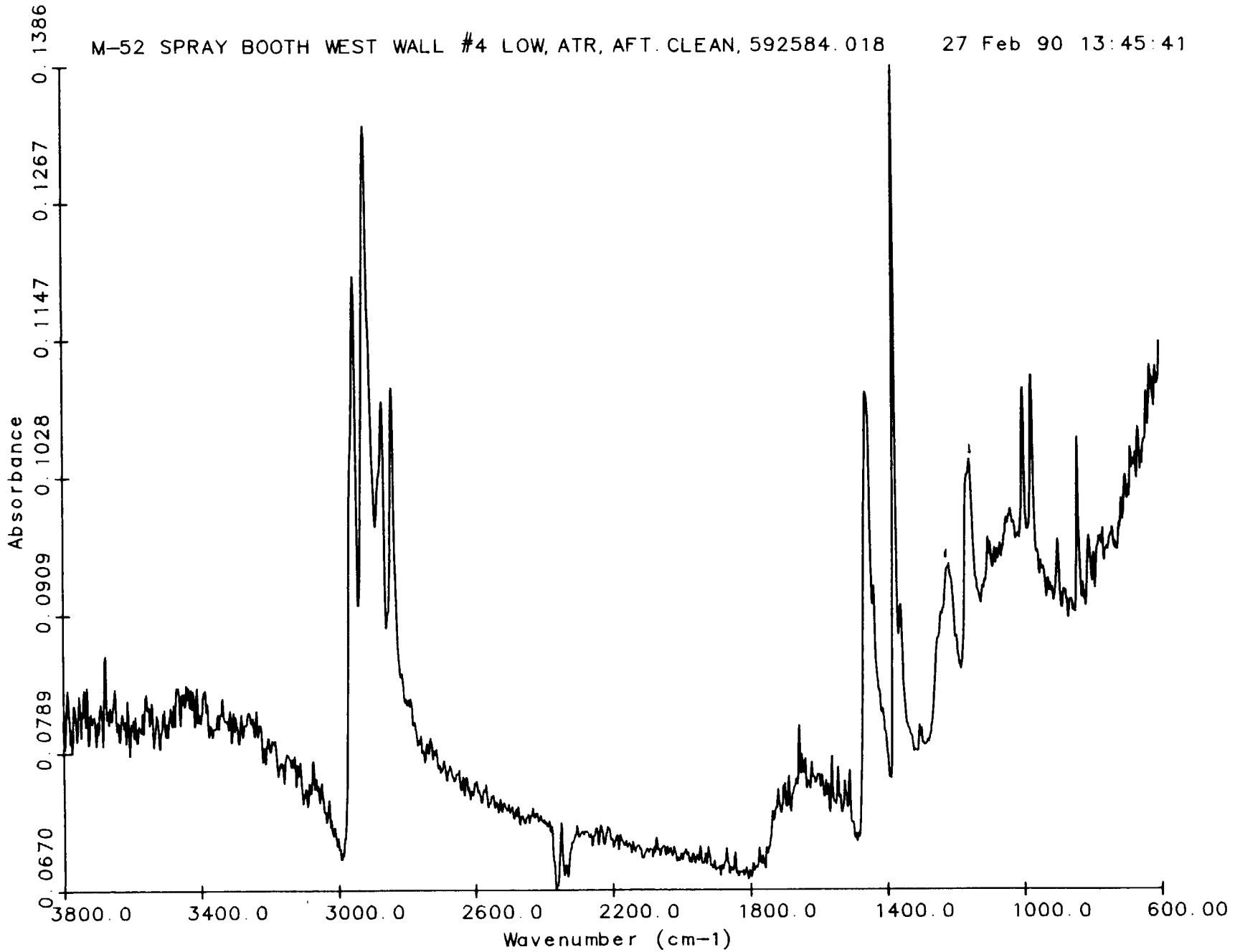

M-52 SPRAY BOOTH WEST WALL #2 HIGH, ATR, AFT. CLEAN, 592584.013
27 Feb 90 11:26:04
Absorbance
0.1360
0.1232
0.1105
0.0978
0.0850
0.0723
0.0596
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

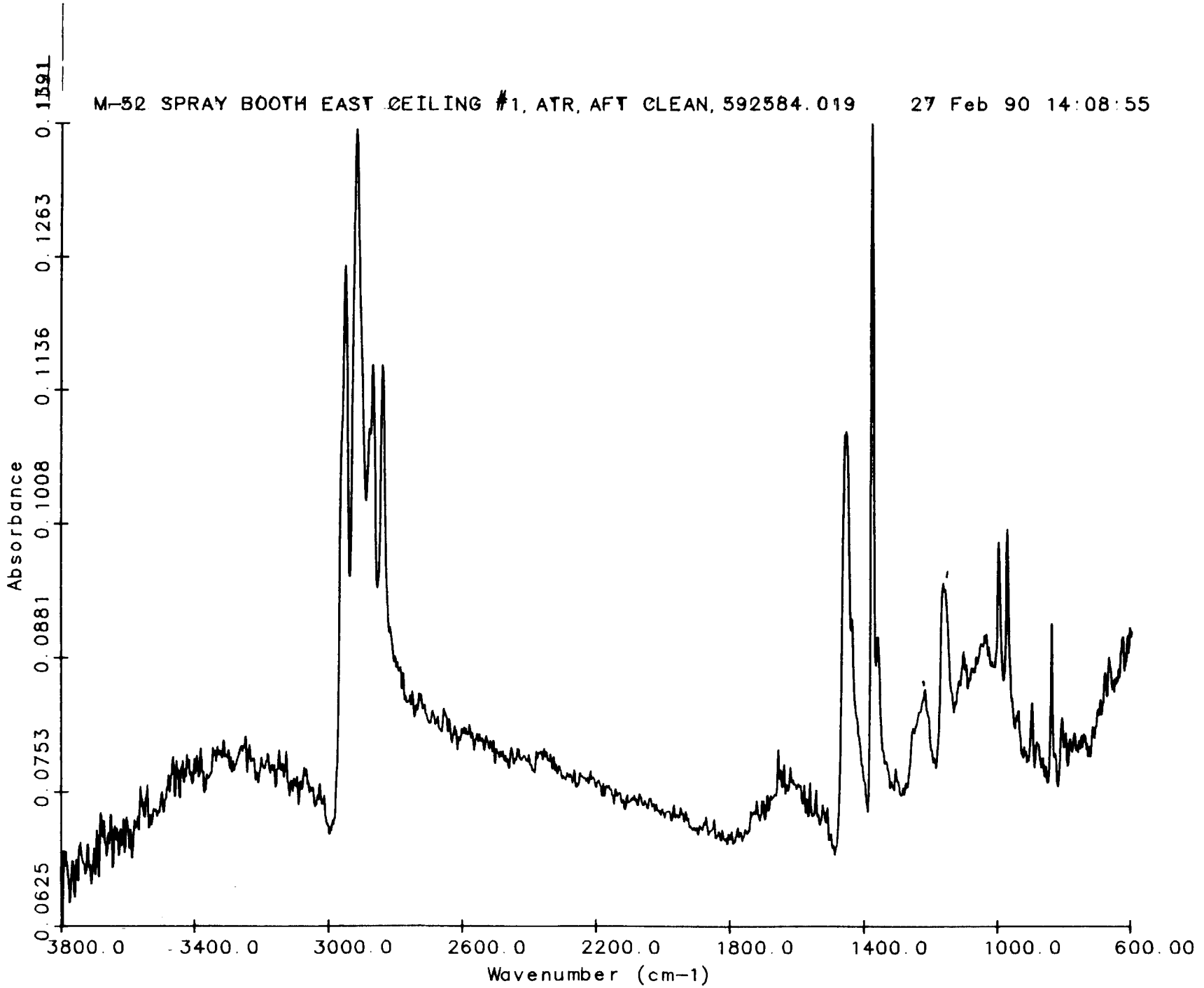

M-52 SPRAY BOOTH WEST WALL #2 LOW, ATR, AFT. CLEAN, 592584.014
27 Feb 90 11:31:48
Absorbance
0.3556
0.3138
0.2721
0.2303
0.1885
0.1468
0.1050
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

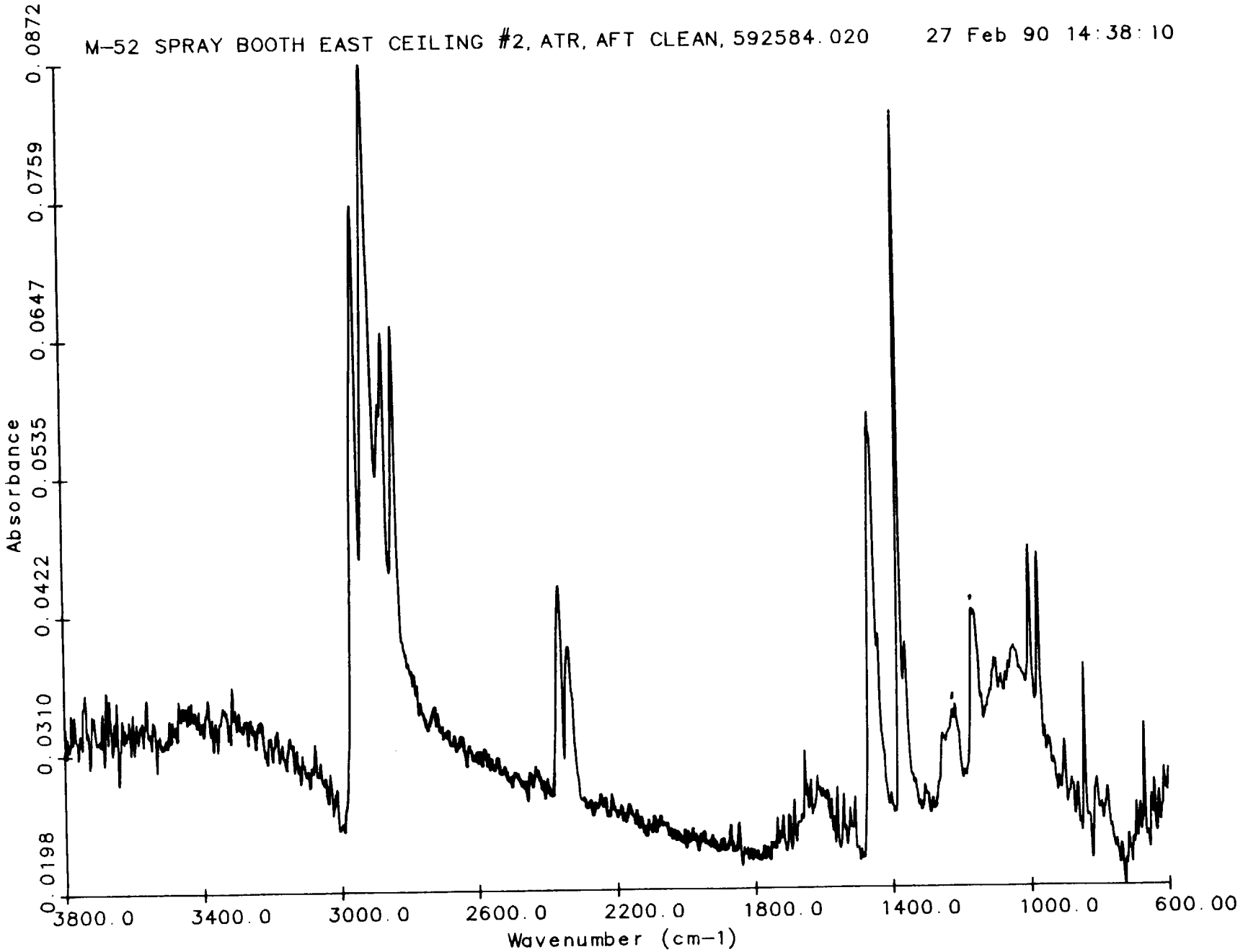

M-52 SPRAY BOOTH WEST WALL #3 HIGH, ATR, AFT CLEAN, 592584.015 27 Feb 90 13:11:17
Absorbance
0.1127
0.1033
0.0939
0.0845
0.0751
0.0658
0.0564
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

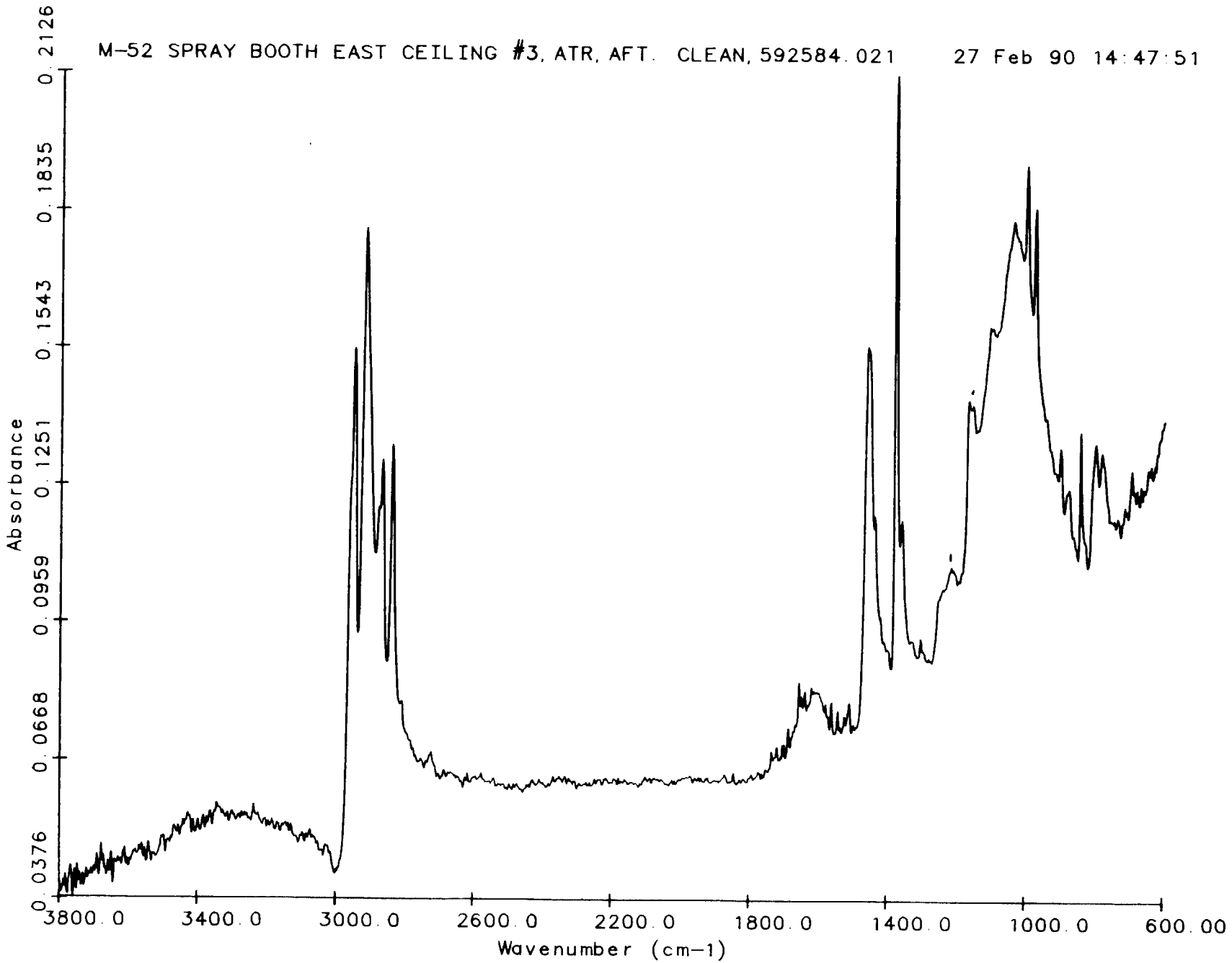

M-52 SPRAY BOOTH WEST WALL #3 LOW, ATR, AFT. CLEAN, 592584.016
27 Feb 90 13:21:31
Absorbance
0.2153
0.1896
0.1639
0.1382
0.1125
0.0868
0.0611
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

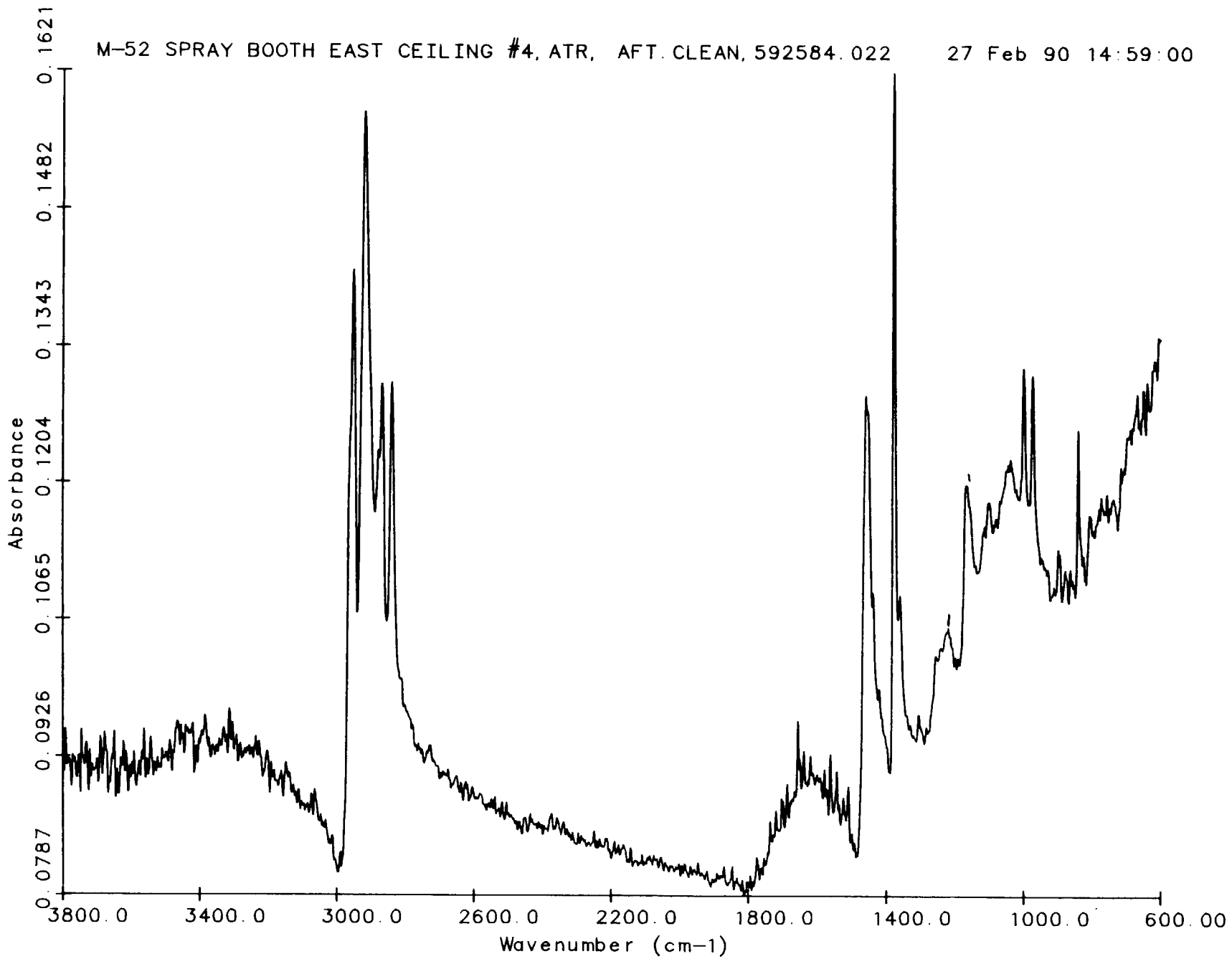

M-52 SPRAY BOOTH WEST WALL #4 HIGH, ATR, AFT. CLEAN, 592584.017
27 Feb 90 13:34:20
Absorbance
0.1333
0.1217
0.1101
0.0986
0.0870
0.0754
0.0638
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

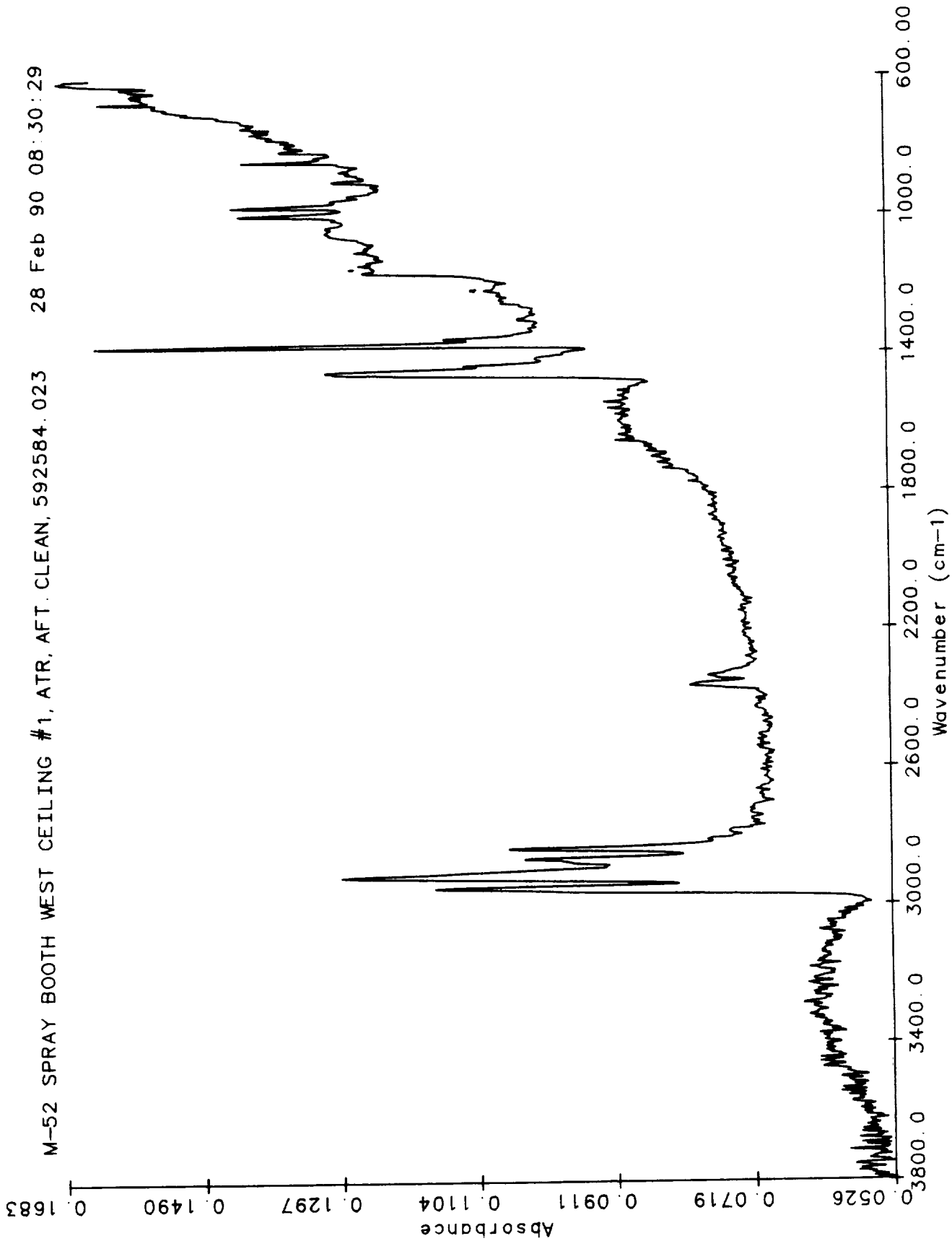

M-52 SPRAY BOOTH WEST WALL #4 LOW, ATR, AFT. CLEAN, 592584.018
27 Feb 90 13:45:41
Absorbance
0.1386
0.1267
0.1147
0.1028
0.0909
0.0789
0.0670
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

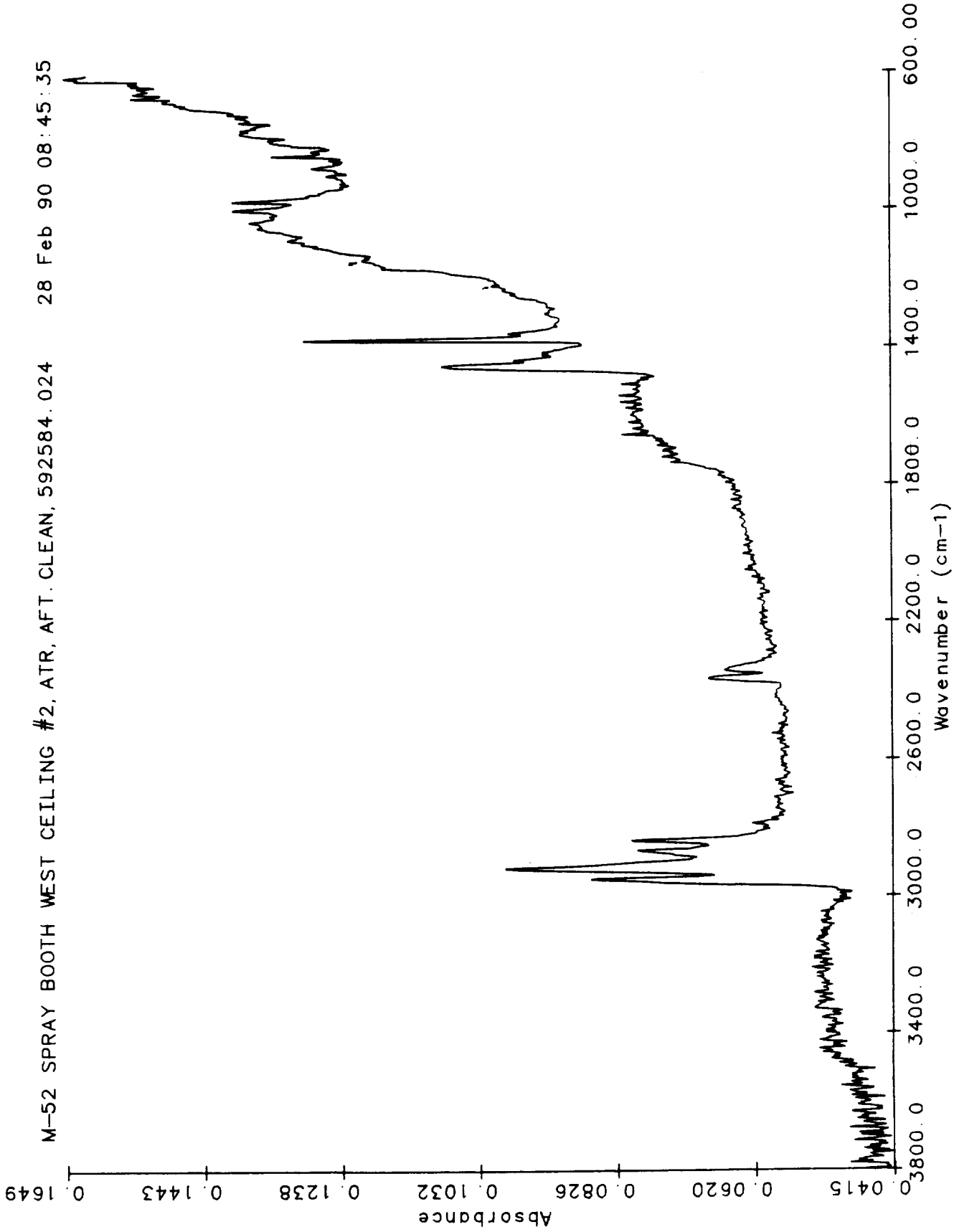

M-52 SPRAY BOOTH EAST CEILING #1, ATR, AFT CLEAN, 592584.019
27 Feb 90 14:08:55
Absorbance
0.1391
0.1263
0.1136
0.1008
0.0881
0.0753
0.0625
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

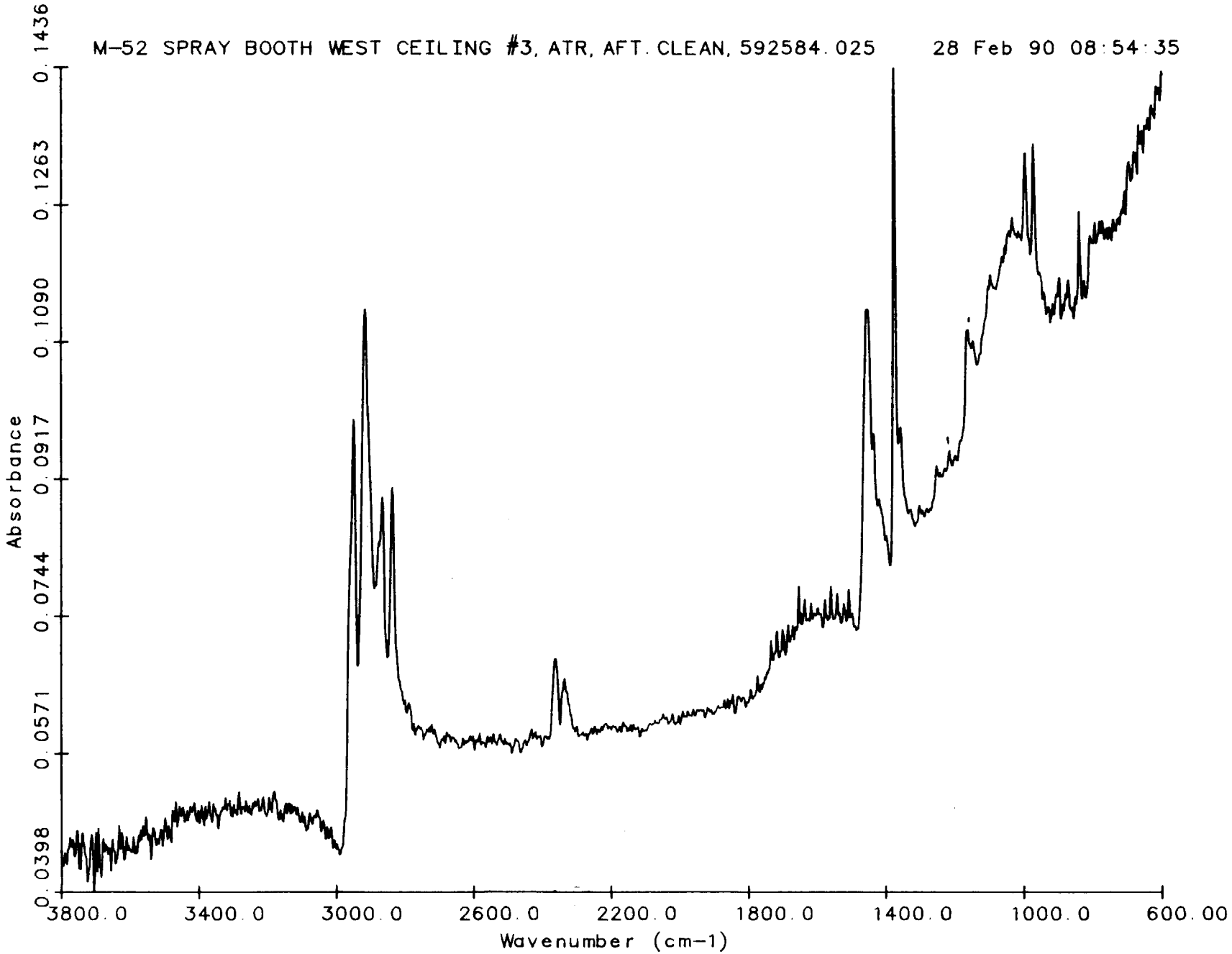

M-52 SPRAY BOOTH EAST CEILING #2, ATR, AFT CLEAN, 592584.020
27 Feb 90 14:38:10
Absorbance
0.0872
0.0759
0.0647
0.0535
0.0422
0.0310
0.0198
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

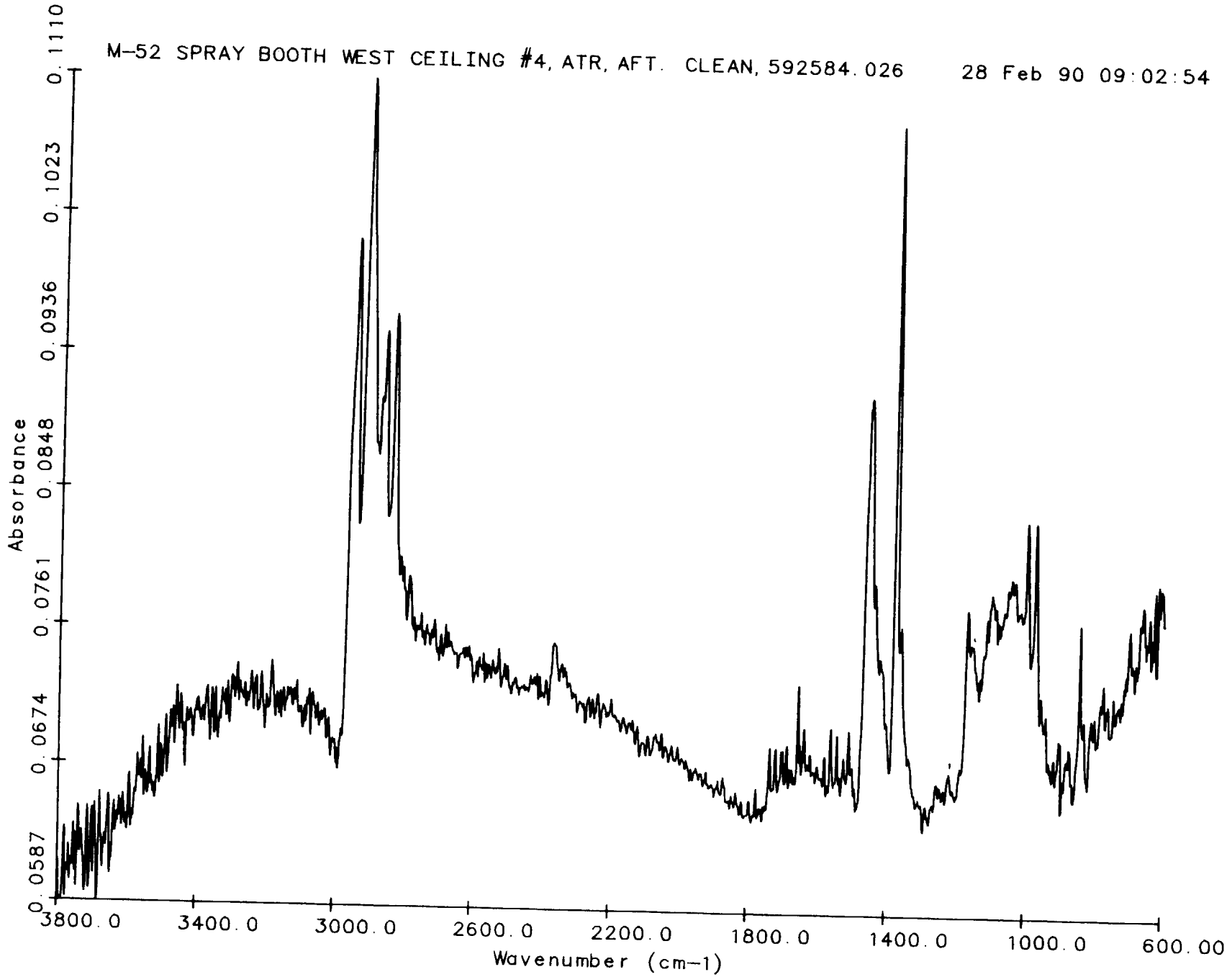

M-52 SPRAY BOOTH EAST CEILING #3, ATR, AFT. CLEAN, 592584.021
27 Feb 90 14:47:51
Absorbance
0.2126
0.1835
0.1543
0.1251
0.0959
0.0668
0.0376
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH EAST CEILING #4, ATR, AFT. CLEAN, 592584.022
27 Feb 90 14:59:00
Absorbance
0.1621
0.1482
0.1343
0.1204
0.1065
0.0926
0.0787
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH WEST CEILING #1, ATR, AFT. CLEAN, 592584.023
28 Feb 90 08:30:29
Absorbance
0.0526
0.0719
0.0911
0.1104
0.1297
0.1490
0.1683
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

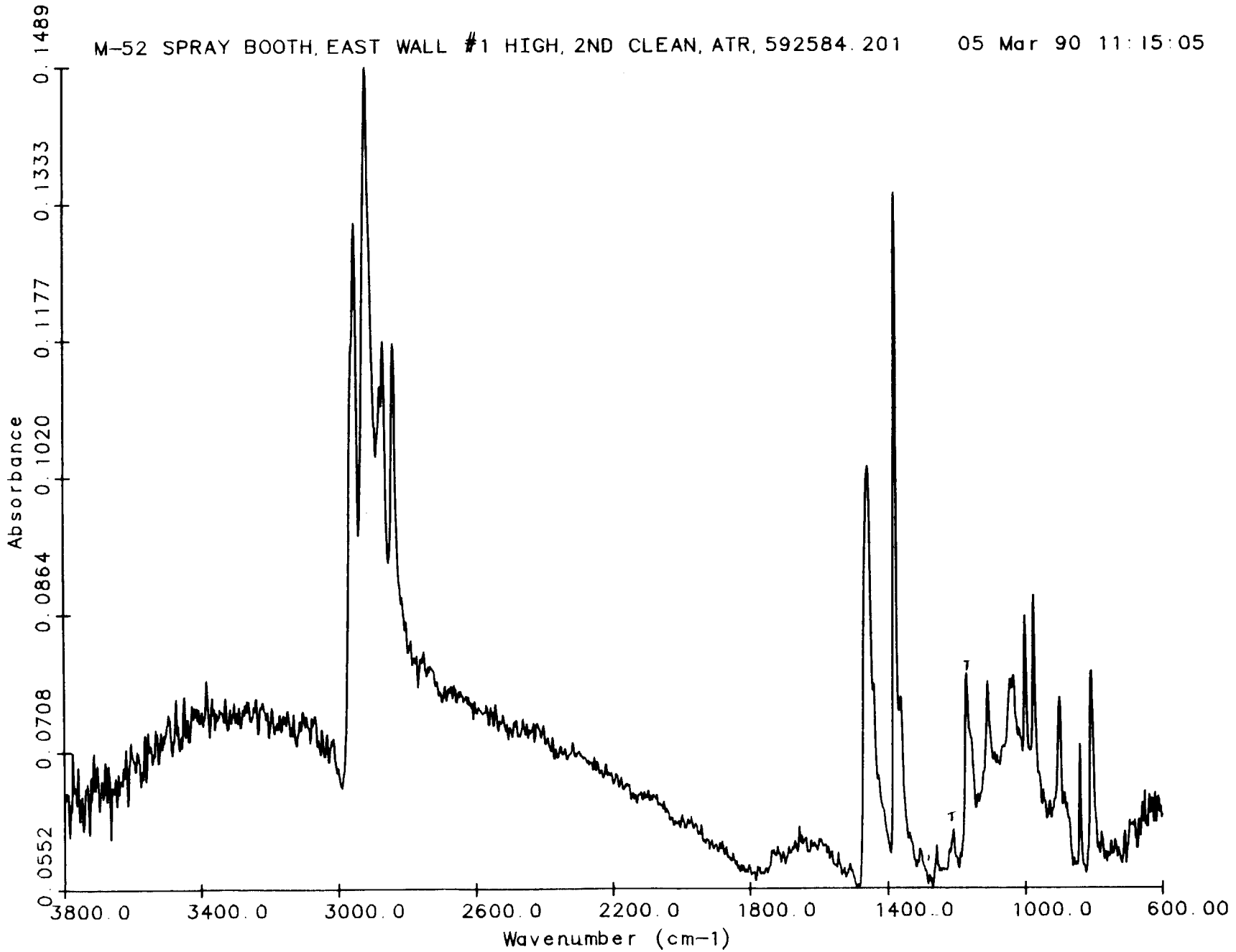

M-52 SPRAY BOOTH WEST CEILING #2, ATR, AFT. CLEAN, 592584.024 28 Feb 90 08:45:35
Absorbance
0.0415
0.0620
0.0826
0.1032
0.1238
0.1443
0.1649
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

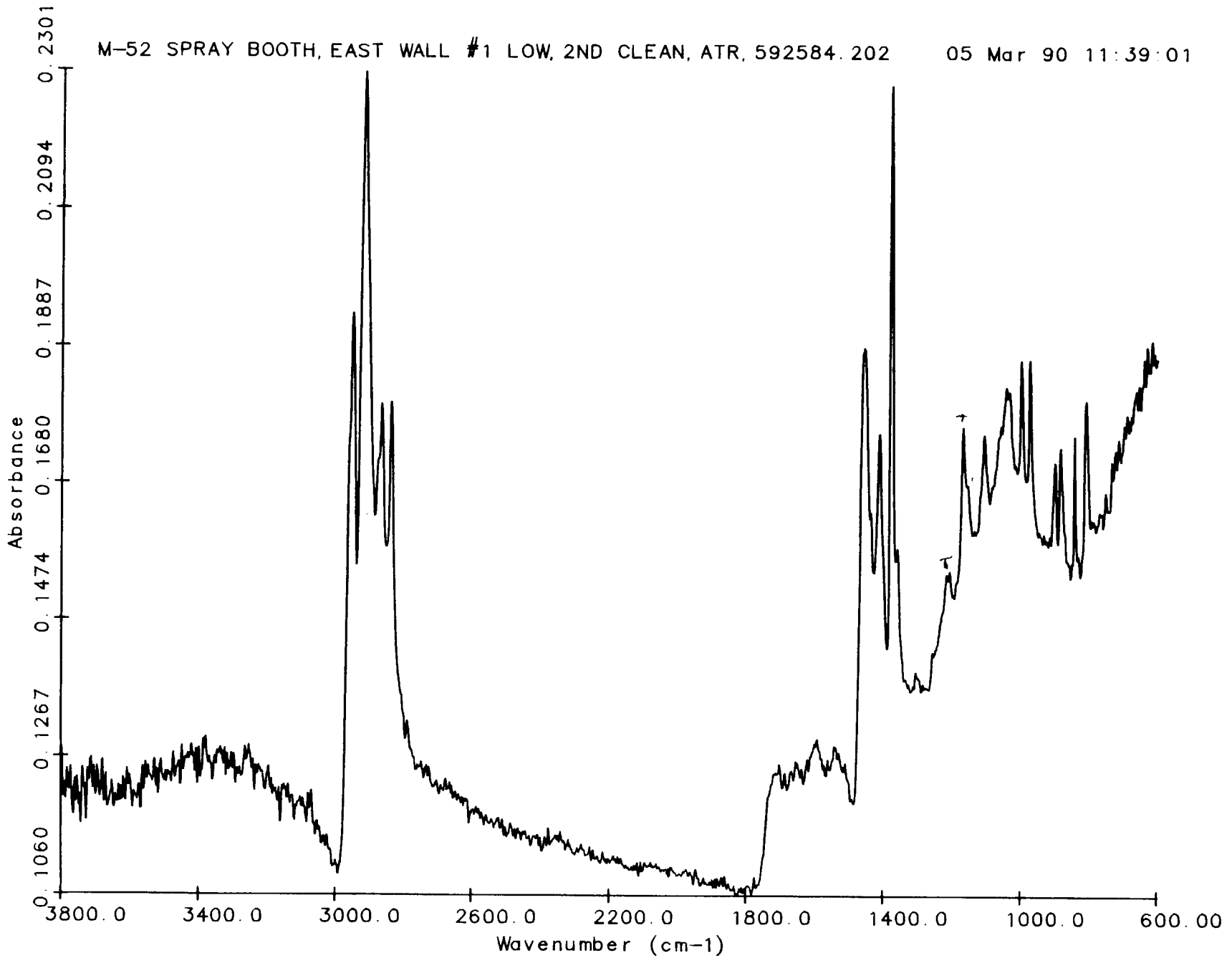

M-52 SPRAY BOOTH WEST CEILING #3, ATR, AFT. CLEAN, 592584.025
28 Feb 90 08:54:35
Absorbance
0.1436
0.1263
0.1090
0.0917
0.0744
0.0571
0.0398
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

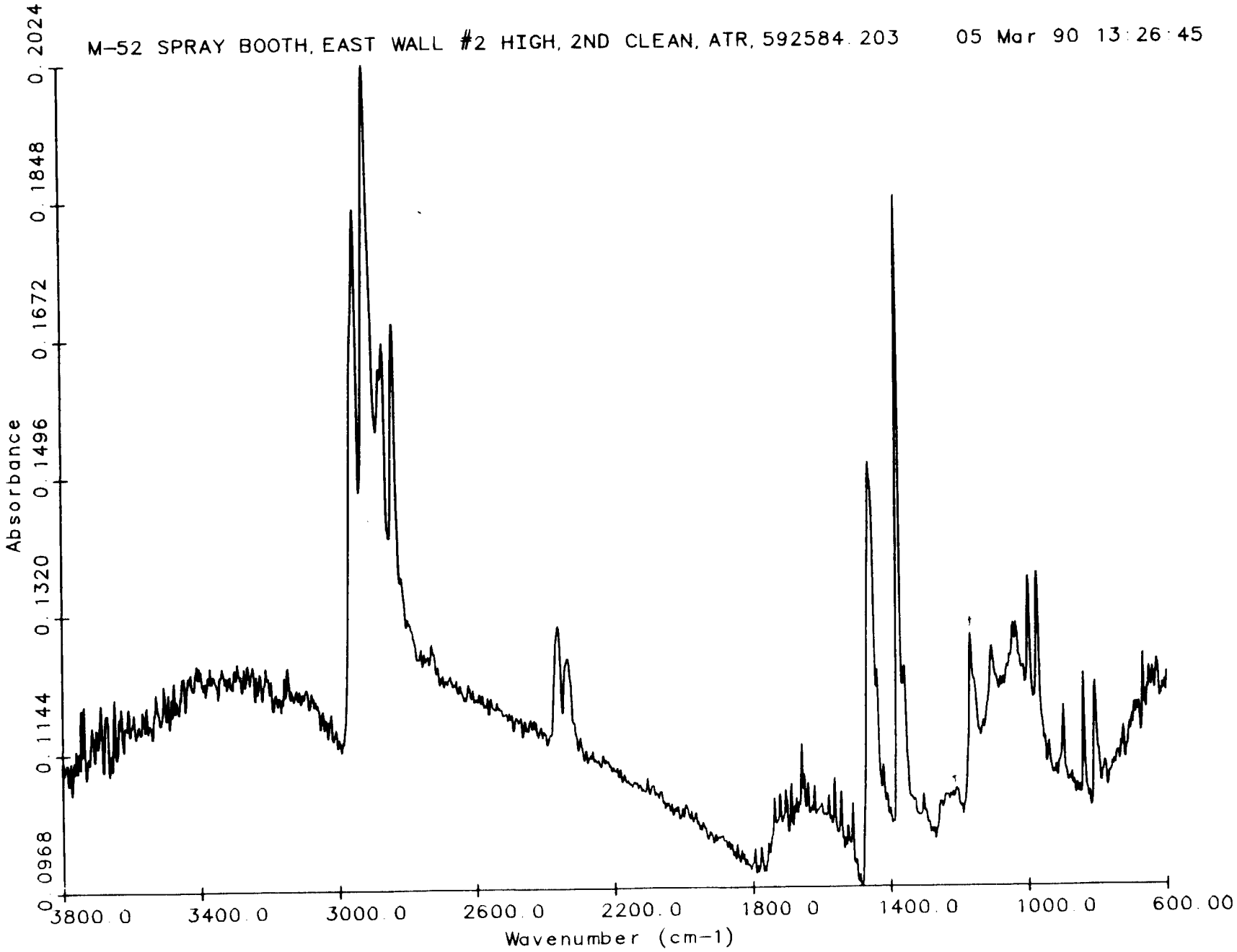

M-52 SPRAY BOOTH WEST CEILING #4, ATR, AFT. CLEAN, 592584.026
28 Feb 90 09:02:54
Absorbance
0.1110
0.1023
0.0936
0.0848
0.0761
0.0674
0.0587
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

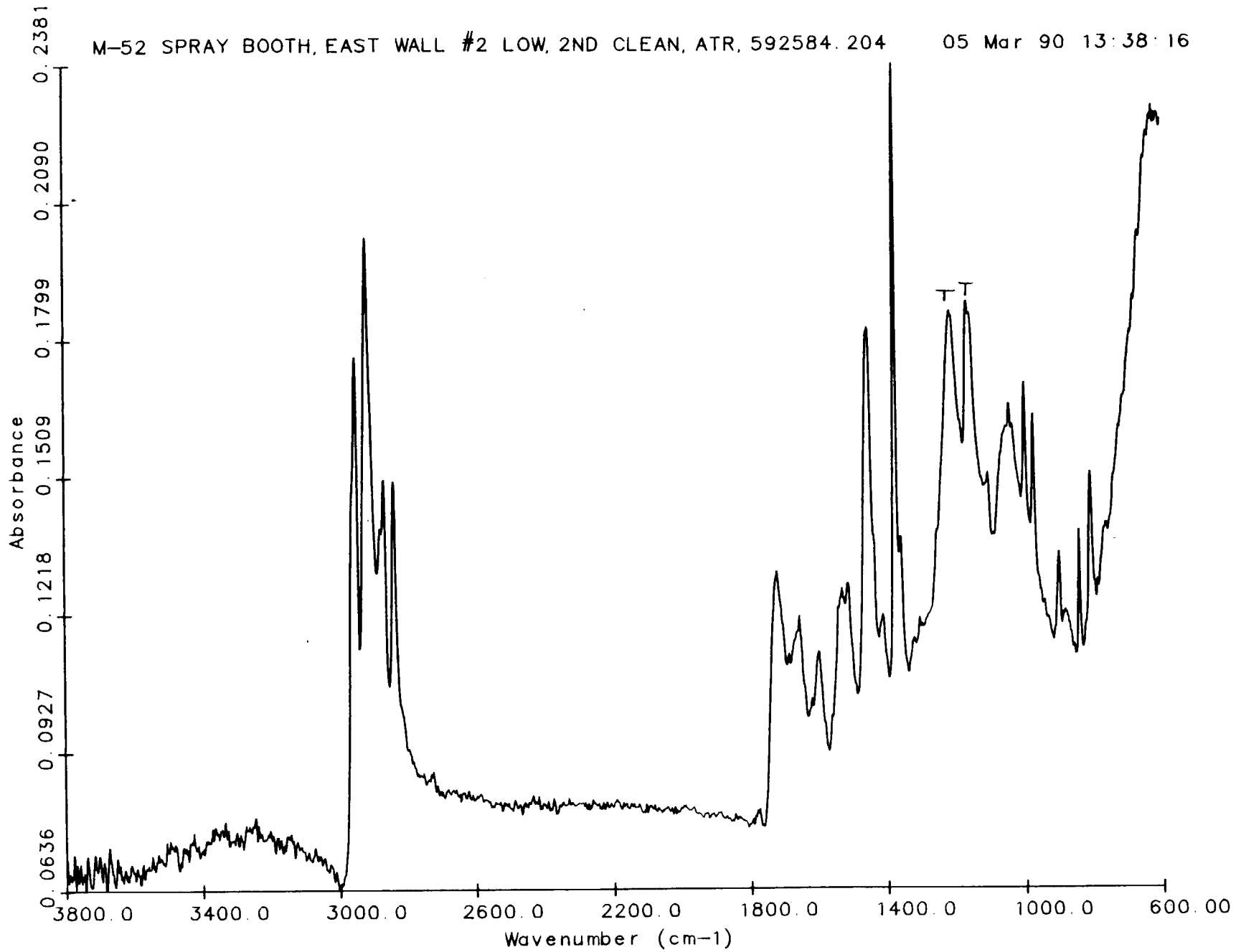
Appendix C

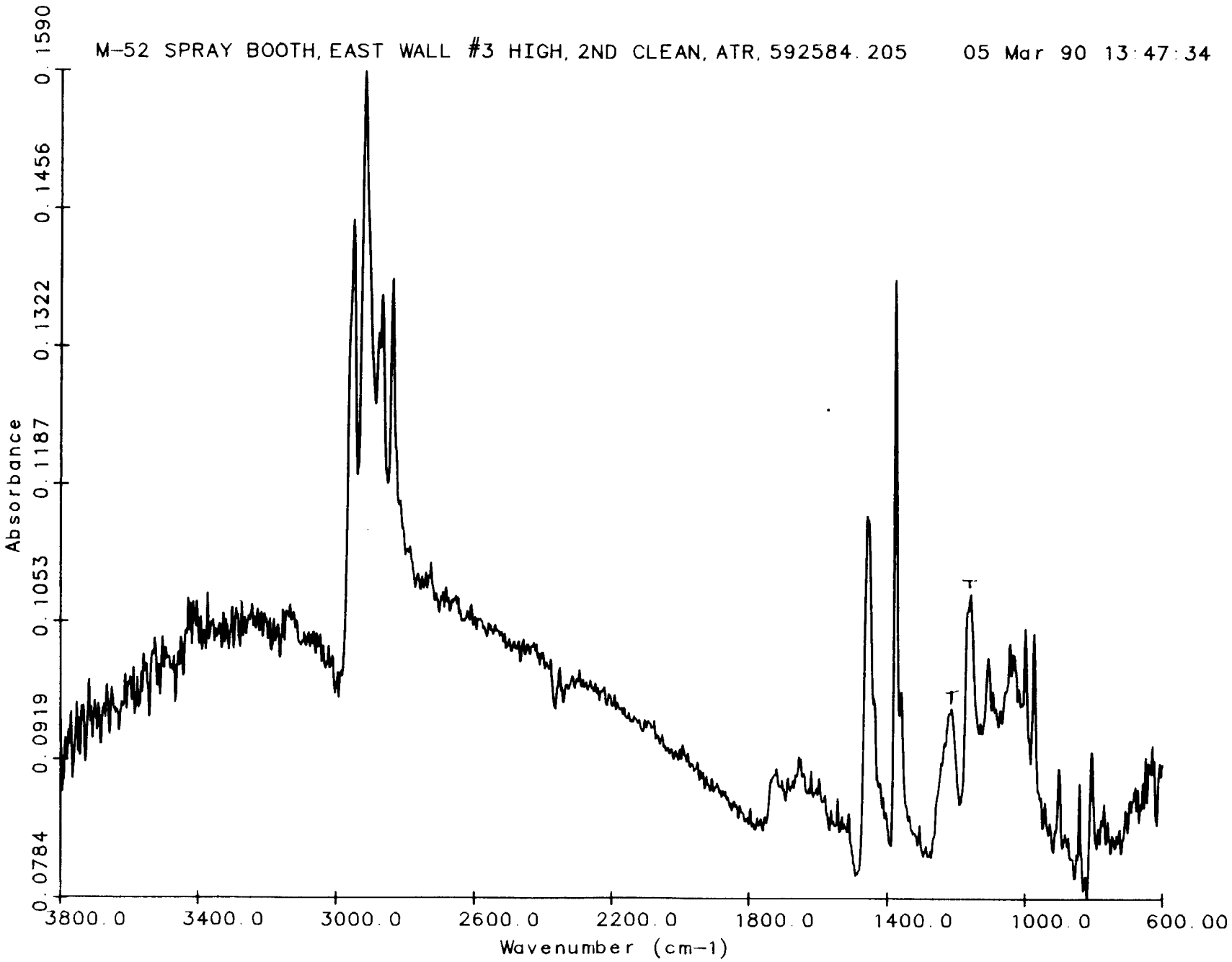
Third FTIR Sample Wipes

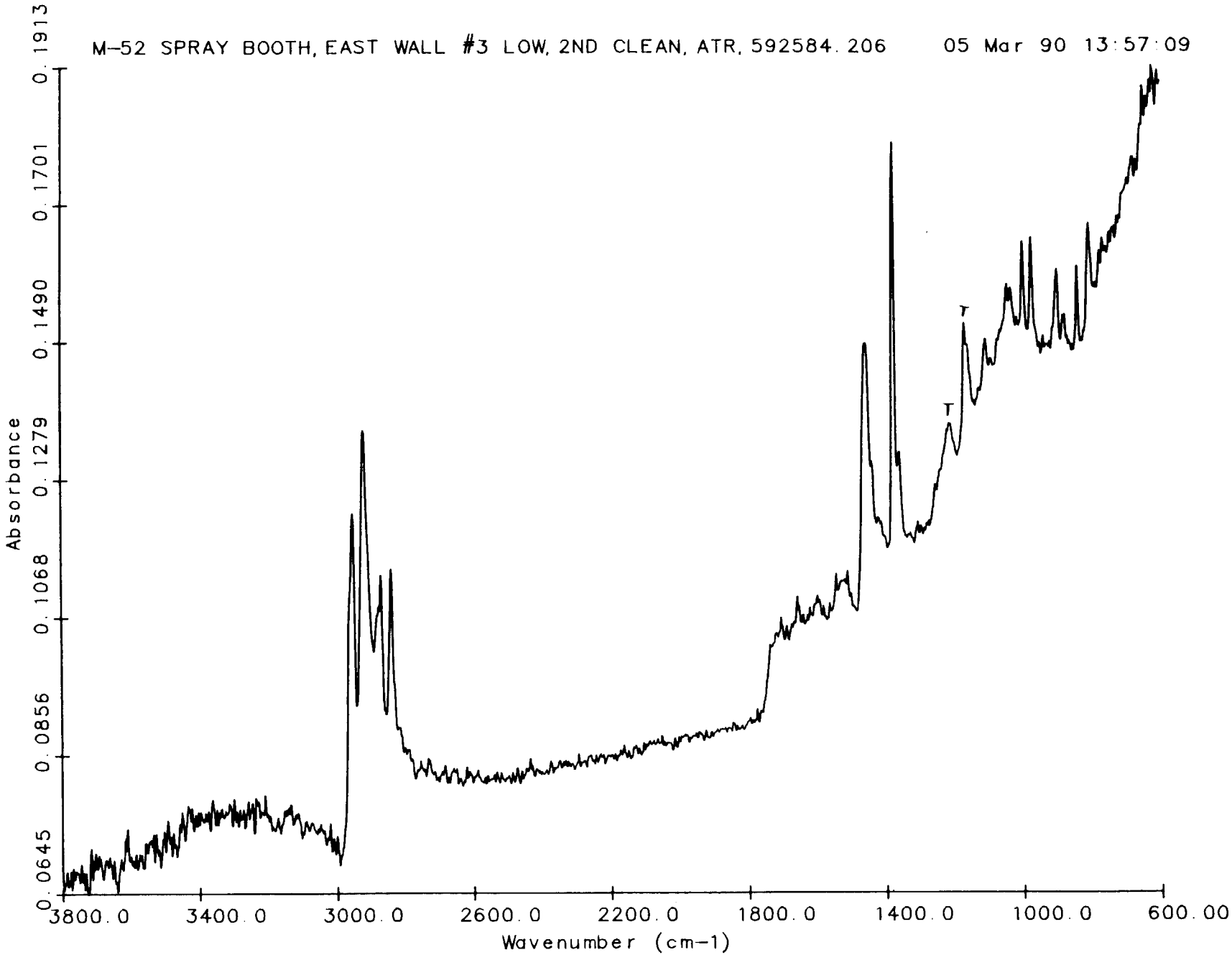

M-52 SPRAY BOOTH, EAST WALL #1 HIGH, 2ND CLEAN, ATR, 592584.201
05 Mar 90 11:15:05
Absorbance
0.1489
0.1333
0.1177
0.1020
0.0864
0.0708
0.0552
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

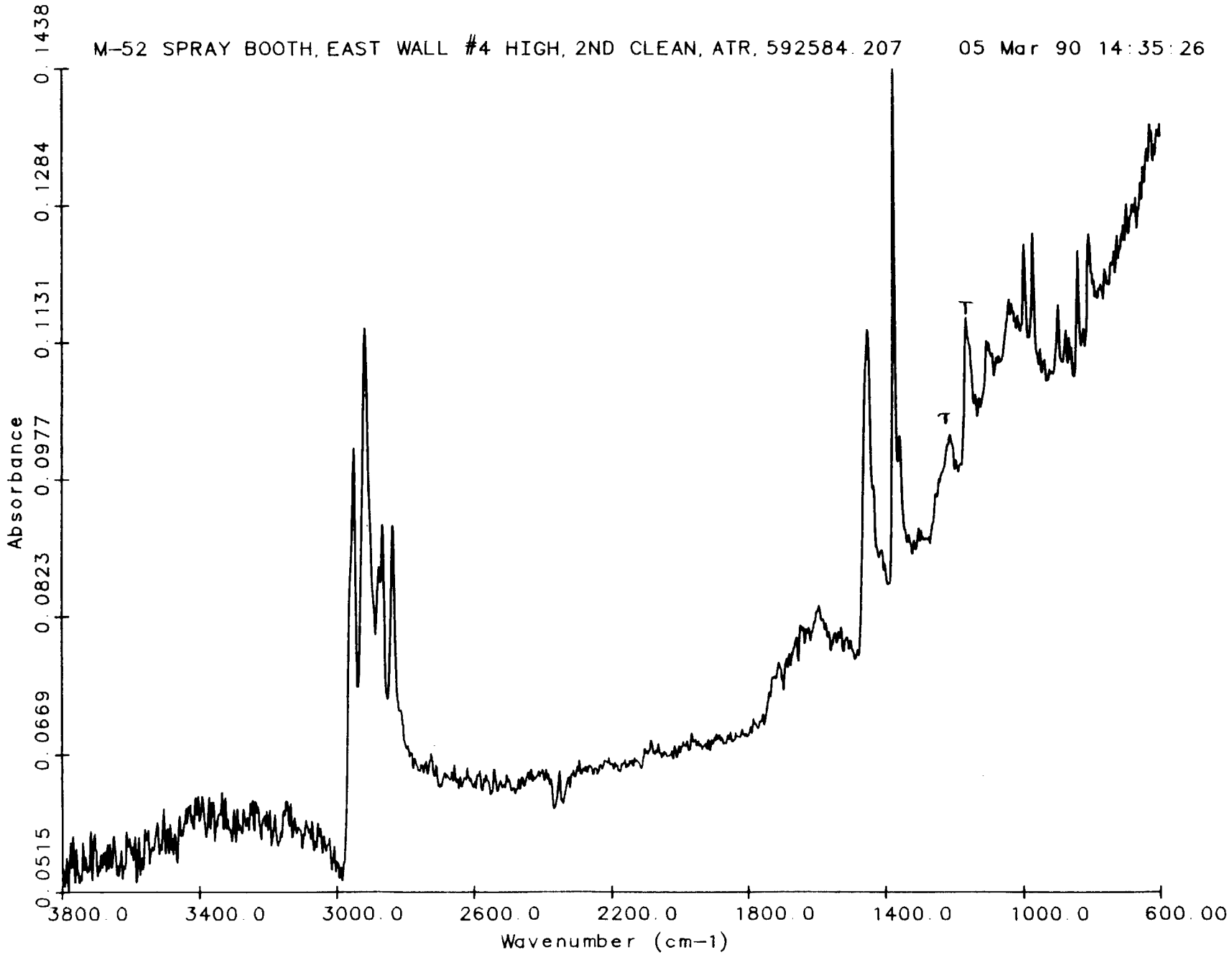

M-52 SPRAY BOOTH, EAST WALL #1 LOW, 2ND CLEAN, ATR, 592584.202
05 Mar 90 11:39:01
Absorbance
0.2301
0.2094
0.1887
0.1680
0.1474
0.1267
0.1060
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

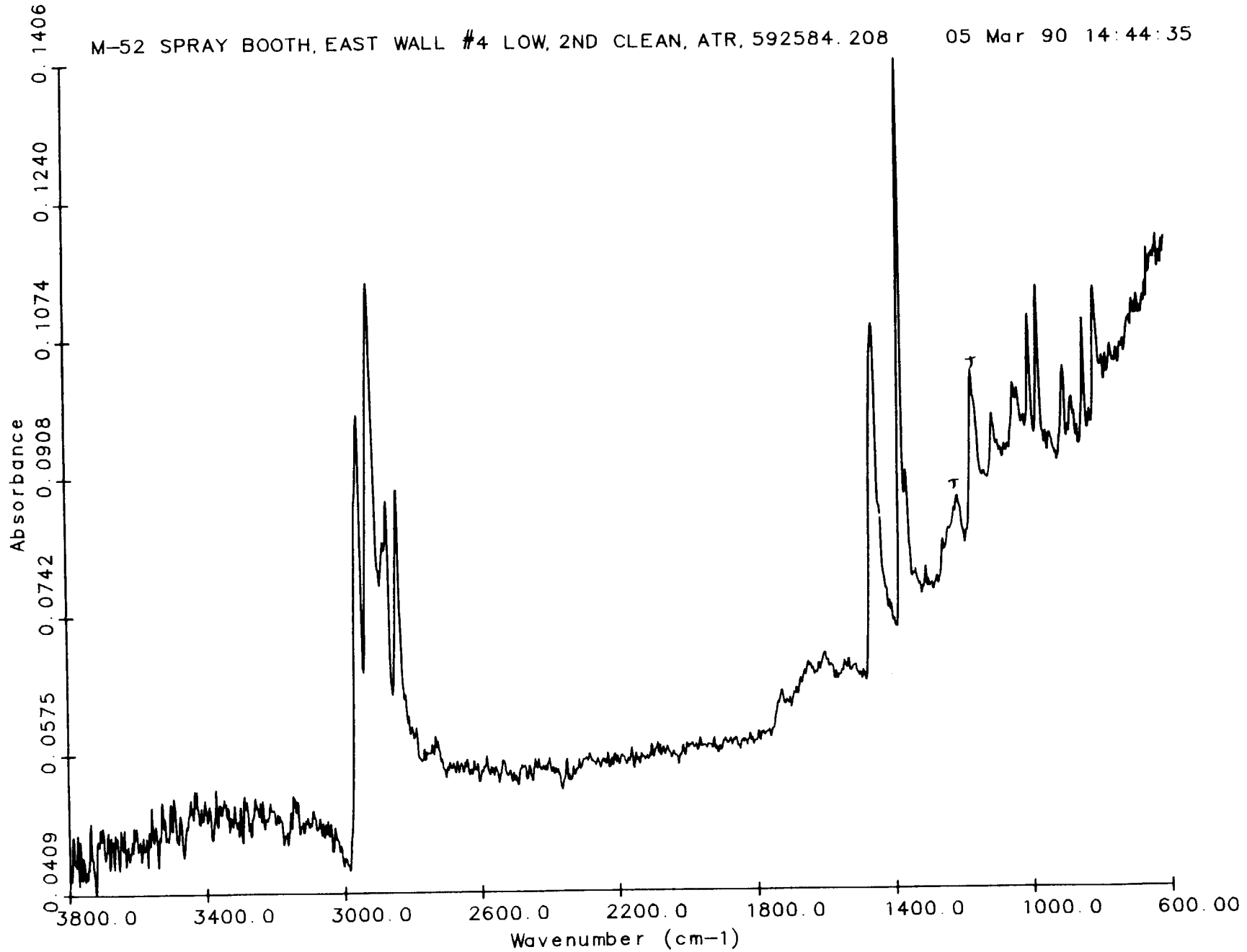

M-52 SPRAY BOOTH, EAST WALL #2 HIGH, 2ND CLEAN, ATR, 592584.203
05 Mar 90 13:26:45
Absorbance
0.2024
0.1848
0.1672
0.1496
0.1320
0.1144
0.0968
0
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

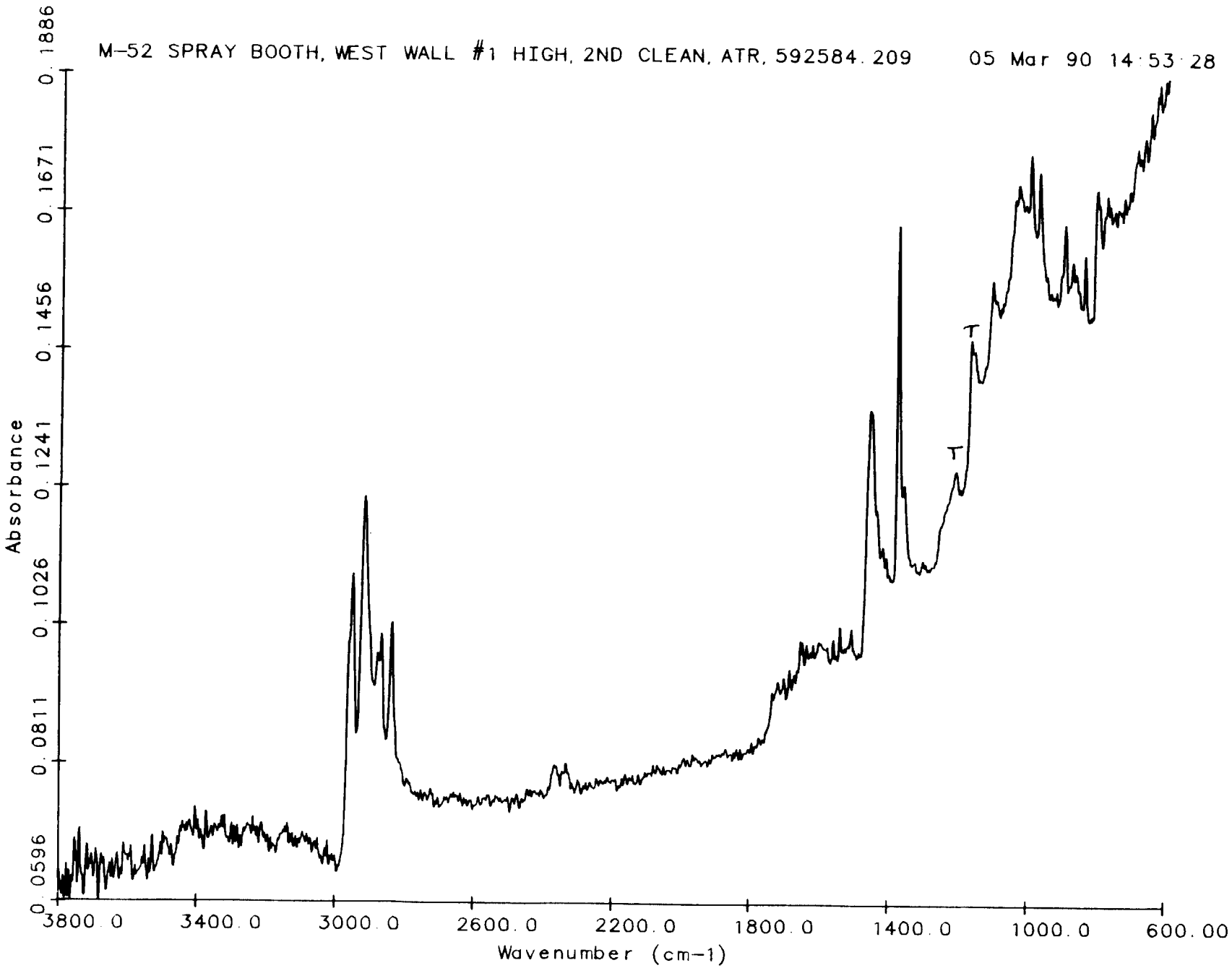

M-52 SPRAY BOOTH, EAST WALL #2 LOW, 2ND CLEAN, ATR, 592584.204
05 Mar 90 13:38:16
Absorbance
0.2381
0.2090
0.1799
0.1509
0.1218
0.0927
0.0636
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

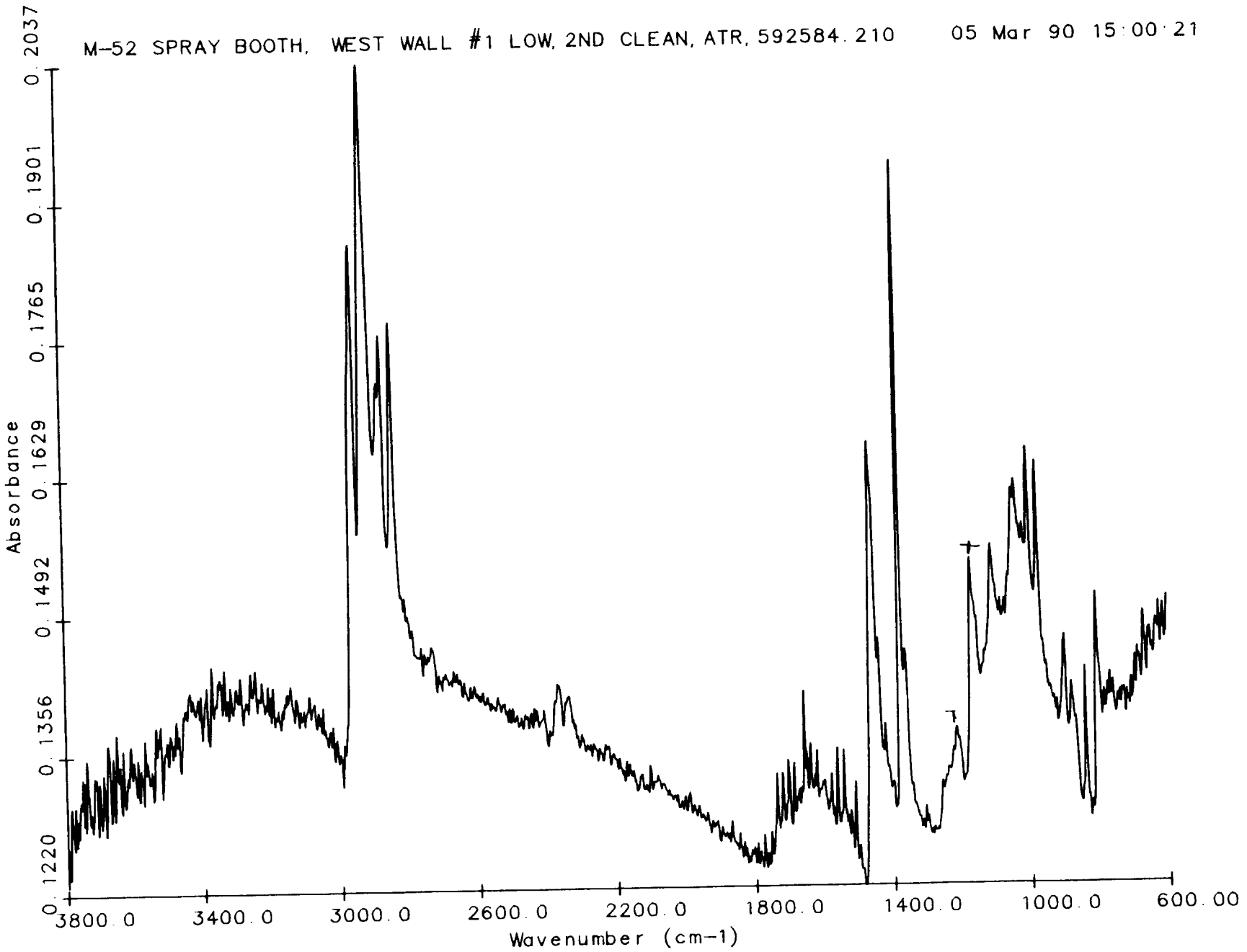

M-52 SPRAY BOOTH, EAST WALL #3 HIGH, 2ND CLEAN, ATR, 592584.205
05 Mar 90 13:47:34
Absorbance
0.1590
0.1456
0.1322
0.1187
0.1053
0.0919
0.0784
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

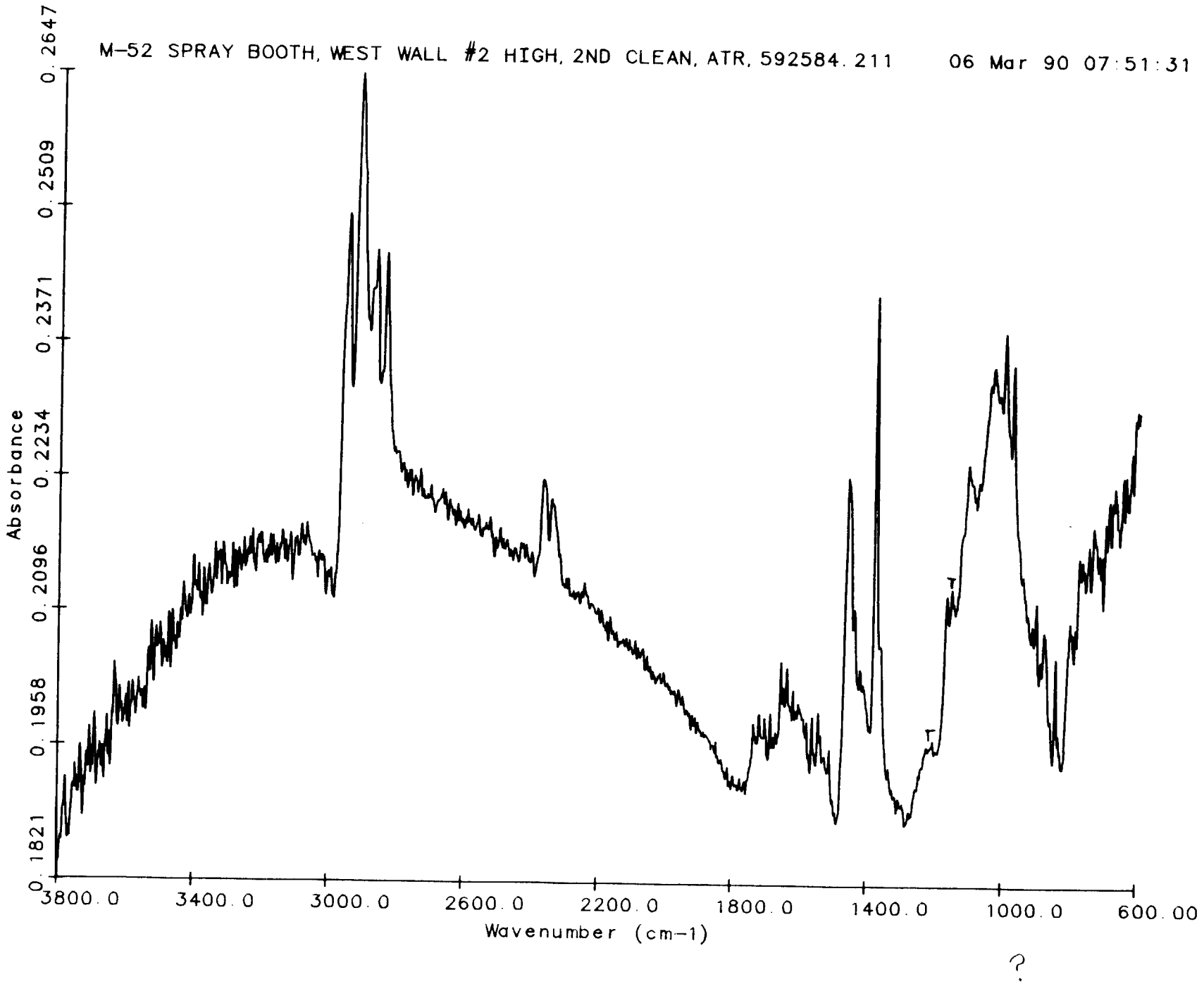

M-52 SPRAY BOOTH, EAST WALL #3 LOW, 2ND CLEAN, ATR, 592584.206
05 Mar 90 13:57:09
Absorbance
0.1913
0.1701
0.1490
0.1279
0.1068
0.0856
0.0645
T
T
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

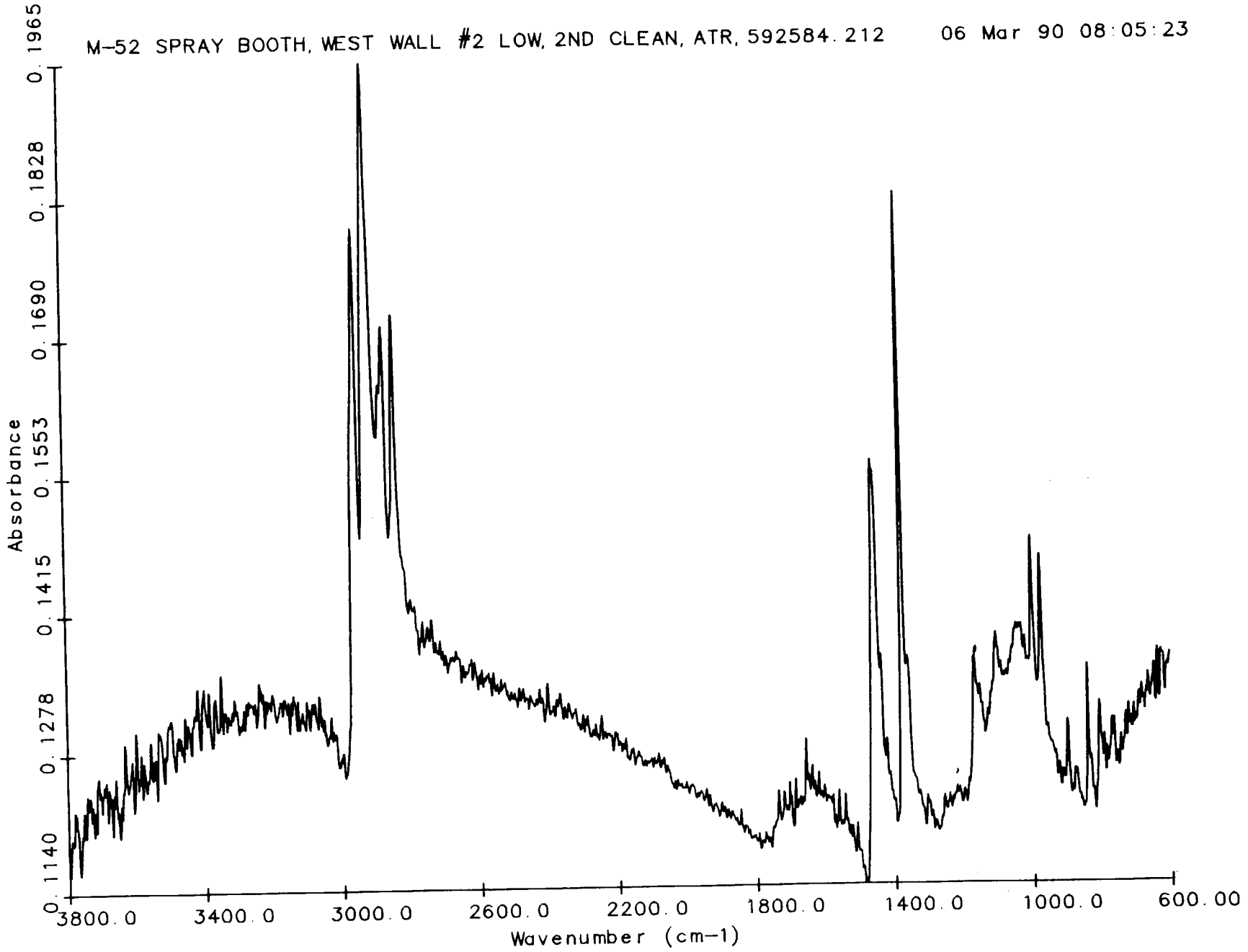

M-52 SPRAY BOOTH, EAST WALL #4 HIGH, 2ND CLEAN, ATR, 592584.207
05 Mar 90 14:35:26
Absorbance
0.1438
0.1284
0.1131
0.0977
0.0823
0.0669
0.0515
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

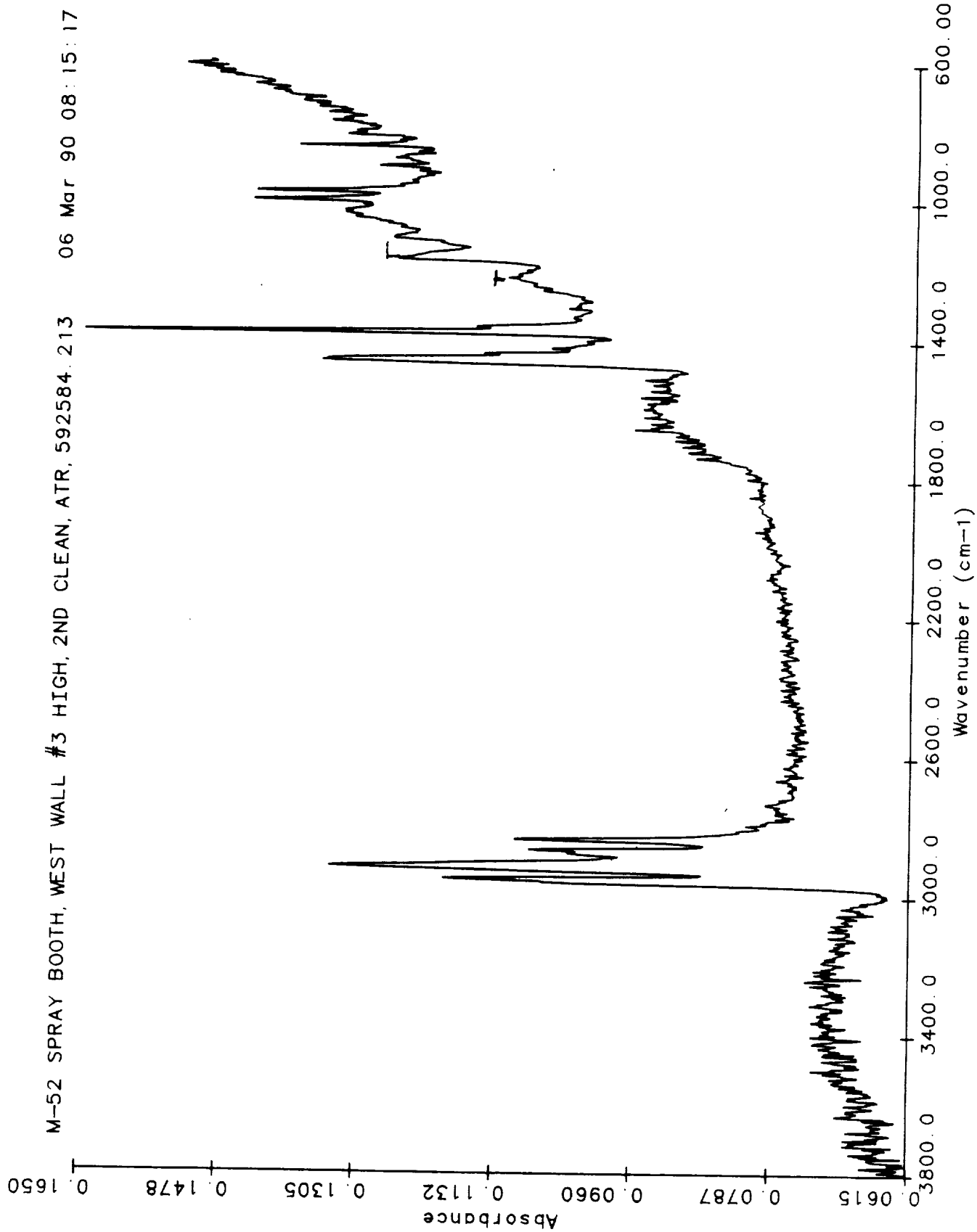

M-52 SPRAY BOOTH, EAST WALL #4 LOW, 2ND CLEAN, ATR, 592584.208
05 Mar 90 14:44:35
Absorbance
0.1406
0.1240
0.1074
0.0908
0.0742
0.0575
0.0409
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

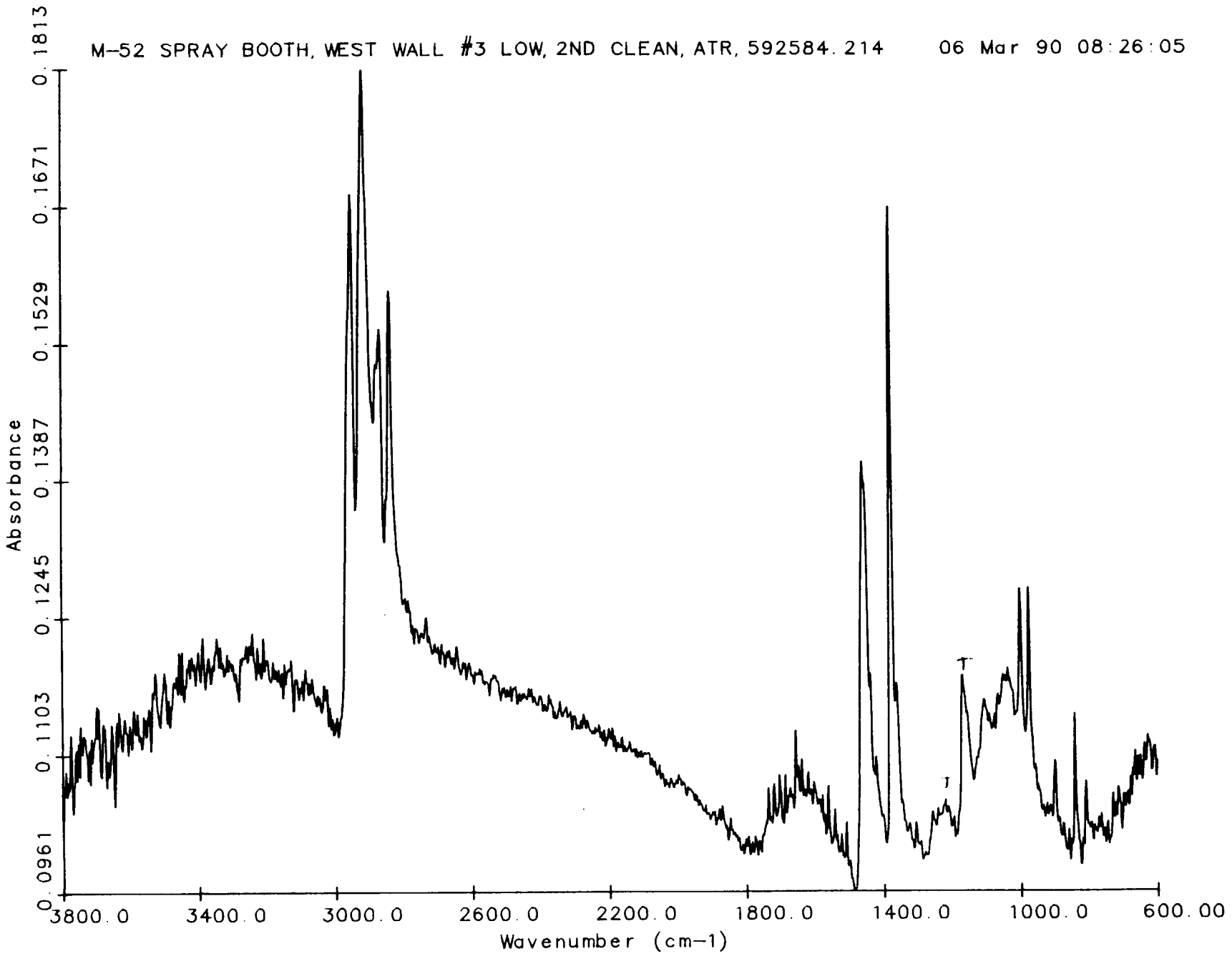

M-52 SPRAY BOOTH, WEST WALL #1 HIGH, 2ND CLEAN, ATR, 592584.209
05 Mar 90 14:53:28
Absorbance
0.1886
0.1671
0.1456
0.1241
0.1026
0.0811
0.0596
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

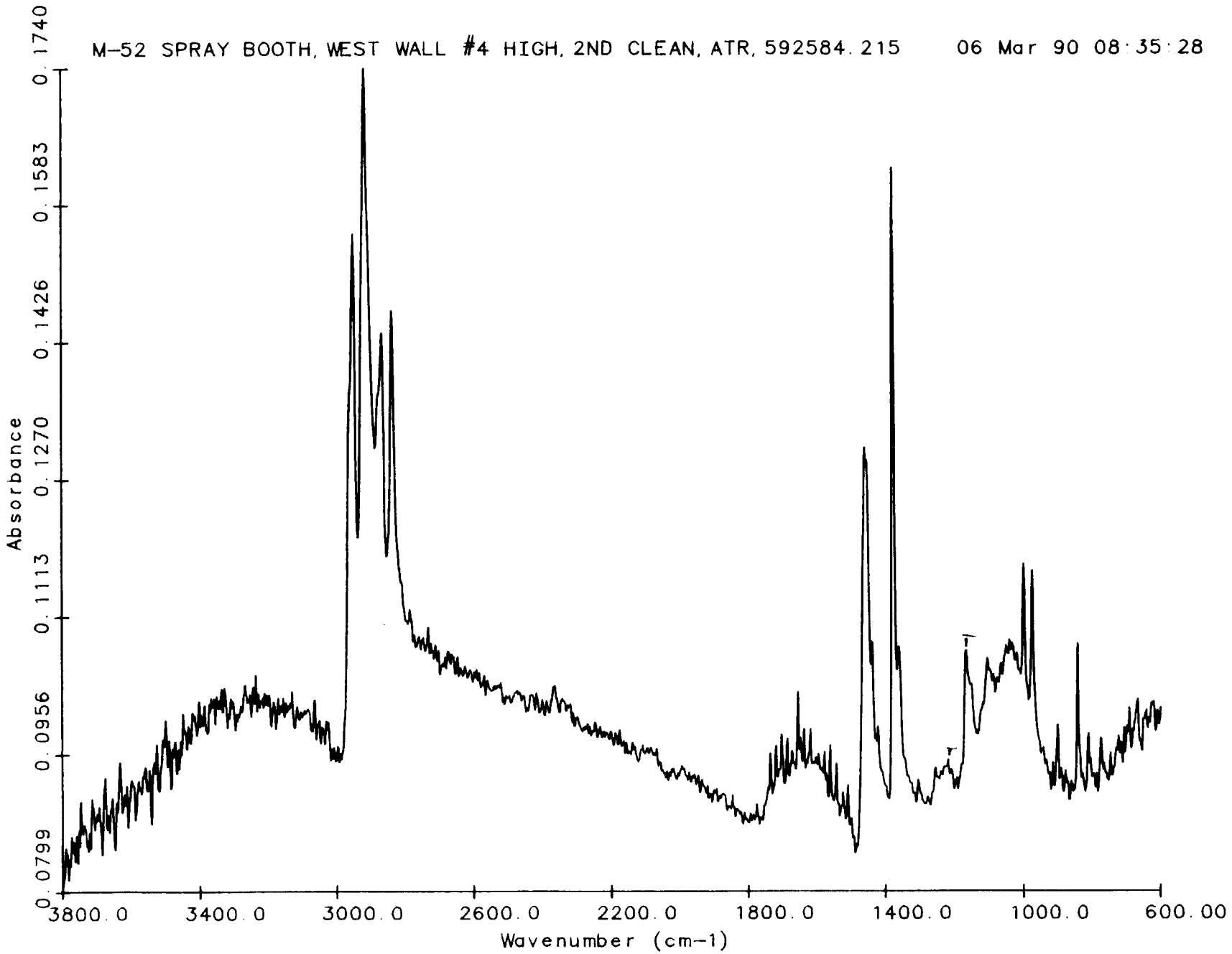

M-52 SPRAY BOOTH, WEST WALL #1 LOW, 2ND CLEAN, ATR, 592584.210
05 Mar 90 15:00:21
Absorbance
0.2037
0.1901
0.1765
0.1629
0.1492
0.1356
0.1220
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

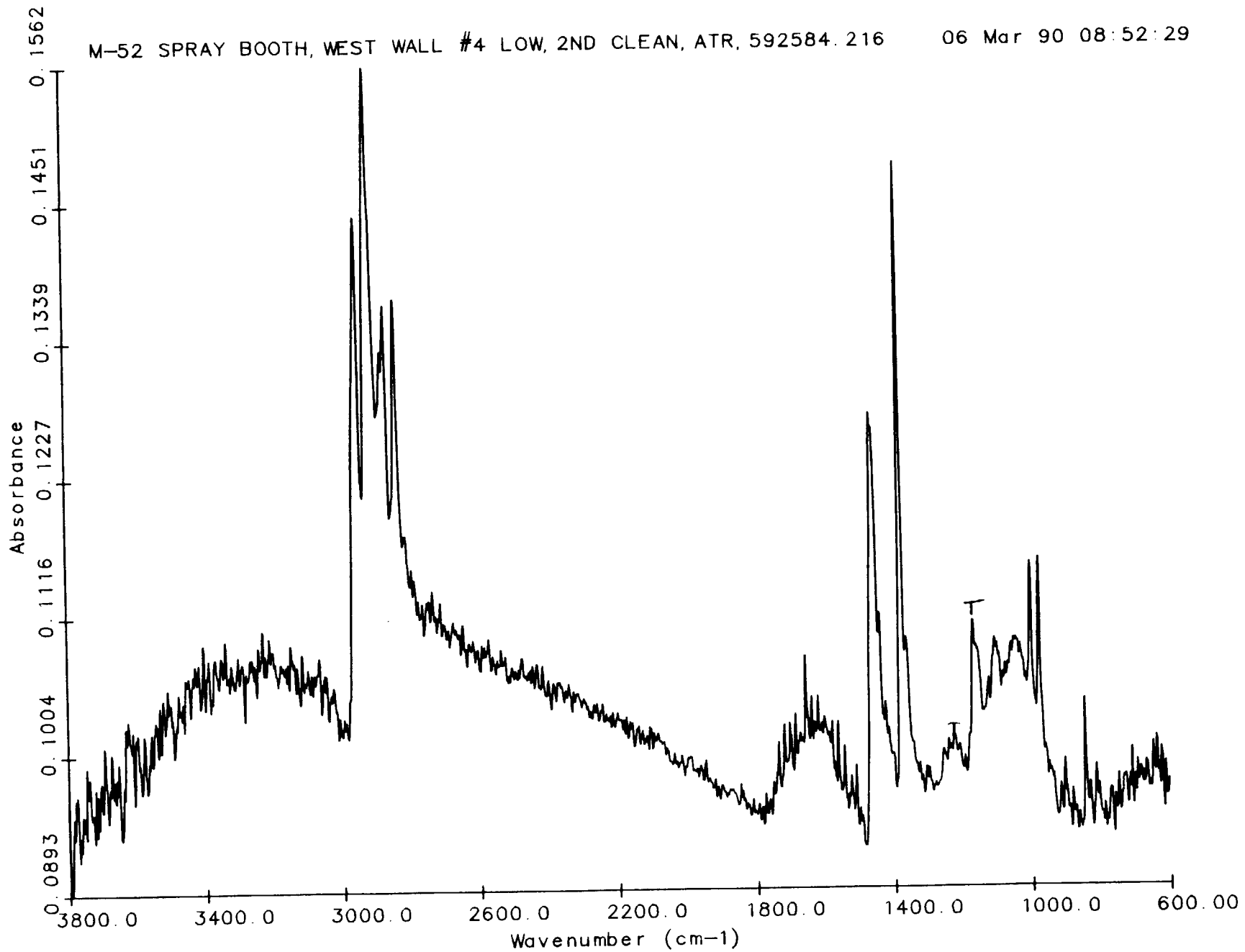

M-52 SPRAY BOOTH, WEST WALL #2 HIGH, 2ND CLEAN, ATR, 592584.211
06 Mar 90 07:51:31
Absorbance
0.2647
0.2509
0.2371
0.2234
0.2096
0.1958
0.1821
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)
?

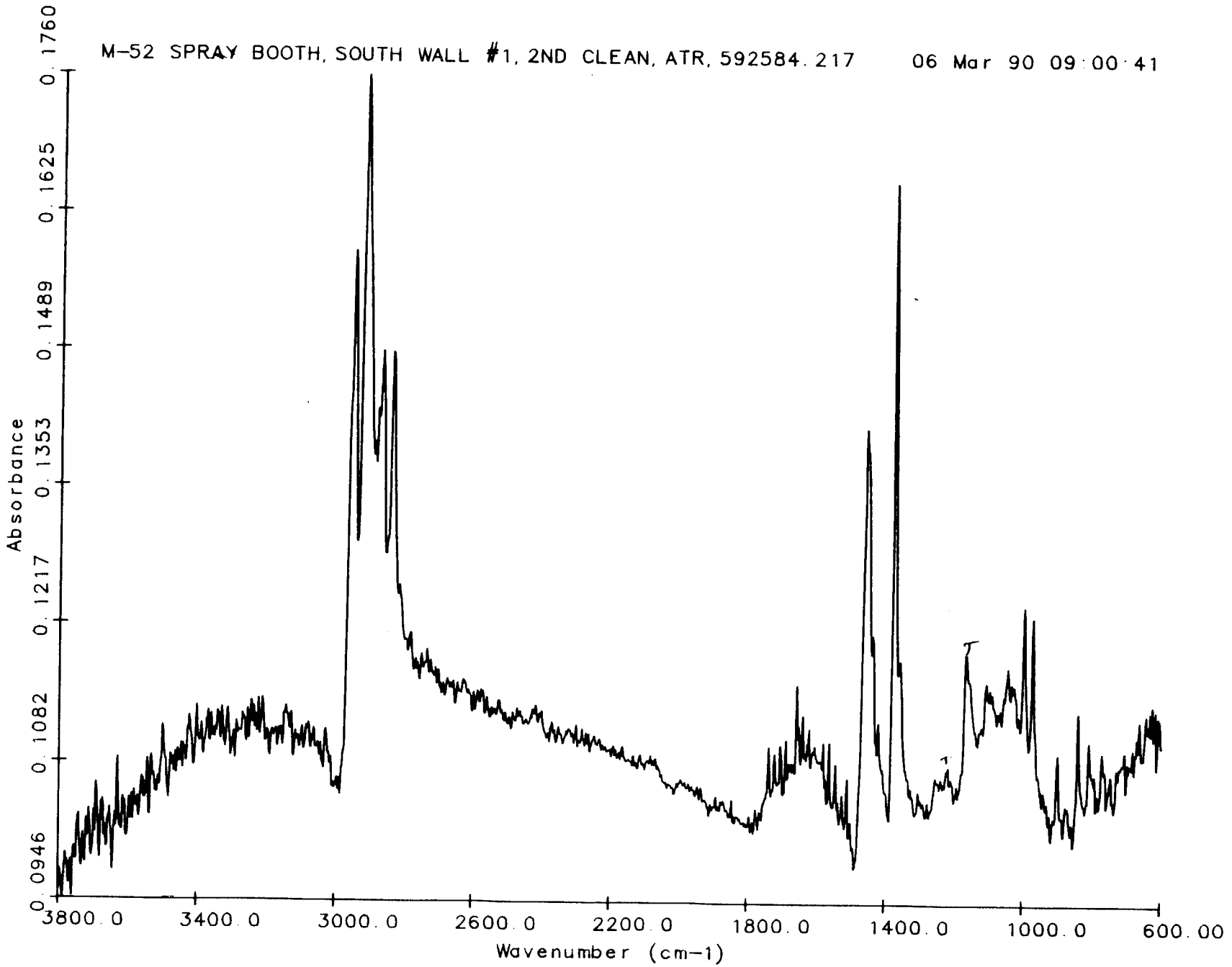

M-52 SPRAY BOOTH, WEST WALL #2 LOW, 2ND CLEAN, ATR, 592584.212
06 Mar 90 08:05:23
Absorbance
0.1965
0.1828
0.1690
0.1553
0.1415
0.1278
0.1140
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

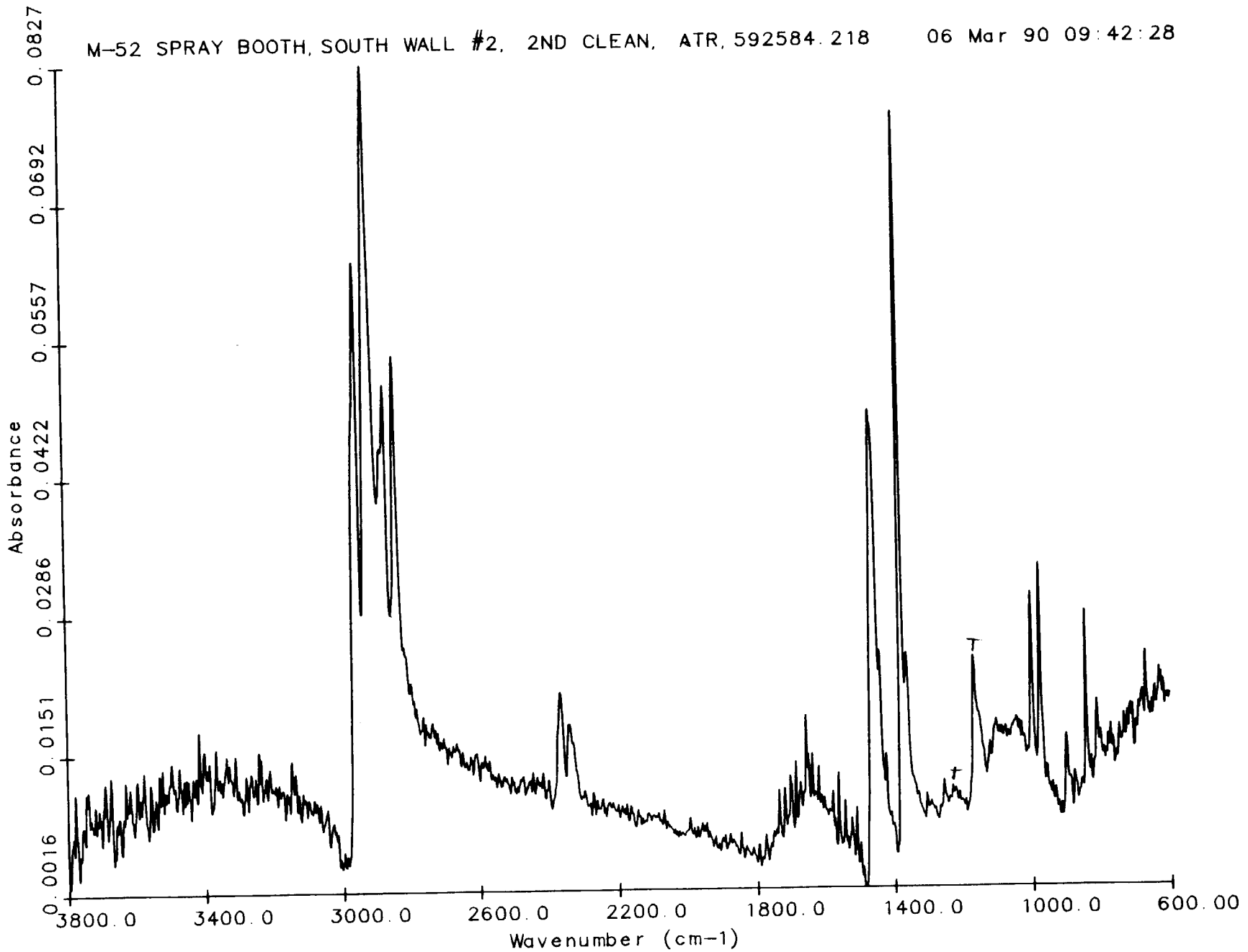

M-52 SPRAY BOOTH, WEST WALL #3 HIGH, 2ND CLEAN, ATR, 592584.213 06 Mar 90 08:15:17
Absorbance
0.1650
0.1478
0.1305
0.1132
0.0960
0.0787
0.0615
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

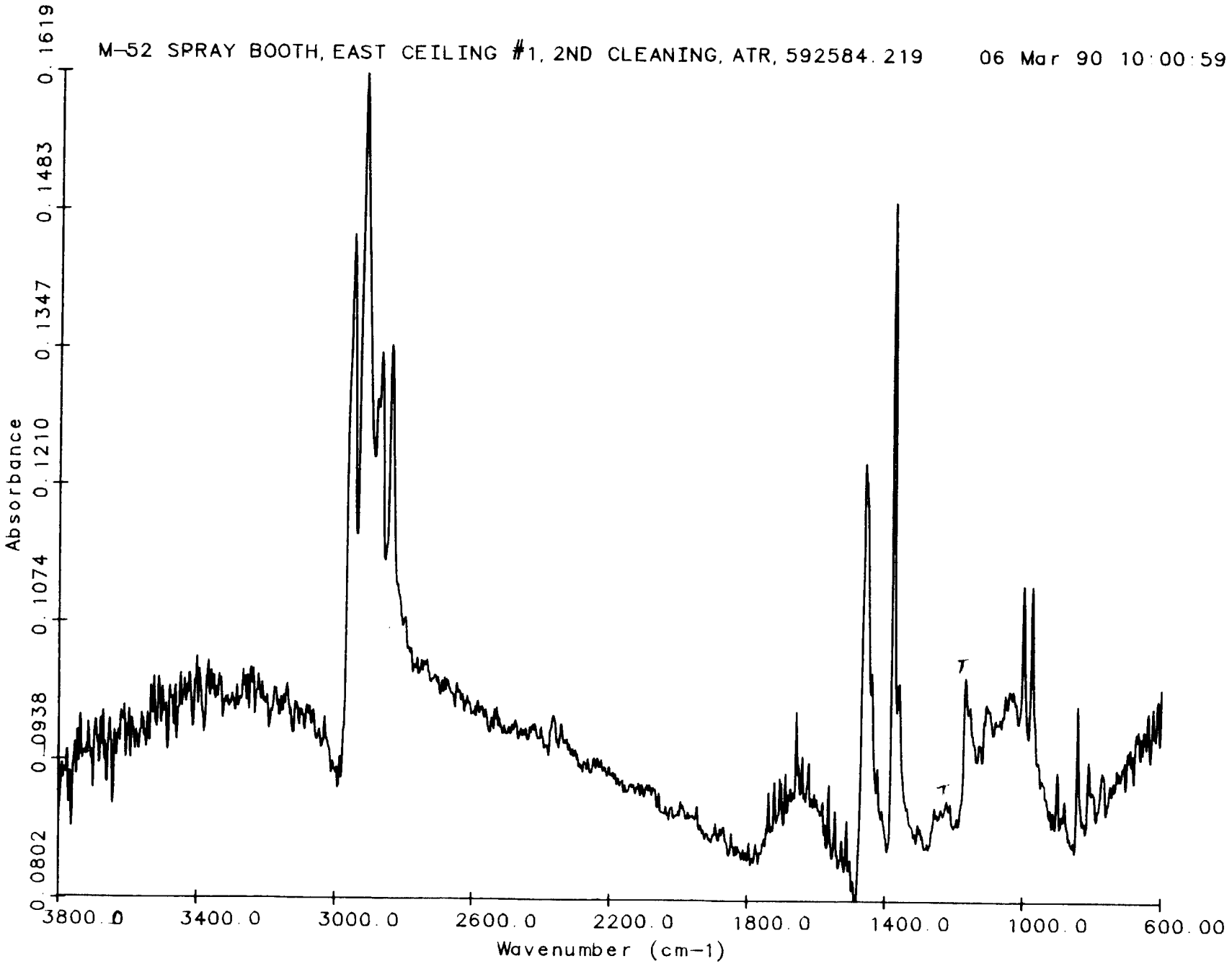

M-52 SPRAY BOOTH, WEST WALL #3 LOW, 2ND CLEAN, ATR, 592584.214
06 Mar 90 08:26:05
Absorbance
0.1813
0.1671
0.1529
0.1387
0.1245
0.1103
0.0961
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

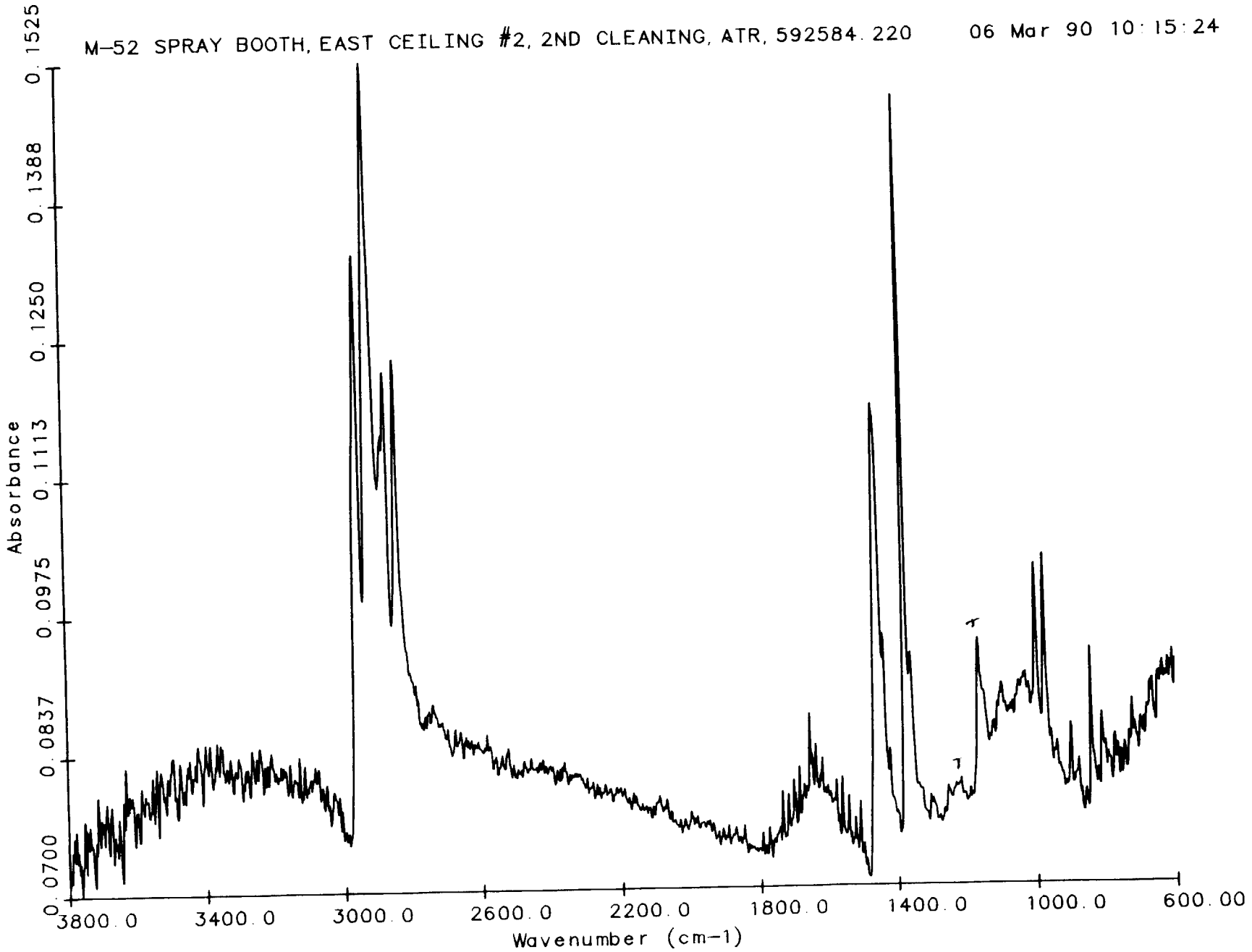

M-52 SPRAY BOOTH, WEST WALL #4 HIGH, 2ND CLEAN, ATR, 592584.215
06 Mar 90 08:35:28
Absorbance
0.1740
0.1583
0.1426
0.1270
0.1113
0.0956
0.0799
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

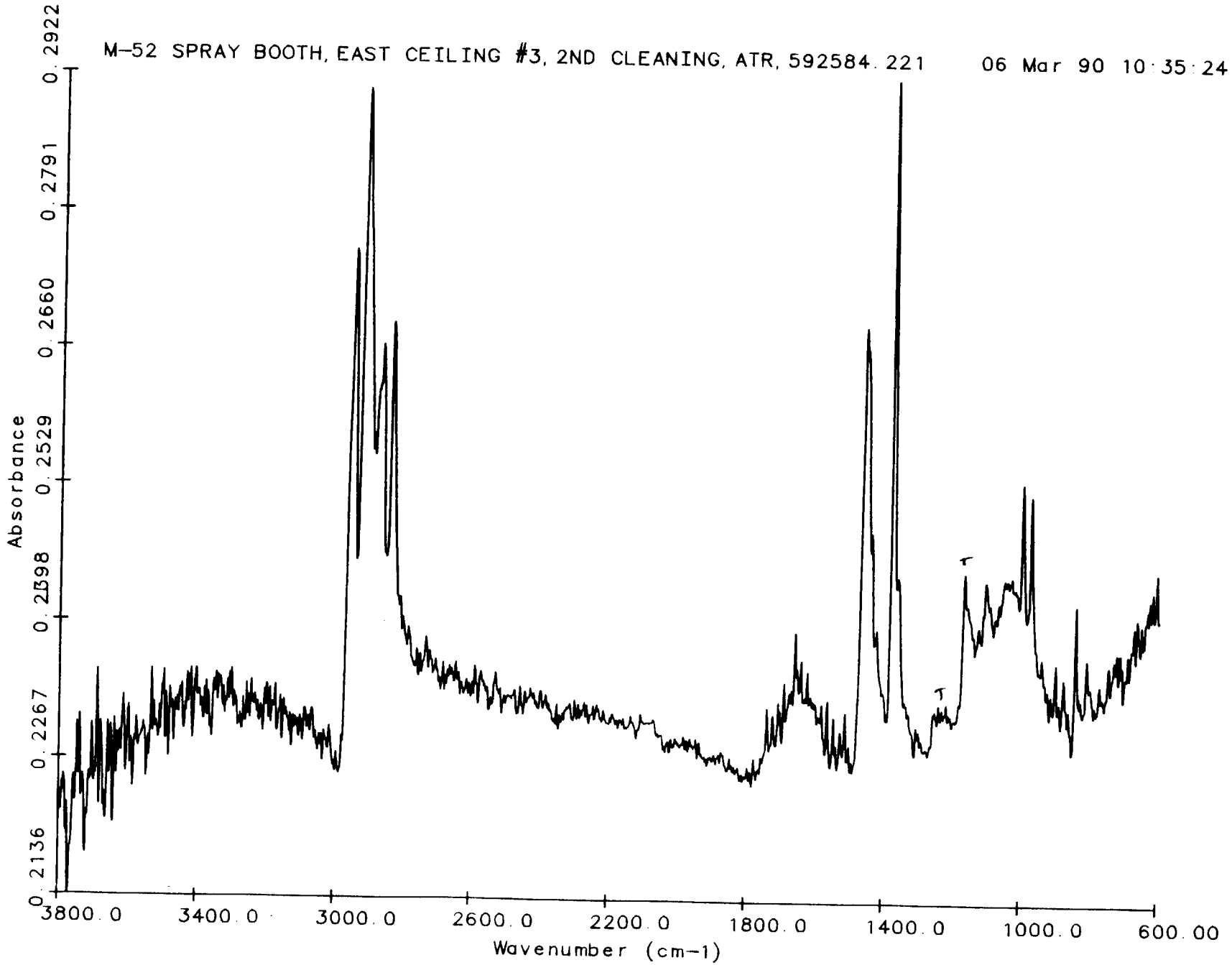

M-52 SPRAY BOOTH, WEST WALL #4 LOW, 2ND CLEAN, ATR, 592584.216
06 Mar 90 08:52:29
Absorbance
0.1562
0.1451
0.1339
0.1227
0.1116
0.1004
0.0893
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

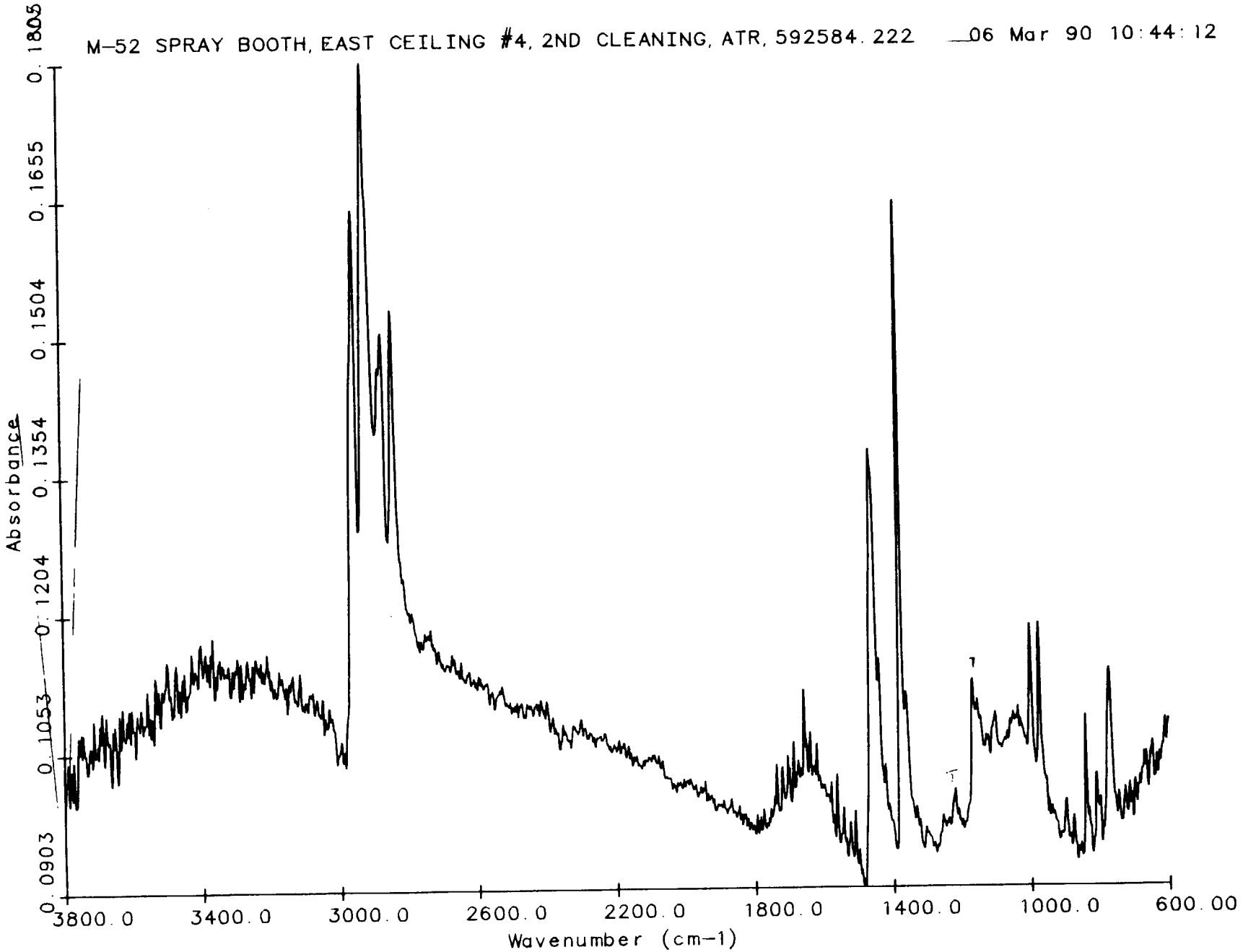

M-52 SPRAY BOOTH, SOUTH WALL #1, 2ND CLEAN, ATR, 592584.217
06 Mar 90 09:00:41
Absorbance
0.1760
0.1625
0.1489
0.1353
0.1217
0.1082
0.0946
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

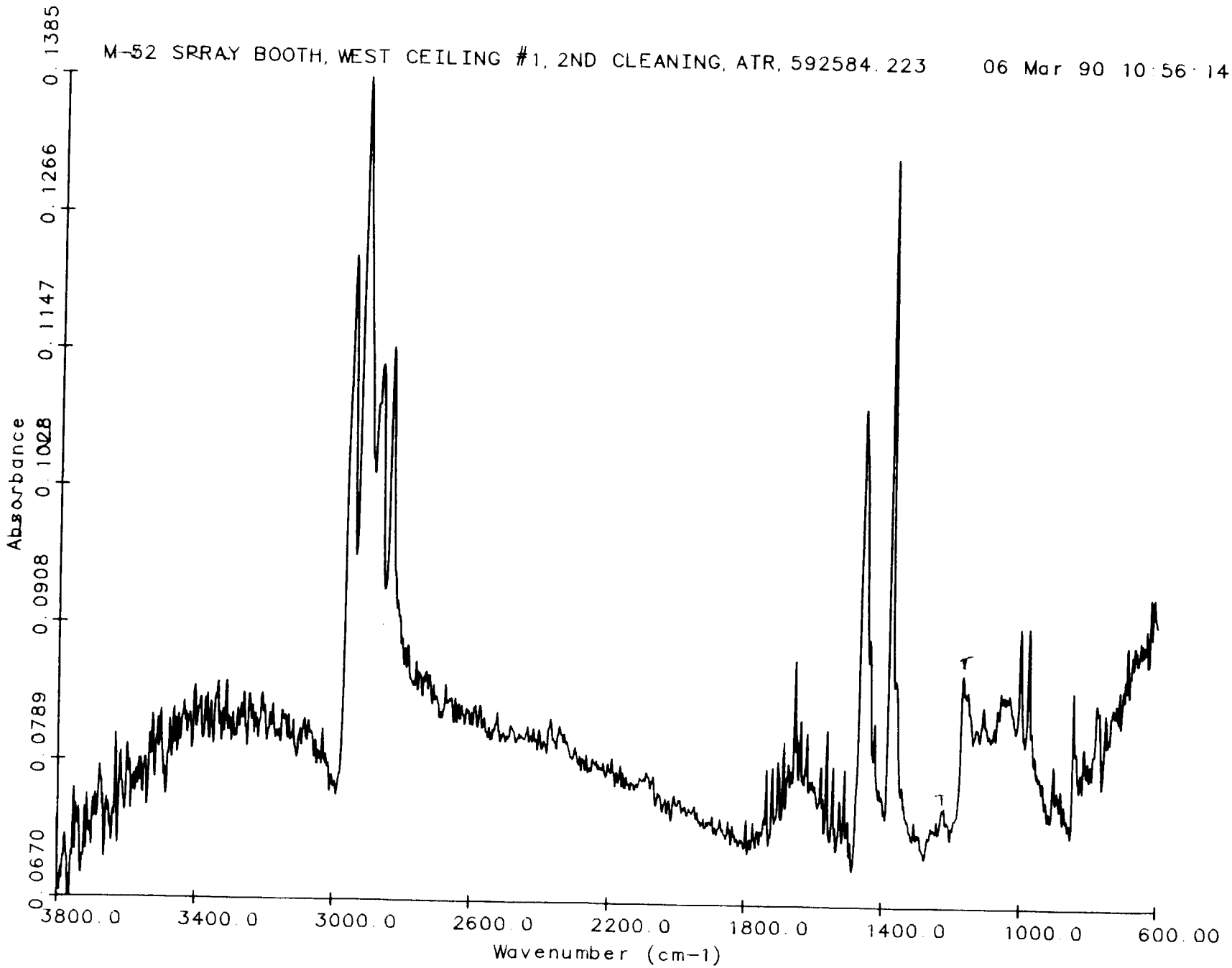

M-52 SPRAY BOOTH, SOUTH WALL #2, 2ND CLEAN, ATR, 592584.218
06 Mar 90 09:42:28
Absorbance
0.0827
0.0692
0.0557
0.0422
0.0286
0.0151
0.0016
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

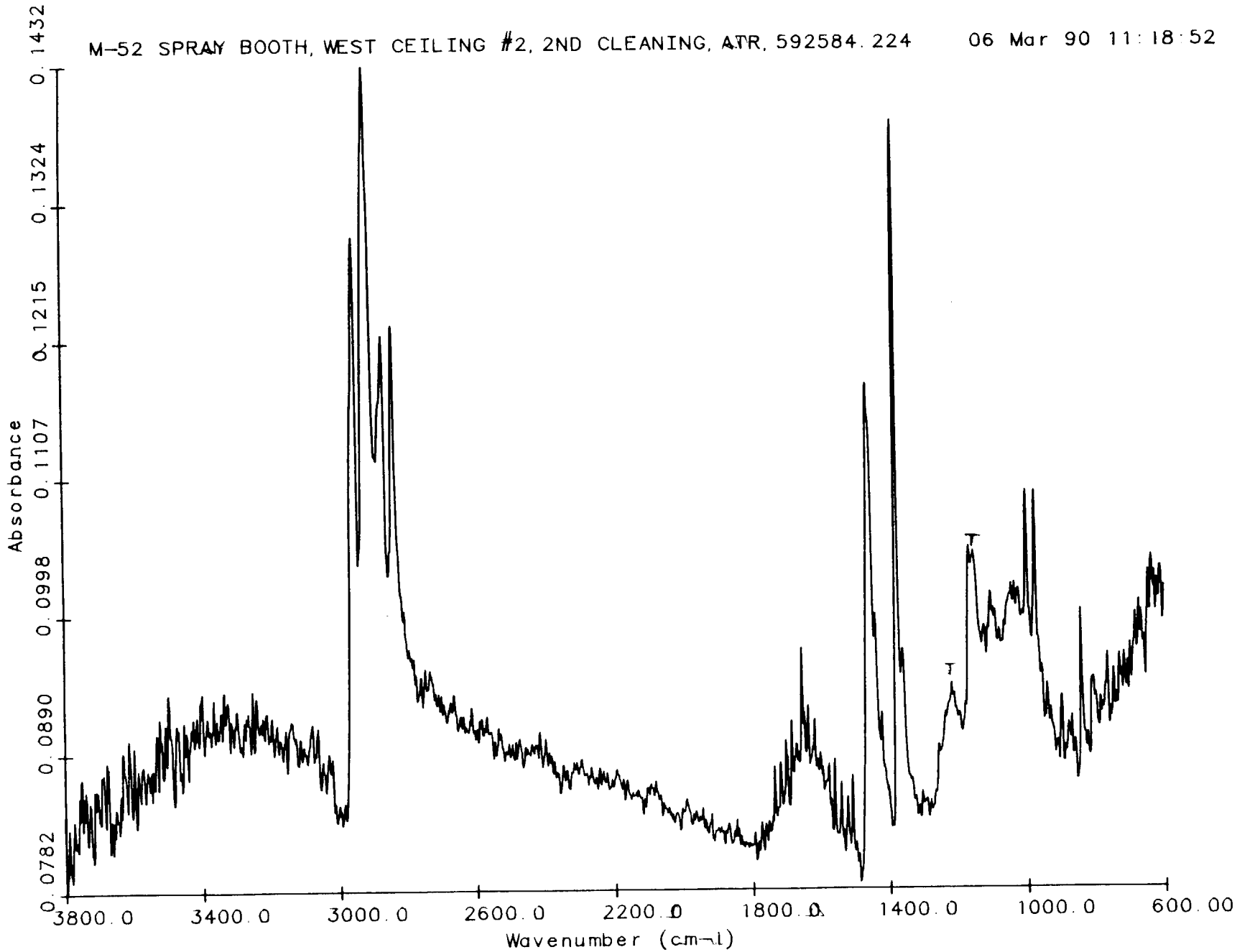

M-52 SPRAY BOOTH, EAST CEILING #1, 2ND CLEANING, ATR, 592584.219
06 Mar 90 10:00:59
Absorbance
0.1619
0.1483
0.1347
0.1210
0.1074
0.0938
0.0802
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

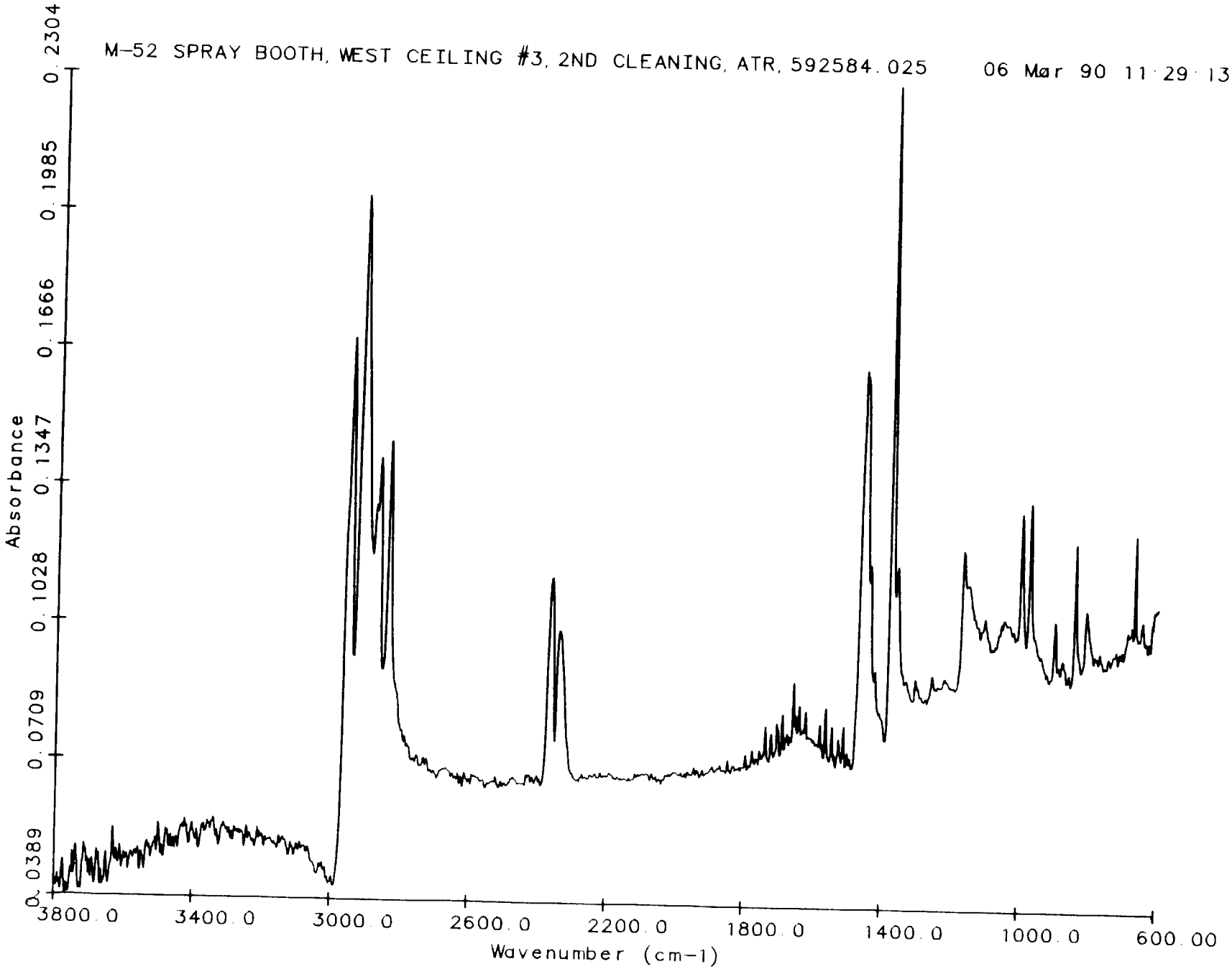

M-52 SPRAY BOOTH, EAST CEILING #2, 2ND CLEANING, ATR, 592584.220
06 Mar 90 10:15:24
Absorbance
0.1525
0.1388
0.1250
0.1113
0.0975
0.0837
0.0700
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

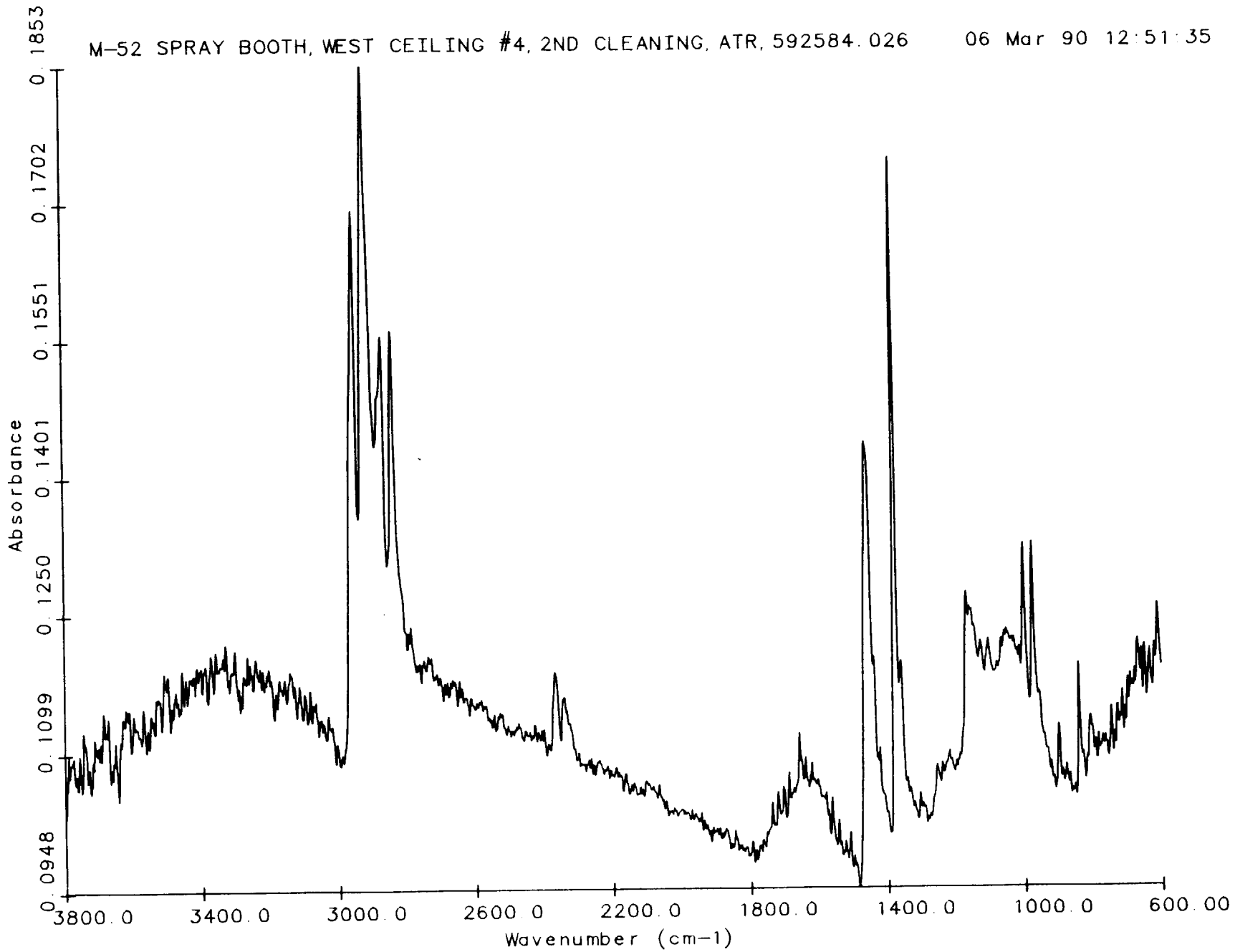

M-52 SPRAY BOOTH, EAST CEILING #3, 2ND CLEANING, ATR, 592584.221
06 Mar 90 10:35:24
Absorbance
0.2922
0.2791
0.2660
0.2529
0.2398
0.2267
0.2136
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, EAST CEILING #4, 2ND CLEANING, ATR, 592584.222
06 Mar 90 10:44:12
Absorbance
0.1805
0.1655
0.1504
0.1354
0.1204
0.1053
0.0903
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SRRAY BOOTH, WEST CEILING #1, 2ND CLEANING, ATR, 592584.223
06 Mar 90 10:56:14
Absorbance
0.1385
0.1266
0.1147
0.1028
0.0908
0.0789
0.0670
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

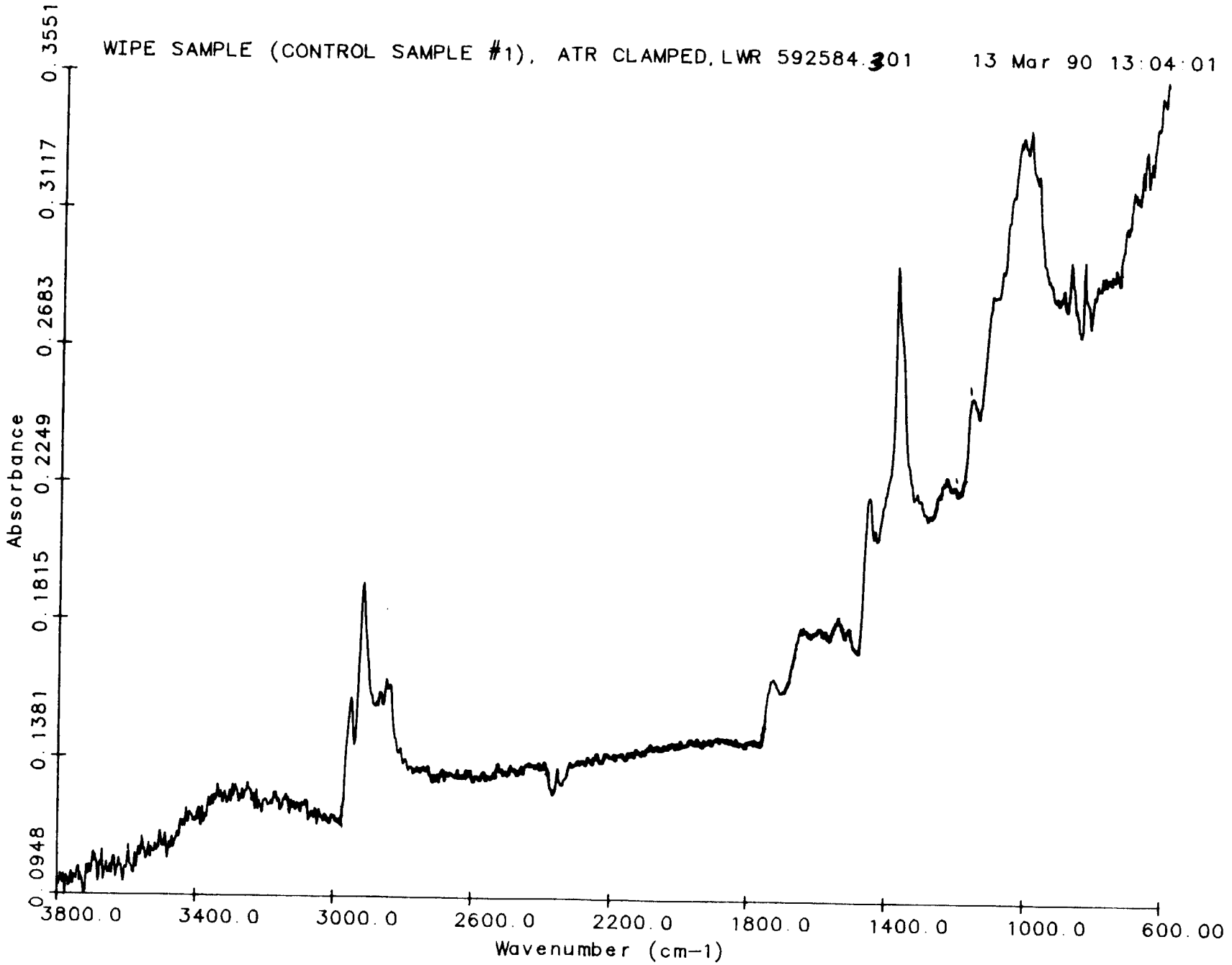

M-52 SPRAY BOOTH, WEST CEILING #2, 2ND CLEANING, ATR, 592584.224
06 Mar 90 11:18:52
Absorbance
0.1432
0.1324
0.1215
0.1107
0.0998
0.0890
0.0782
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

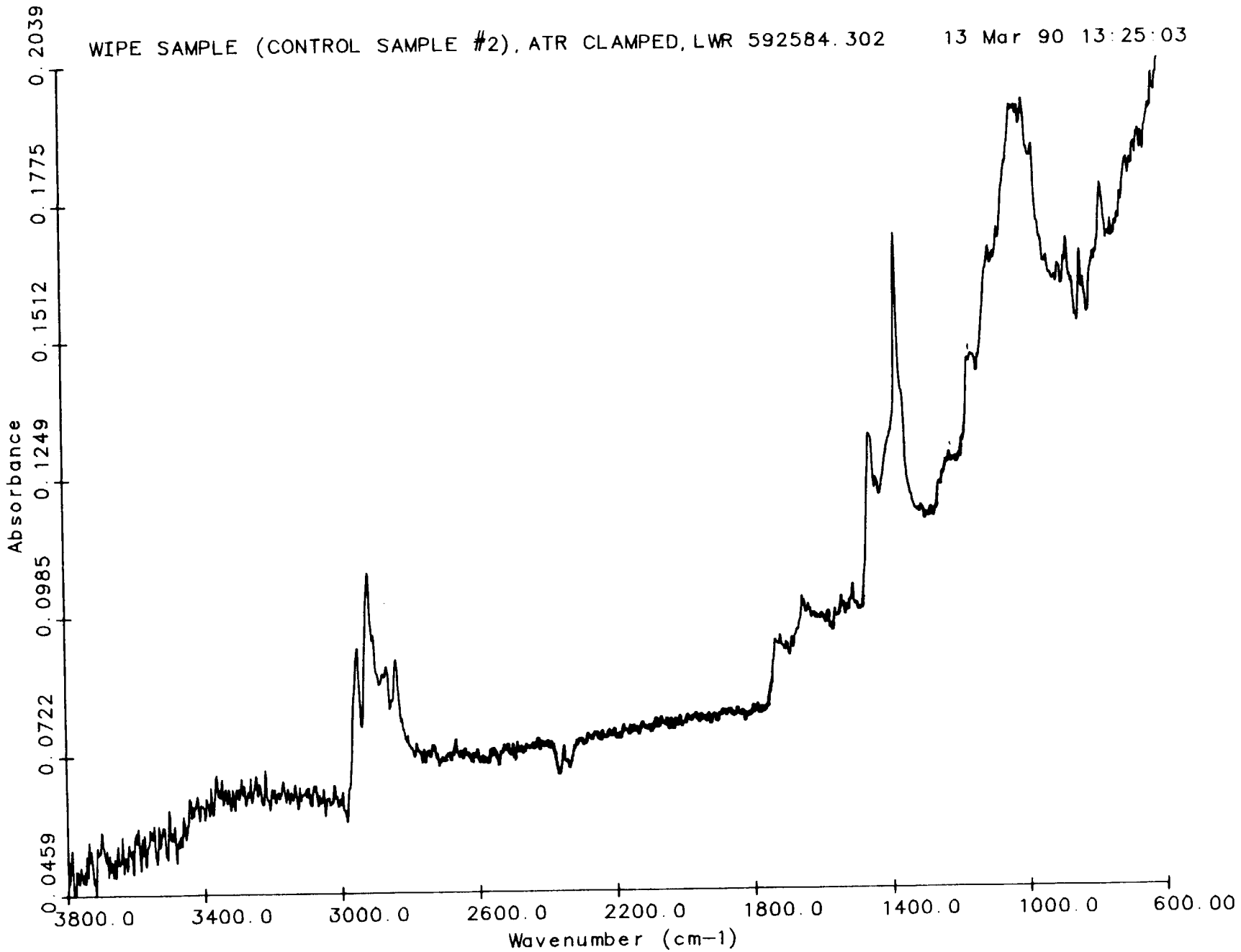

M-52 SPRAY BOOTH, WEST CEILING #3, 2ND CLEANING, ATR, 592584.025
06 Mar 90 11:29:13
Absorbance
0.2304
0.1985
0.1666
0.1347
0.1028
0.0709
0.0389
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

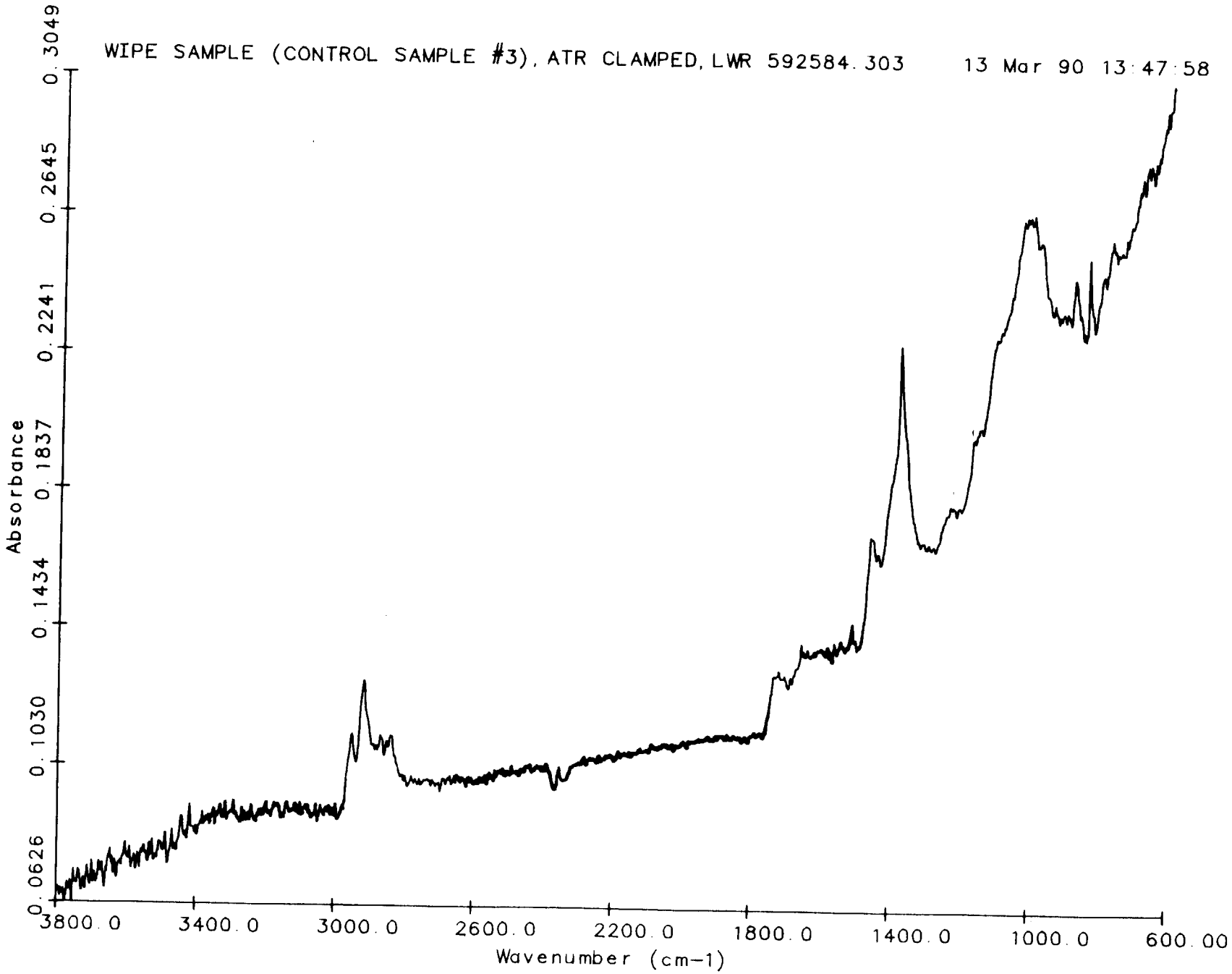

M-52 SPRAY BOOTH, WEST CEILING #4, 2ND CLEANING, ATR, 592584.026
06 Mar 90 12:51:35
Absorbance
0.1853
0.1702
0.1551
0.1401
0.1250
0.1099
0.0948
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

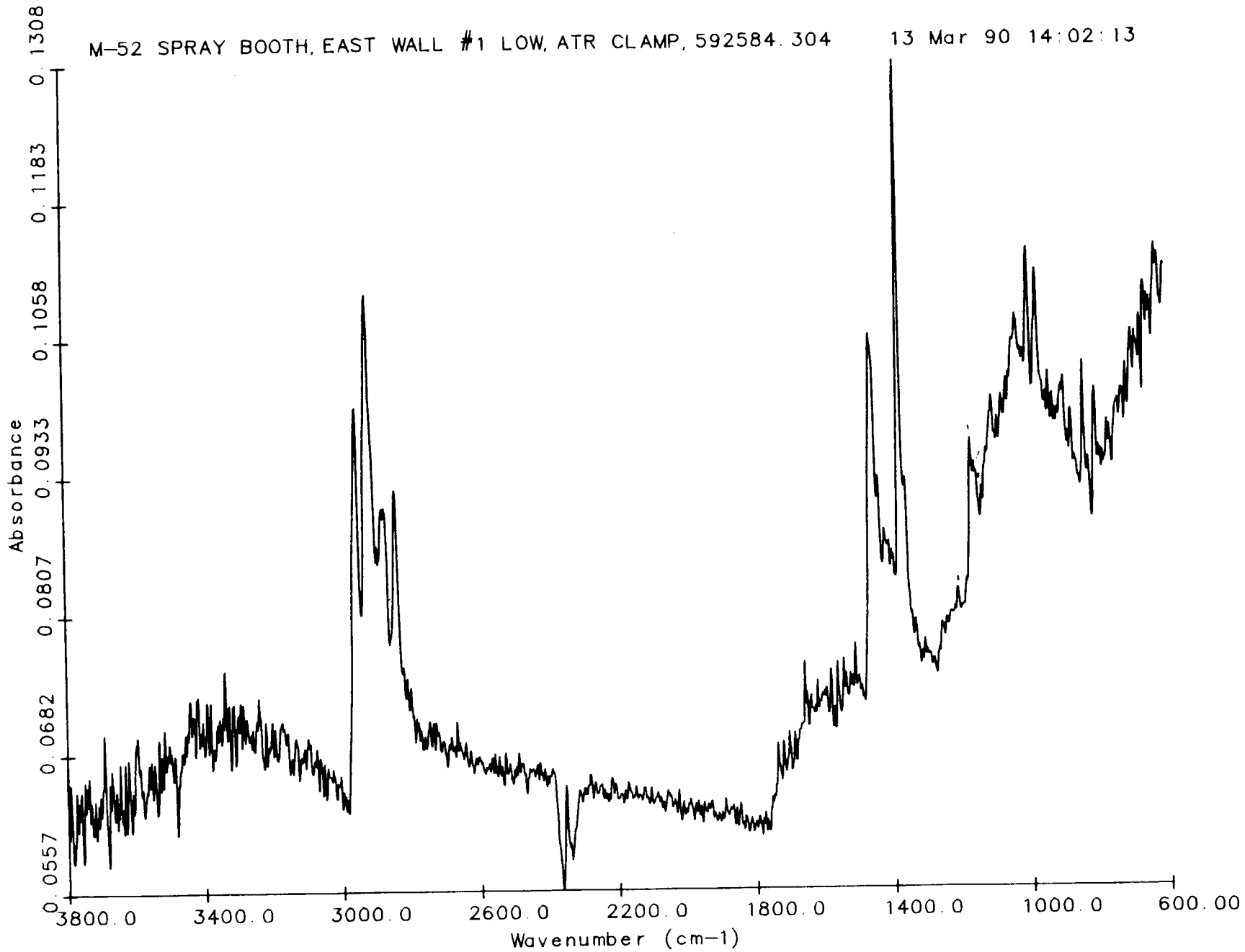
Appendix D

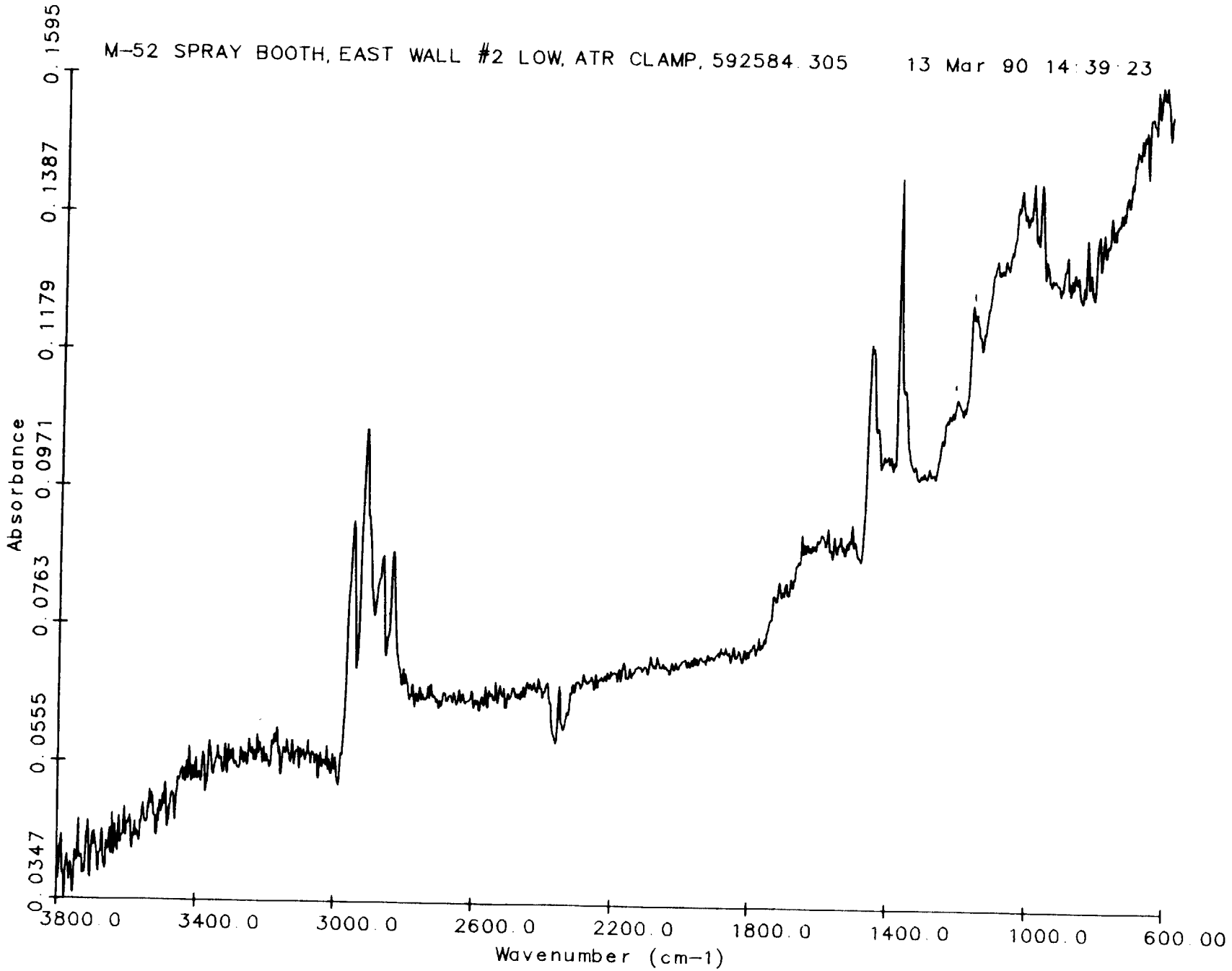
Fourth FTIR Sample Wipes

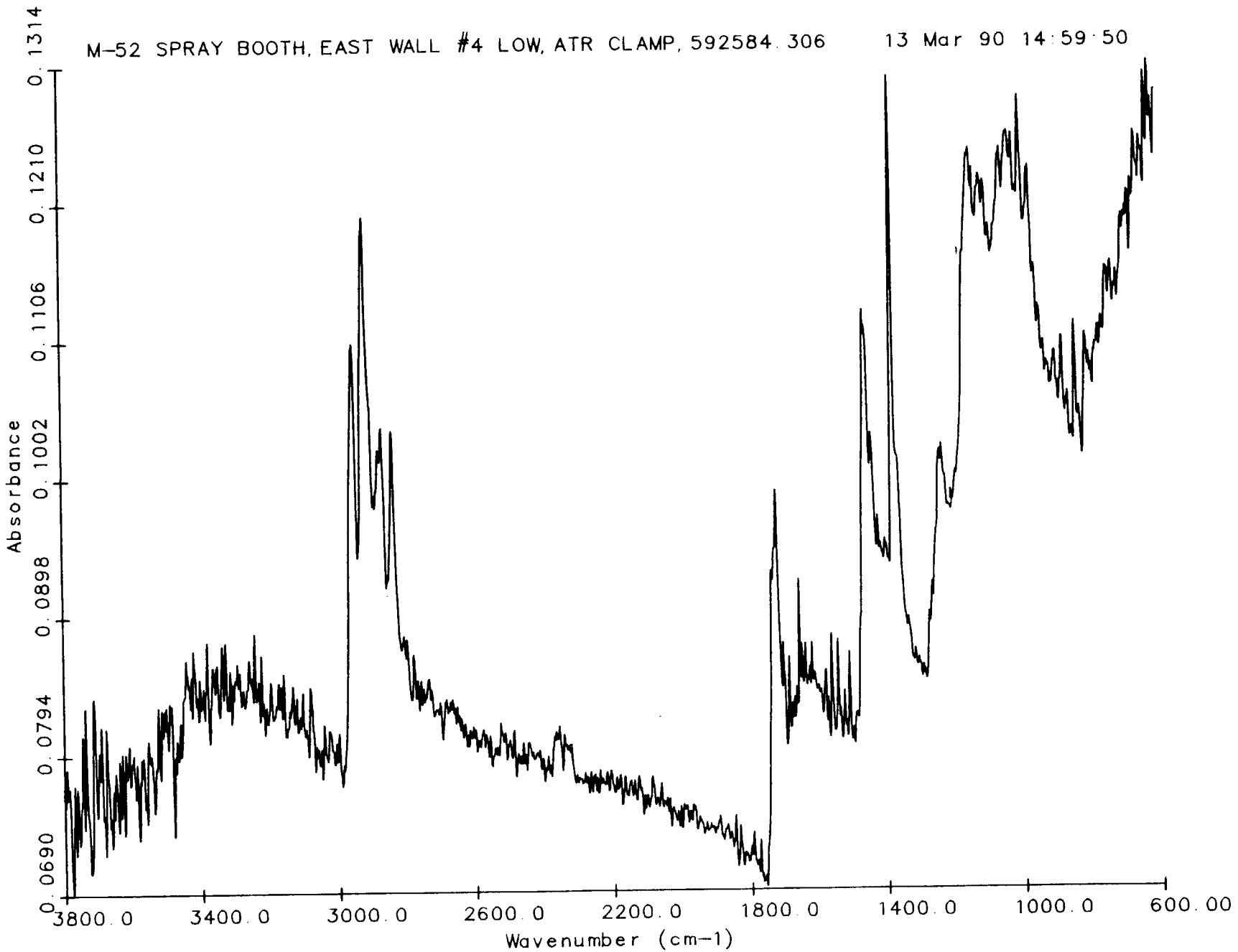

WIPE SAMPLE (CONTROL SAMPLE #1), ATR CLAMPED, LWR 592584.301
13 Mar 90 13:04:01
Absorbance
0.3551
0.3117
0.2683
0.2249
0.1815
0.1381
0.0948
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

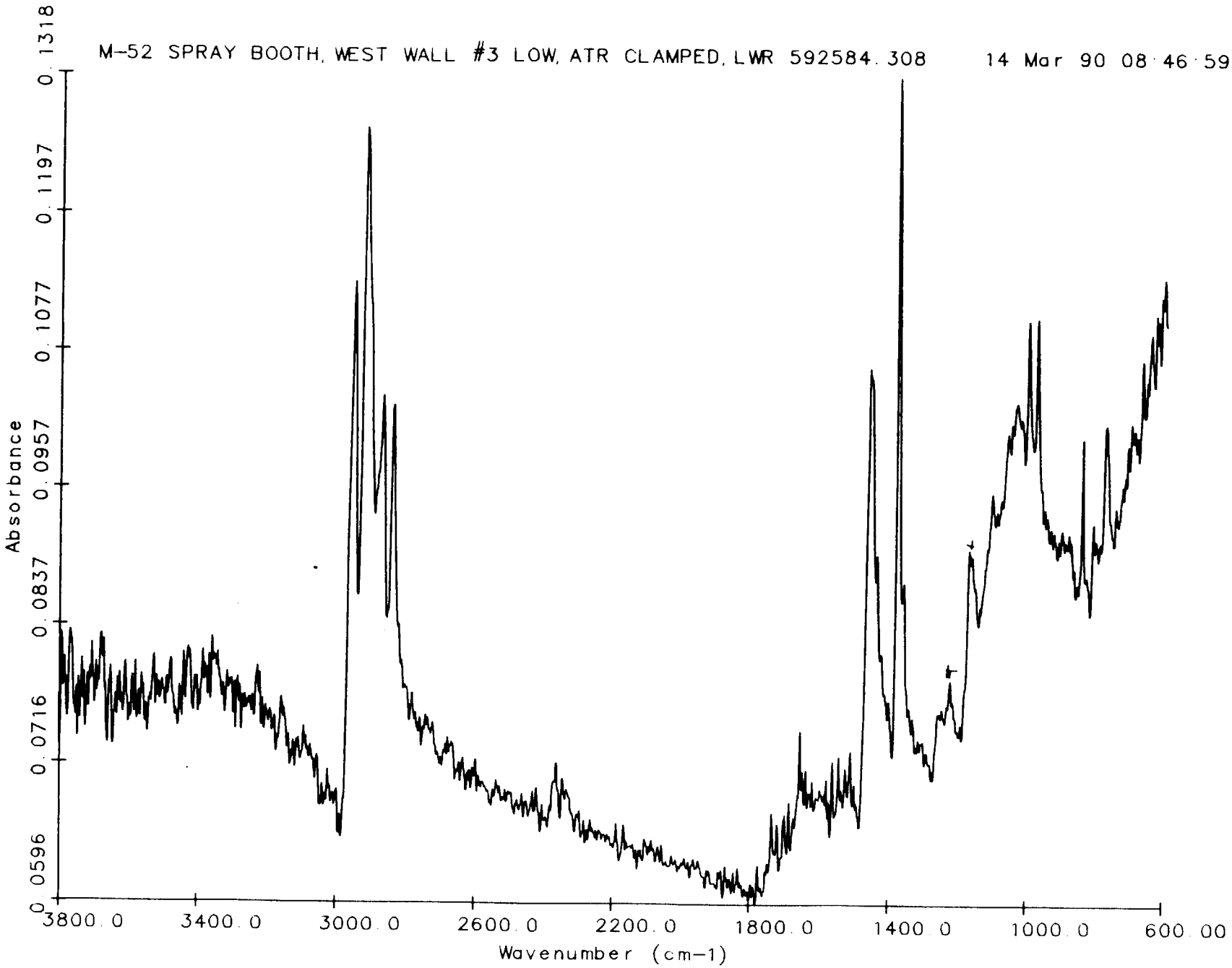

WIPE SAMPLE (CONTROL SAMPLE #2), ATR CLAMPED, LWR 592584.302
13 Mar 90 13:25:03
Absorbance
0.2039
0.1775
0.1512
0.1249
0.0985
0.0722
0.0459
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

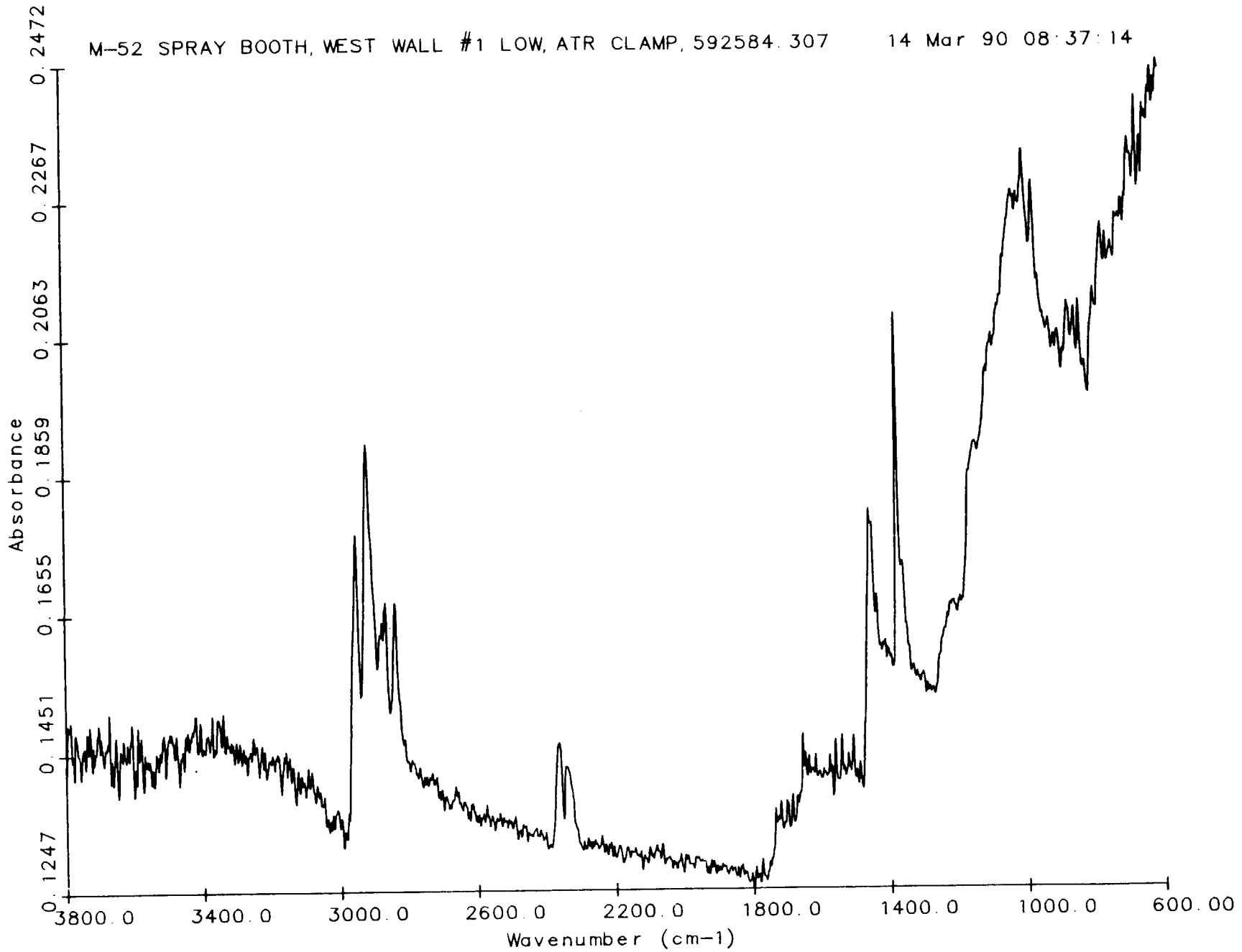

WIPE SAMPLE (CONTROL SAMPLE #3), ATR CLAMPED, LWR 592584.303
13 Mar 90 13:47:58
Absorbance
0.3049
0.2645
0.2241
0.1837
0.1434
0.1030
0.0626
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

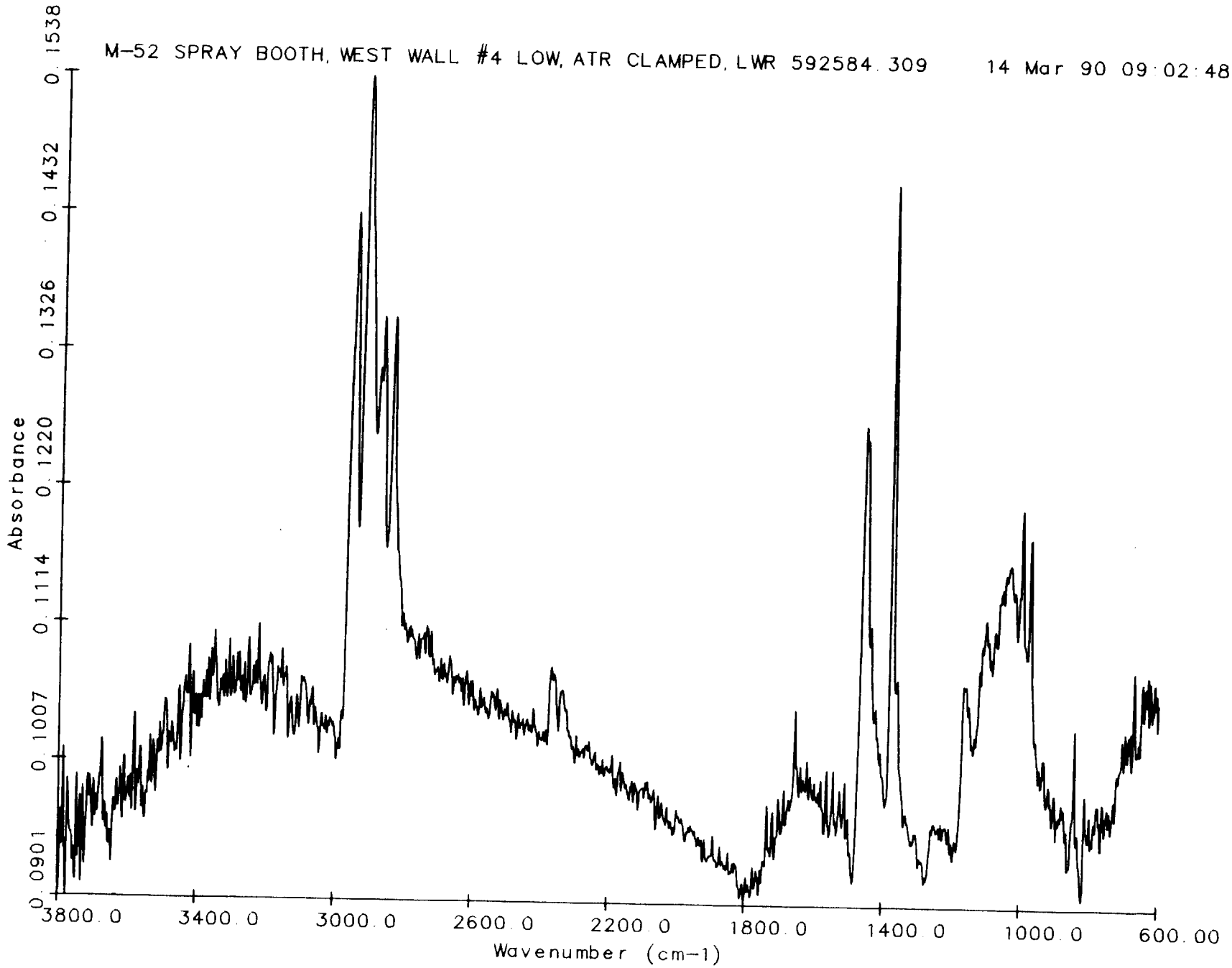

M-52 SPRAY BOOTH, EAST WALL #1 LOW, ATR CLAMP, 592584.304
13 Mar 90 14:02:13
Absorbance
0.1308
0.1183
0.1058
0.0933
0.0807
0.0682
0.0557
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

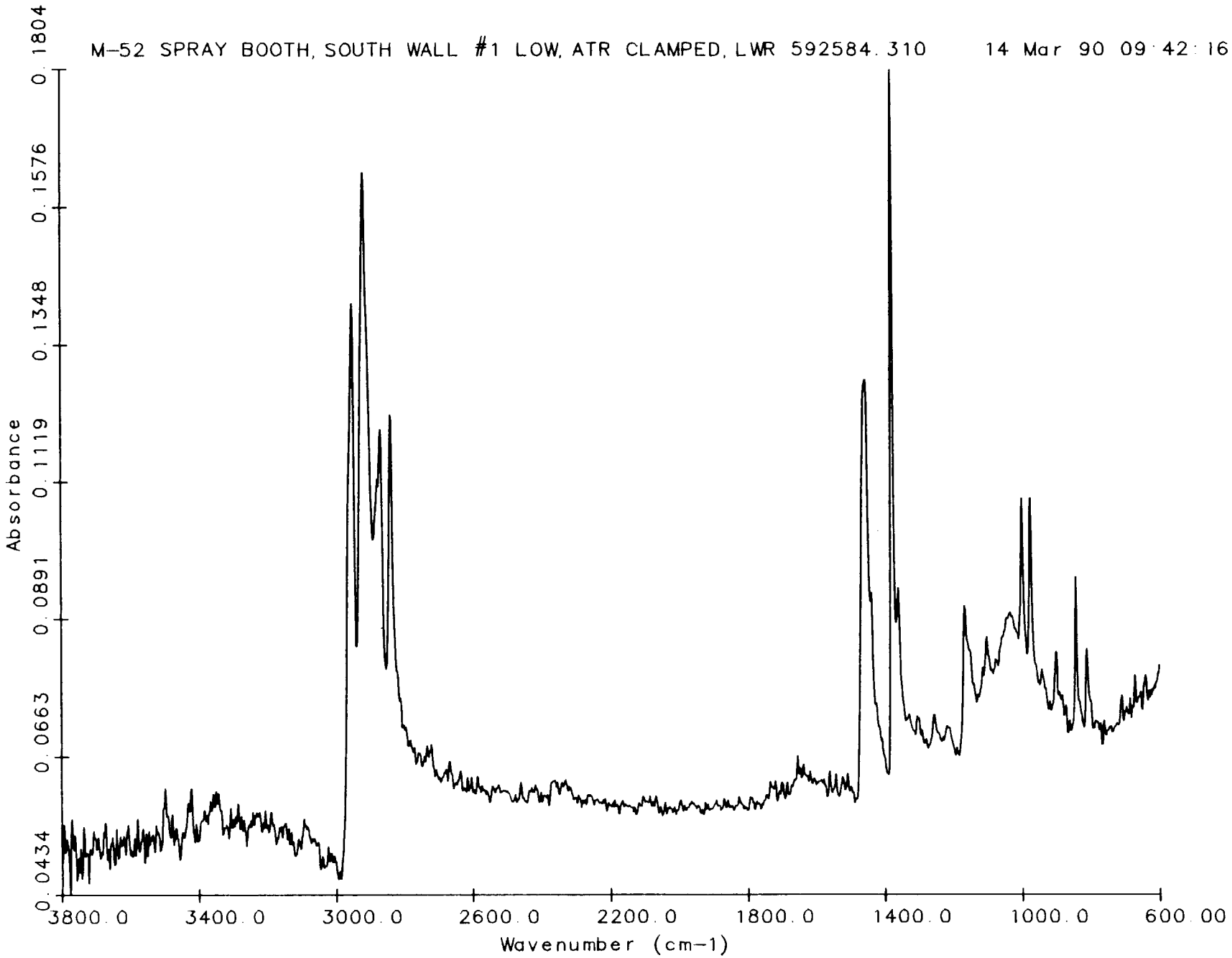

M-52 SPRAY BOOTH, EAST WALL #2 LOW, ATR CLAMP, 592584.305
13 Mar 90 14:39:23
Absorbance
0.1595
0.1387
0.1179
0.0971
0.0763
0.0555
0.0347
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

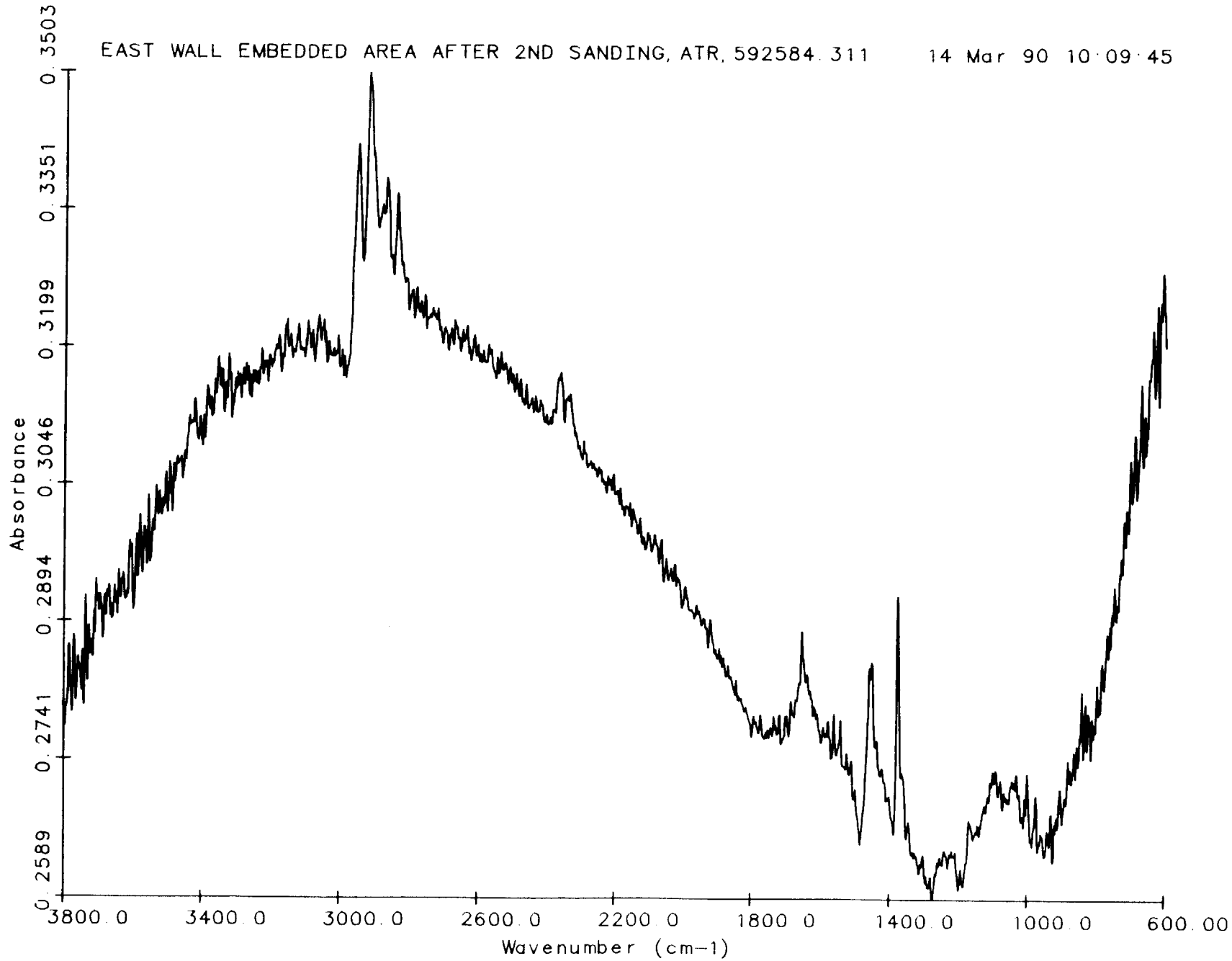

M-52 SPRAY BOOTH, EAST WALL #4 LOW, ATR CLAMP, 592584.306
13 Mar 90 14:59:50
Absorbance
0.1314
0.1210
0.1106
0.1002
0.0898
0.0794
0.0690
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

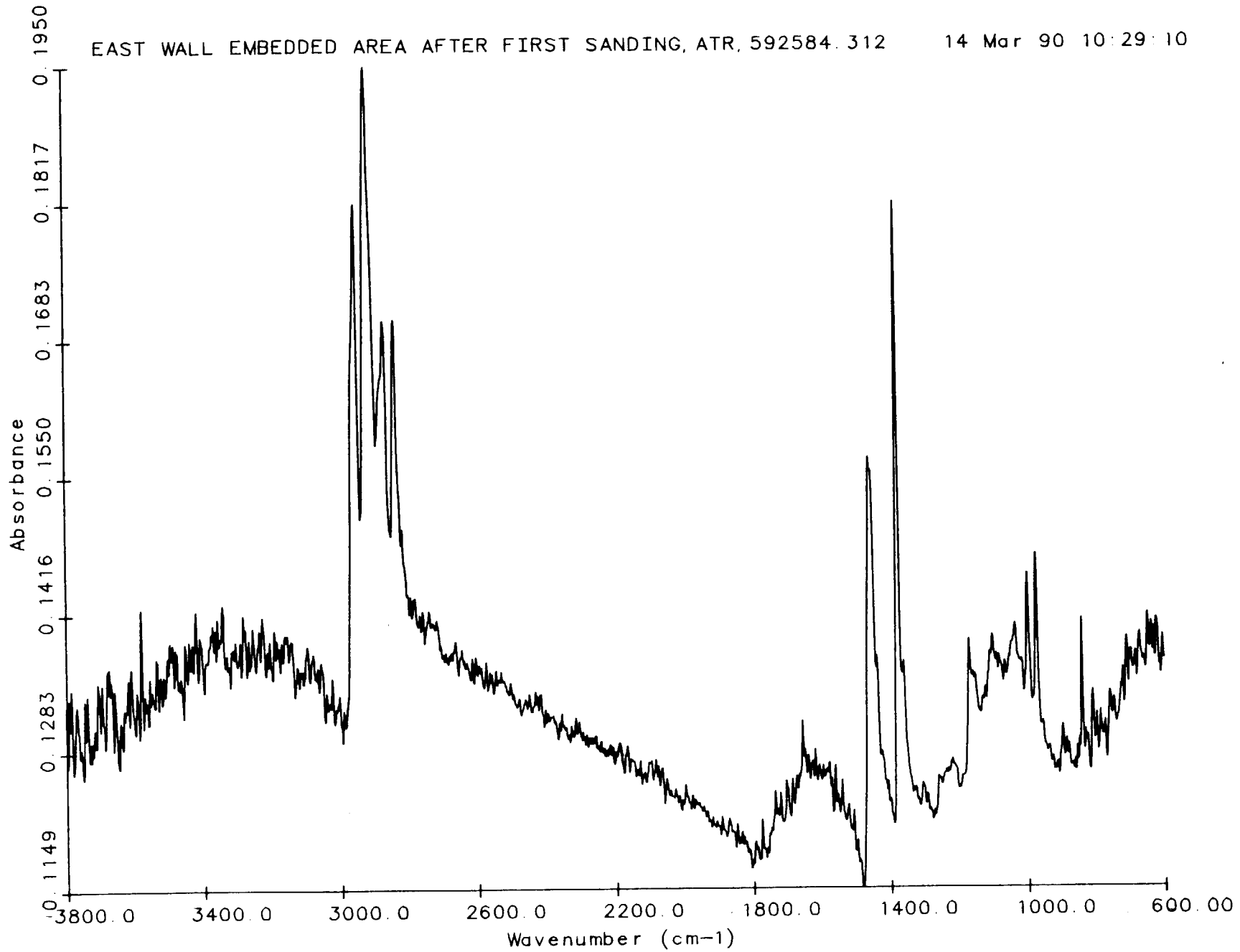

M-52 SPRAY BOOTH, WEST WALL #3 LOW, ATR CLAMPED, LWR 592584.308
14 Mar 90 08:46:59
Absorbance
0.1318
0.1197
0.1077
0.0957
0.0837
0.0716
0.0596
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

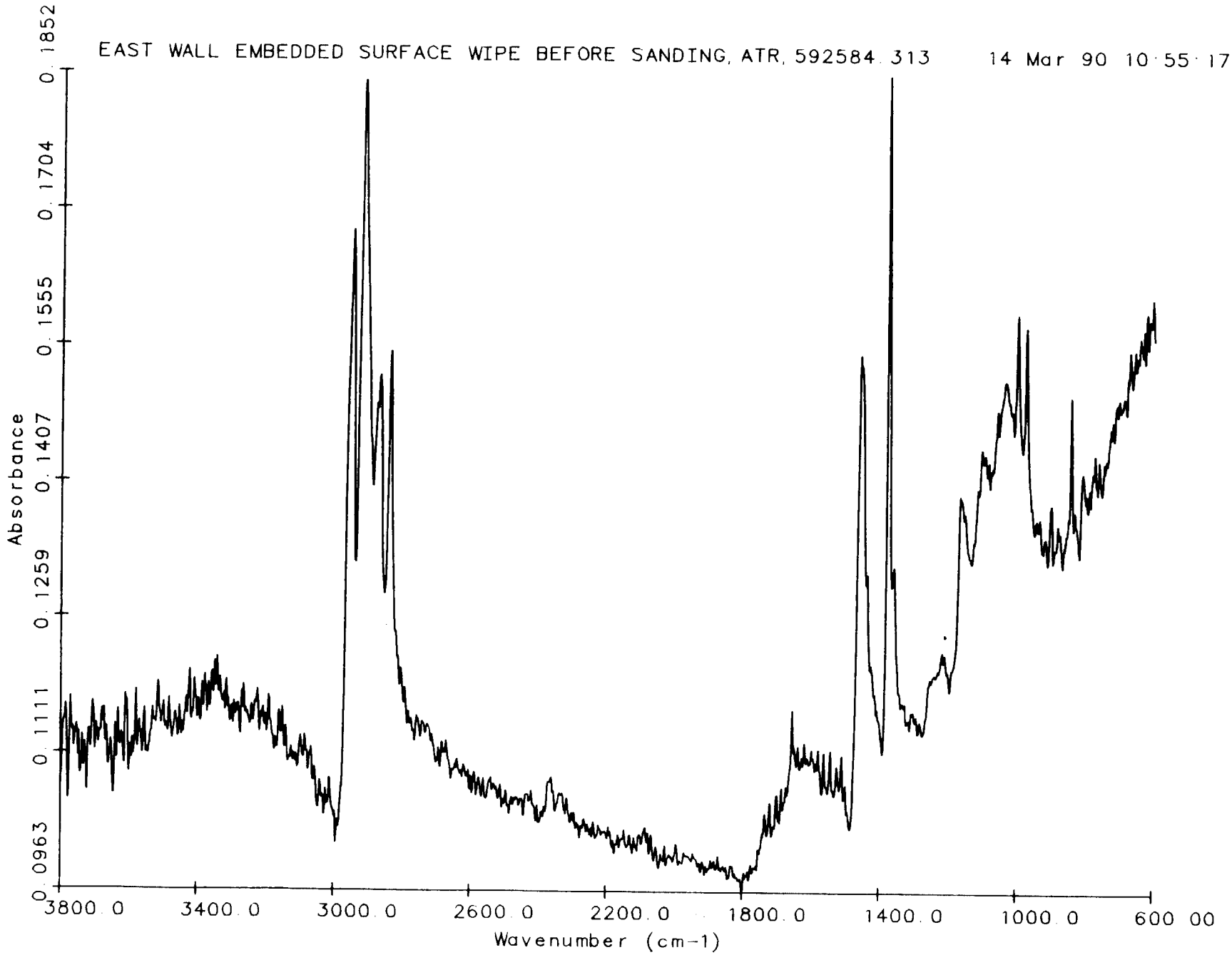

M-52 SPRAY BOOTH, WEST WALL #1 LOW, ATR CLAMP, 592584.307
14 Mar 90 08:37:14
Absorbance
0.2472
0.2267
0.2063
0.1859
0.1655
0.1451
0.1247
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

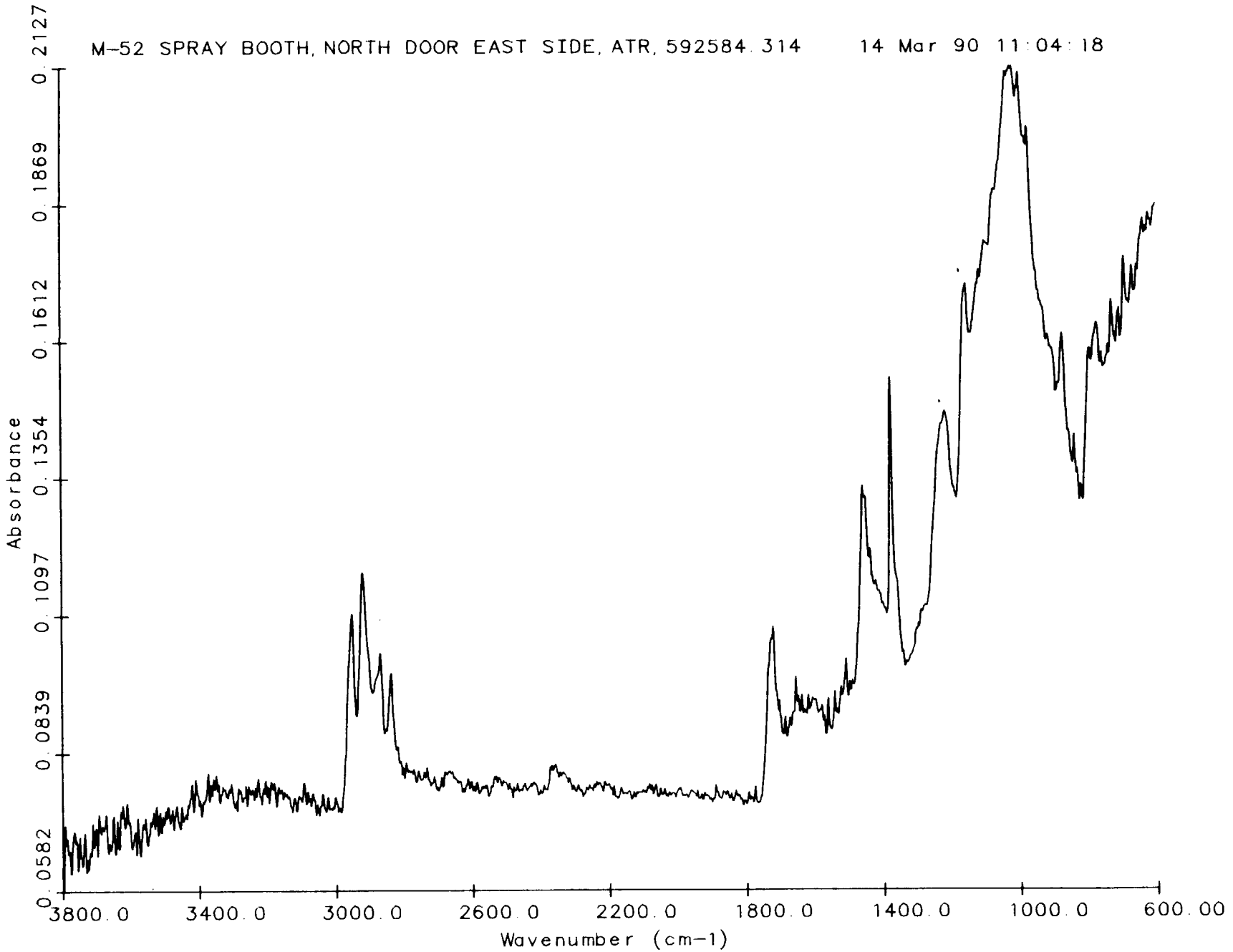

M-52 SPRAY BOOTH, WEST WALL #4 LOW, ATR CLAMPED, LWR 592584.309
14 Mar 90 09:02:48
Absorbance
0.1538
0.1432
0.1326
0.1220
0.1114
0.1007
0.0901
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

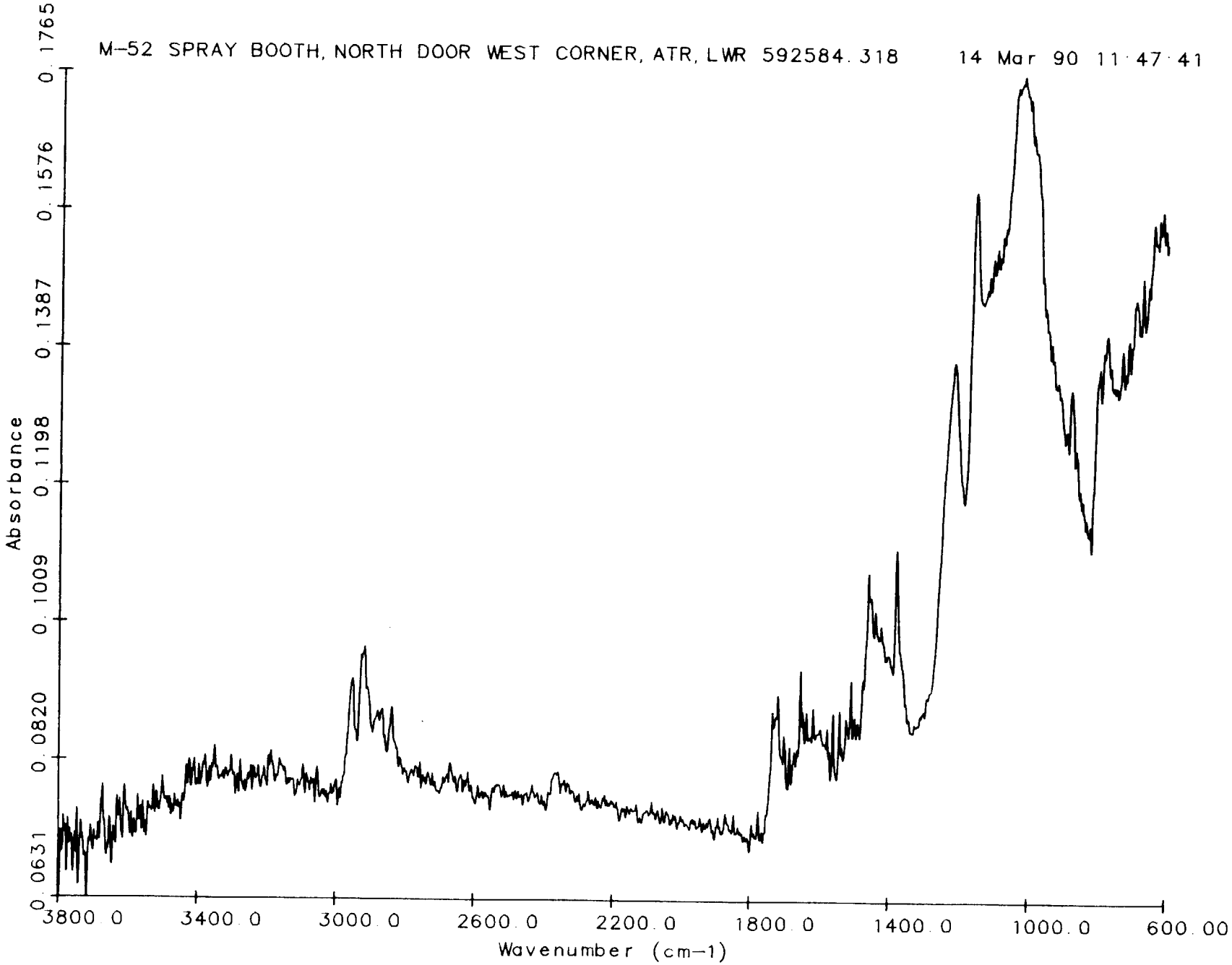

M-52 SPRAY BOOTH, SOUTH WALL #1 LOW, ATR CLAMPED, LWR 592584.310
14 Mar 90 09:42:16
Absorbance
0.1804
0.1576
0.1348
0.1119
0.0891
0.0663
0.0434
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

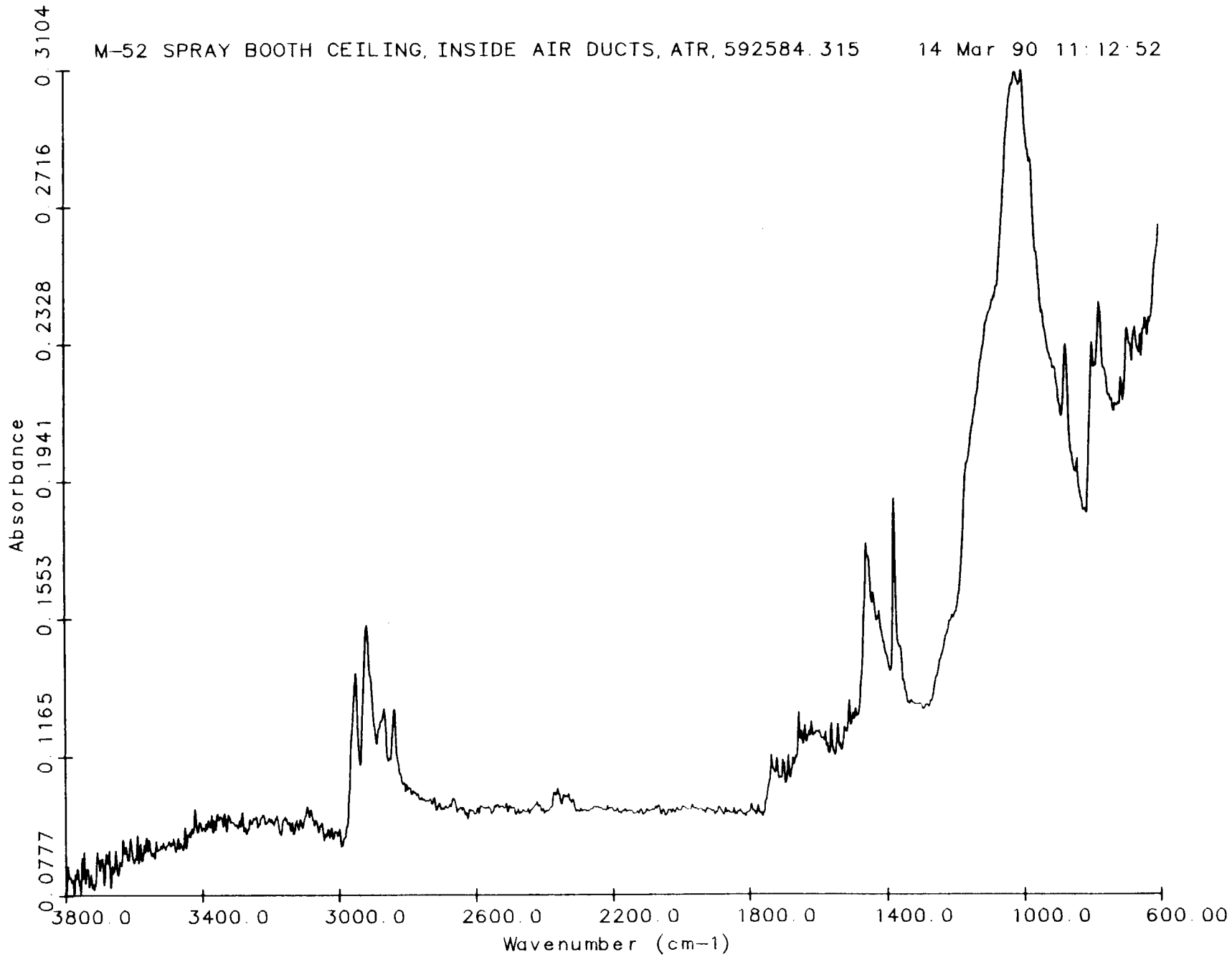

EAST WALL EMBEDDED AREA AFTER 2ND SANDING, ATR, 592584.311
14 Mar 90 10:09:45
Absorbance
0.3503
0.3351
0.3199
0.3046
0.2894
0.2741
0.2589
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

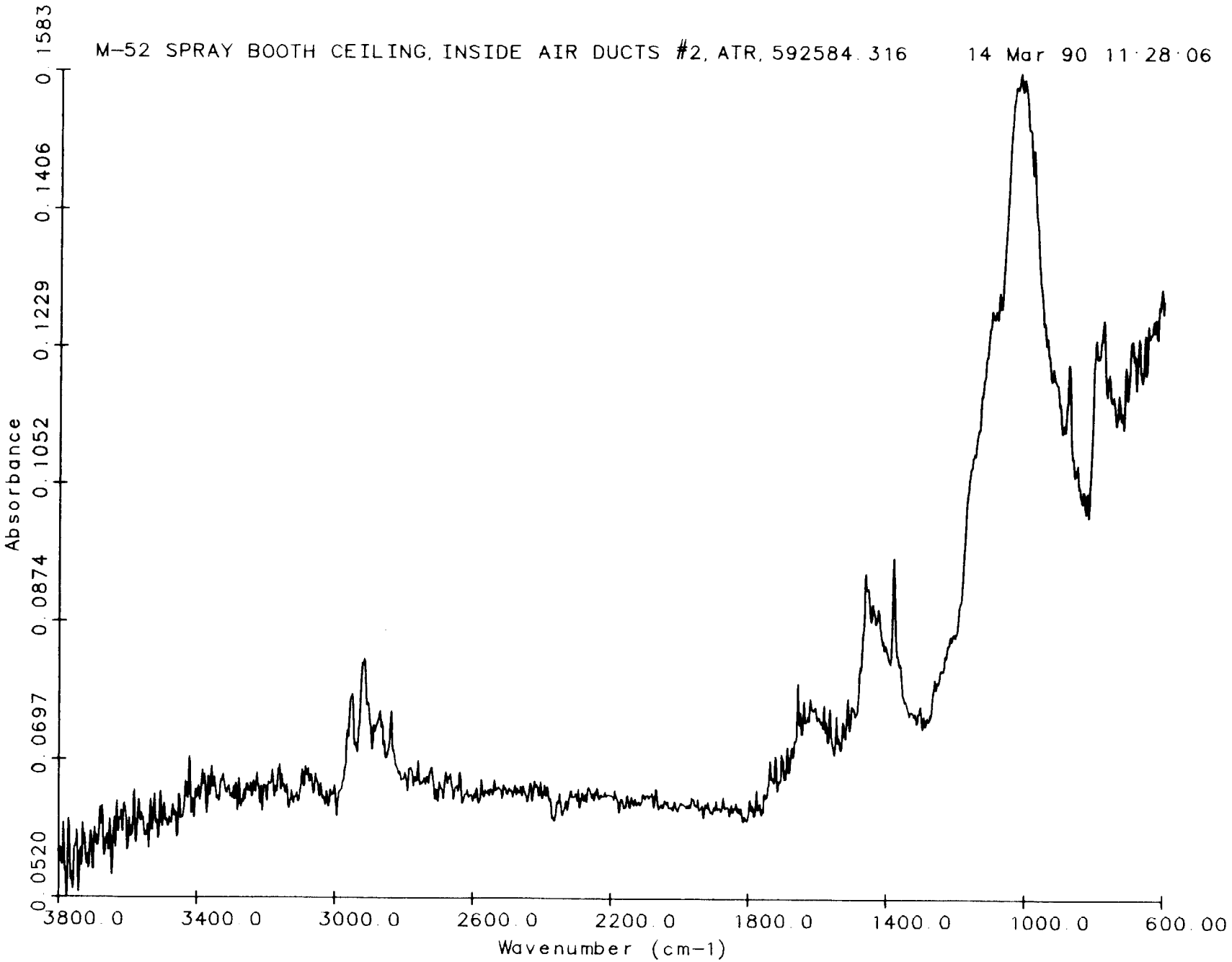

EAST WALL EMBEDDED AREA AFTER FIRST SANDING, ATR, 592584.312
14 Mar 90 10:29:10
Absorbance
0.1950
0.1817
0.1683
0.1550
0.1416
0.1283
0.1149
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

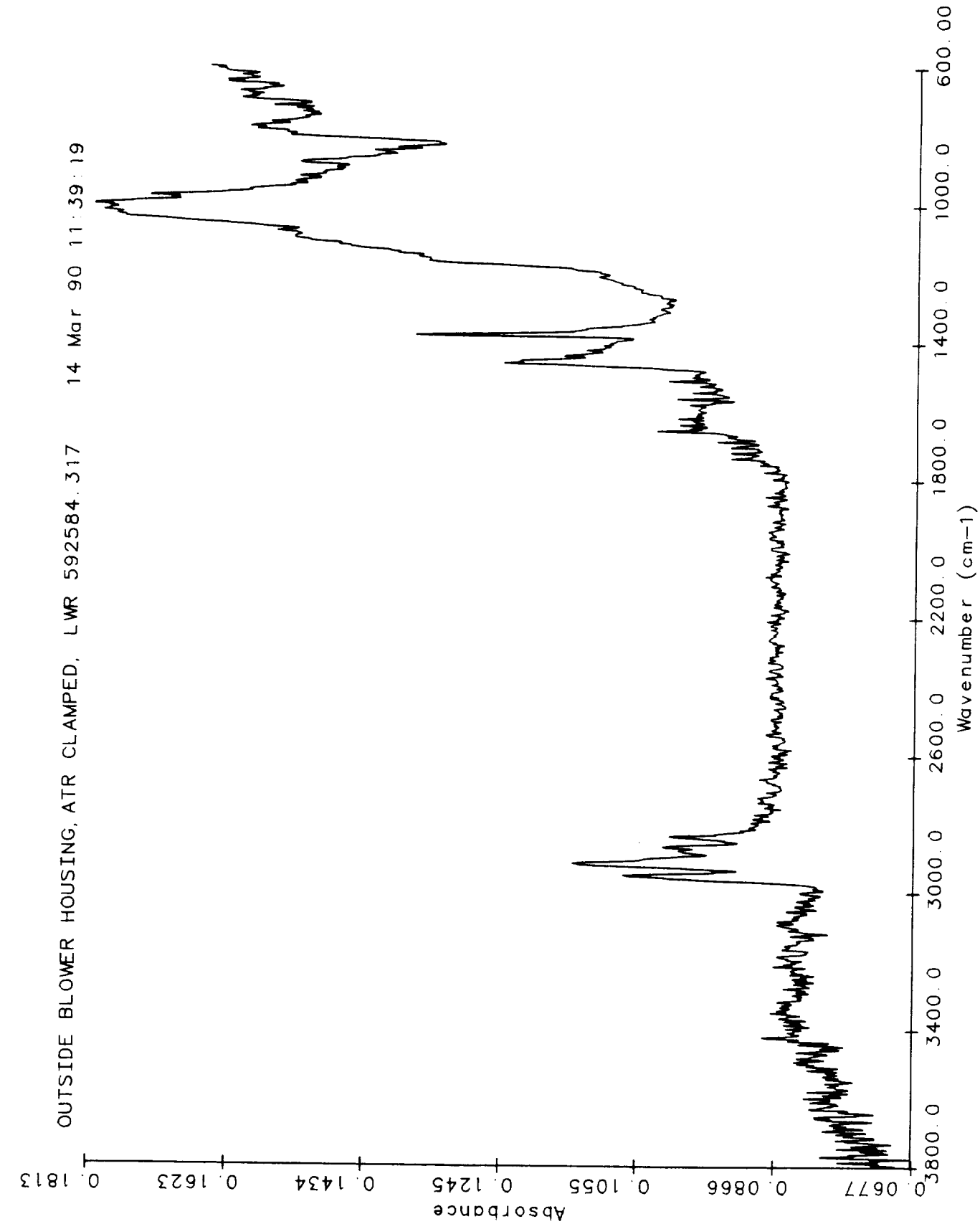

EAST WALL EMBEDDED SURFACE WIPE BEFORE SANDING, ATR, 592584.313
14 Mar 90 10:55:17
Absorbance
0.1852
0.1704
0.1555
0.1407
0.1259
0.1111
0.0963
0
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

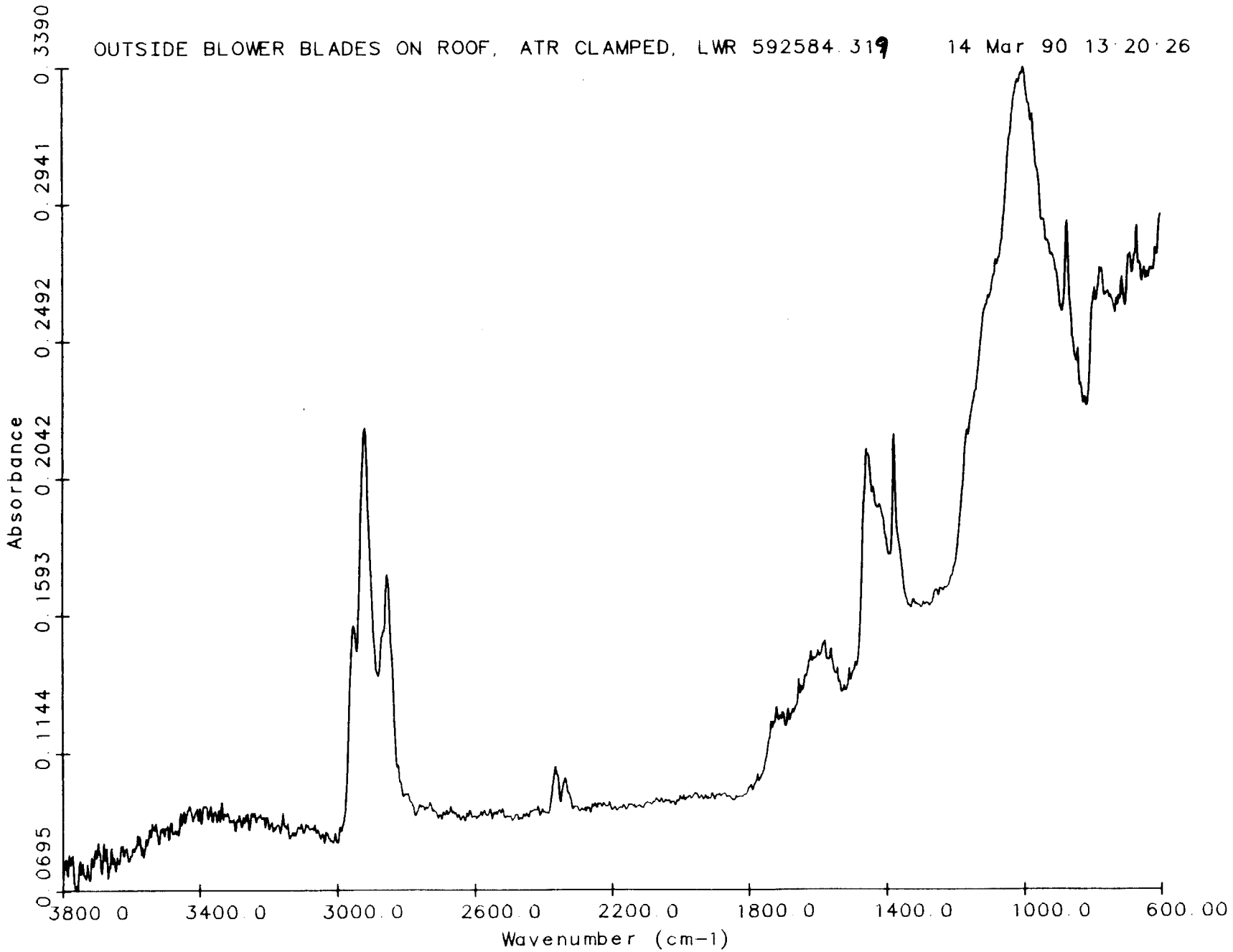

M-52 SPRAY BOOTH, NORTH DOOR EAST SIDE, ATR, 592584.314
14 Mar 90 11:04:18
Absorbance
0.2127
0.1869
0.1612
0.1354
0.1097
0.0839
0.0582
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

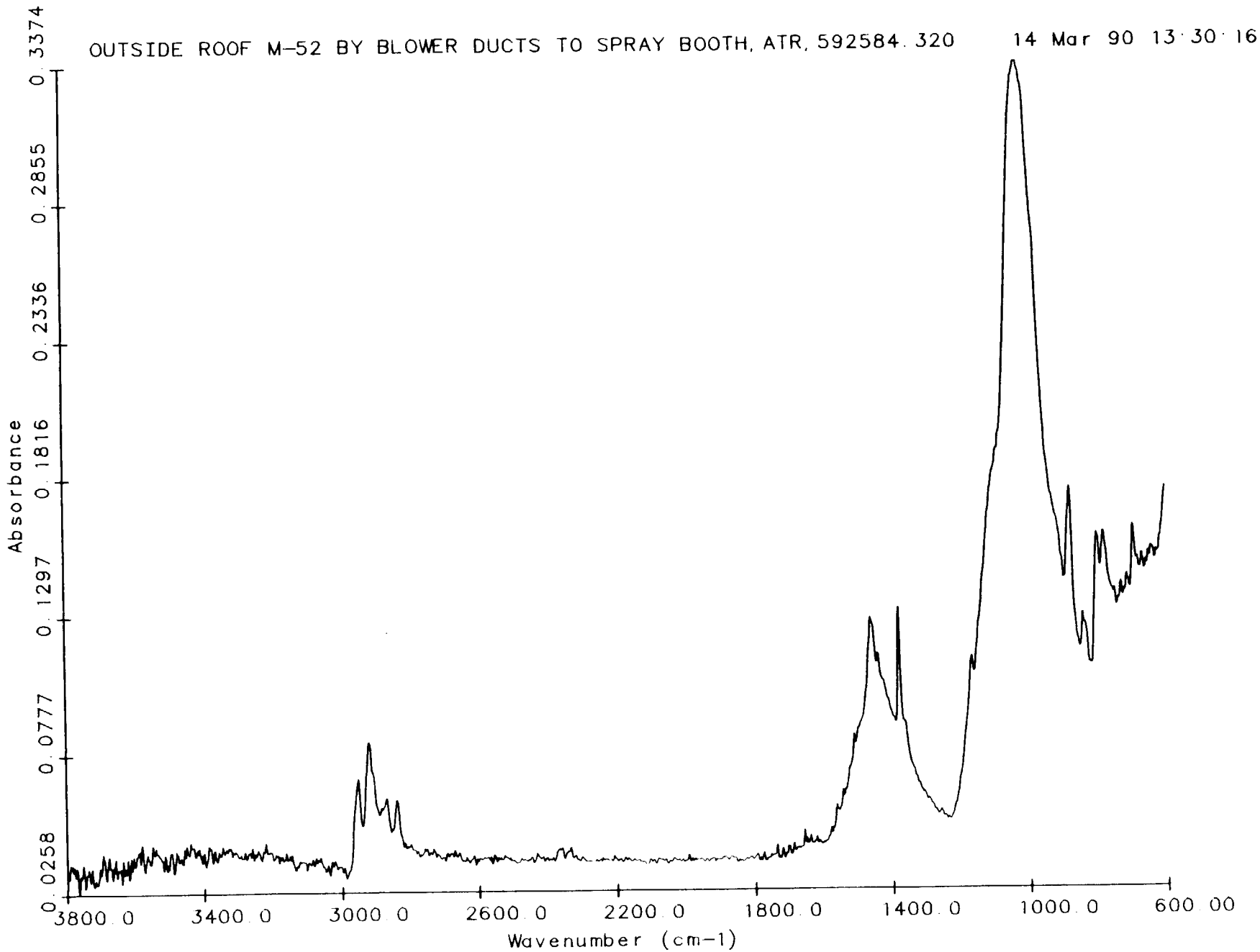

M-52 SPRAY BOOTH, NORTH DOOR WEST CORNER, ATR, LWR 592584.318
14 Mar 90 11:47:41
Absorbance
0.1765
0.1576
0.1387
0.1198
0.1009
0.0820
0.0631
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

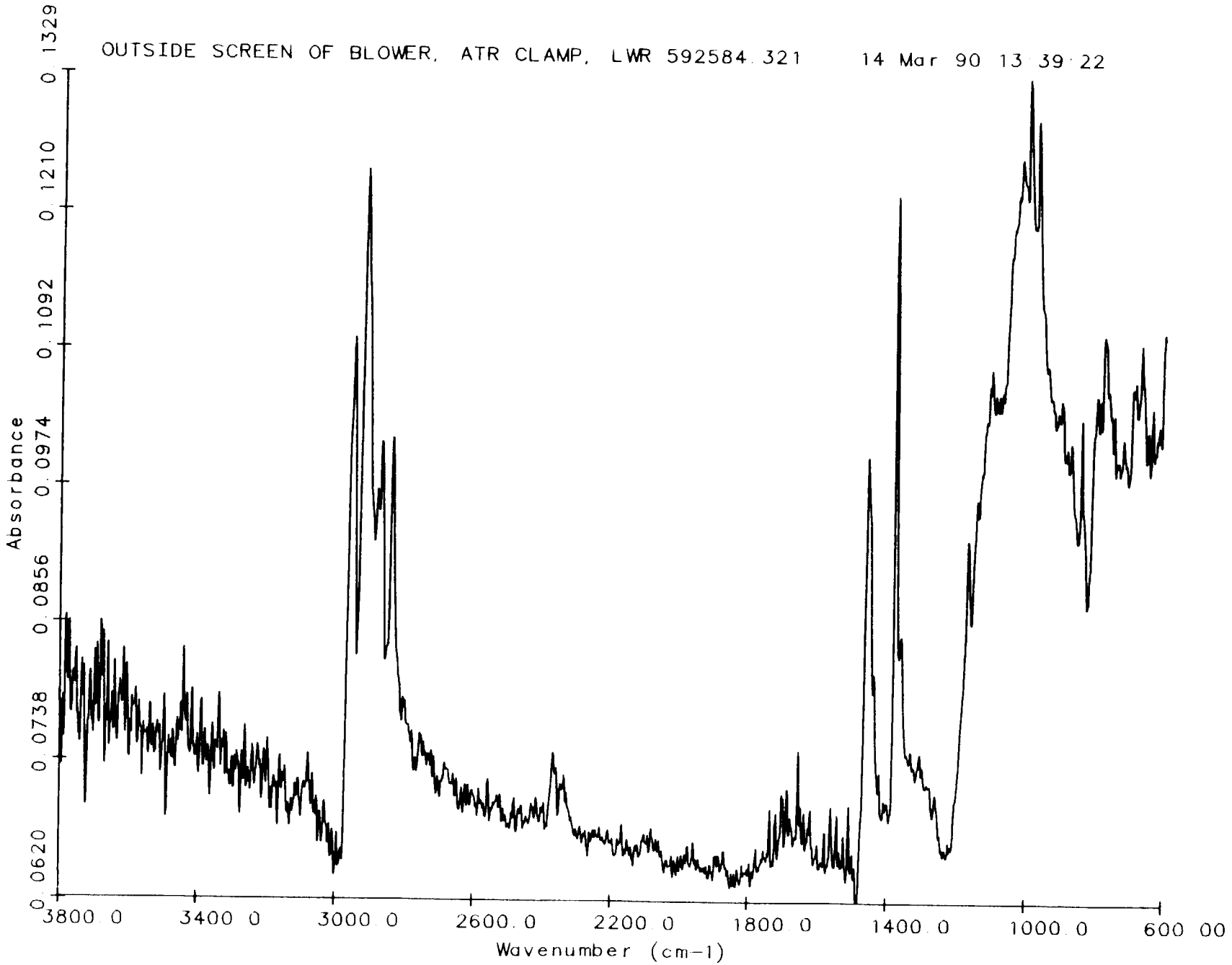

M-52 SPRAY BOOTH CEILING, INSIDE AIR DUCTS, ATR, 592584.315
14 Mar 90 11:12:52
Absorbance
0.3104
0.2716
0.2328
0.1941
0.1553
0.1165
0.0777
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH CEILING, INSIDE AIR DUCTS #2, ATR, 592584.316
14 Mar 90 11:28:06
Absorbance
0.1583
0.1406
0.1229
0.1052
0.0874
0.0697
0.0520
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


OUTSIDE BLOWER HOUSING, ATR CLAMPED, LWR 592584.317 14 Mar 90 11:39:19
Absorbance
0.0677
0.0866
0.1055
0.1245
0.1434
0.1623
0.1813
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


OUTSIDE BLOWER BLADES ON ROOF, ATR CLAMPED, LWR 592584.319
14 Mar 90 13:20:26
Absorbance
0.3390
0.2941
0.2492
0.2042
0.1593
0.1144
0.0695
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


OUTSIDE ROOF M-52 BY BLOWER DUCTS TO SPRAY BOOTH, ATR, 592584.320
14 Mar 90 13:30:16
Absorbance
0.3374
0.2855
0.2336
0.1816
0.1297
0.0777
0.0258
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


OUTSIDE SCREEN OF BLOWER, ATR CLAMP, LWR 592584.321
14 Mar 90 13:39:22
Absorbance
0.1329
0.1210
0.1092
0.0974
0.0856
0.0738
0.0620
0
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

Appendix E

Process Modification Discussion

Thiokol CORPORATION
SPACE OPERATIONS

21 March 1990
L623-FY90-M120

TO: Distribution

FROM: V. Fitch
Thermal Insulation Design

SUBJECT: CTP-0142, 'M-52 Spray Booth', Meeting Minutes, 15 March 1990

REFERENCE: L623-FY90-M112, 'Meeting Minutes 3-9-90 CTP-0142 (M-52 Spray Booth), V. Fitch, 9 March 1990

1.0 INTRODUCTION

The second CTP-0142 (M-52 spray booth) meeting was held 15 March. The spray booth is being qualified for paint and Chemlok® application processes of domes. The spray booth had been previously used for Teflon® application processes. The meeting was held to discuss results of FTIR analyses for Teflon® (not a test plan requirement) directed via the meeting held 9 March in response to cleaning/inspection iterations (See Reference 1).

2.0 SUMMARY

Teflon was detected on the walls and ceiling of the M-52 spray booth subsequent to each of three (1 prior to the test and 2 during the test) labor intensive solvent scrub/rinse cleaning operations. Direction was given to perform the subject FTIR analyses prior to proceeding with the test plan. The subject analyses provided answers to the questions brought forth during the previous meeting. Following completion of the action arrived at via the results of the analyses and dispensed in the subject meeting, direction was given on 20 March to proceed with the test plan (start at paragraph 8.2.1 B) as written.

3.0 CONCLUSIONS

The conclusion arrived at via the results of the subject FTIR analyses are listed below.

1) The FTIR analyses were validated as accurate (no false positives).

2) Teflon is not present in the spray booth air intake system.

3) The Teflon contamination is spotty.

A023243a

4) Teflon particles are, in part, embedded within the booth surfaces.

5) The cleaning methodology was flawed; contamination was transferred from area to area.

4.0 ACTION

Repeat the cleaning operation. Perform cleaning such that a discrete region (a panel) is scrubbed with solvent soaked scotch-brite pads, scrubbed with detergent and new scotch-brite pads, and then rinsed. Dispose of solvent and cleaning aids and repeat the procedure for each panel. After cleaning the entire booth, perform FTIR analyses for Teflon on the wipes taken over the entire booth. Re-clean any region (not just the randomly selected wipe area within the region) identified as contaminated. Repeat analysis for Teflon by taking another random wipe within the region.

5.0 DISCUSSION

Results of the subject analyses are discussed in sequence with the conclusions.

1) Some FTIR results were suspected as being false positives due to background. The suspicion arose from Teflon traces being identified on the new section of the west wall. Analyses for Teflon were performed on three wipes taken on the west wall (recently constructed) outside of the spray booth around the environmental monitor and also on a solvent dampened wipe. The analyses identified that false positives were not occurring.

2) Teflon particles were suspected as becoming airborne due to the ventilation system possibly being contaminated. Analyses of wipes taken on the roof by the air intake (1), within the blower housing (2), on the blower fan blade (1), and on the spray booth duct work (2) did not identify a trace of Teflon.

3) The detected levels of Teflon were suspected as being skewed due to the size of each wiped area. The subject wipes were taken on a much larger area (approximately 2 ft^2 as compared to approximately 25 in^2 for previous wipes). The results were compared to results after the second test plan cleaning (see attachment A).

   Note that each sample wipe is taken randomly within an approximately 7 x 7 ft region. Therefore, a wipe from an area within a region may have Teflon identified for one test and a second wipe from an area within the same region may not have Teflon identified, and vice-versa. Results of the analyses on the wipes demonstrate that the contaminated areas are localized or patchy. Certification of a Teflon free booth requires that all randomly selected wipes test negative for Teflon.

A023243a

4) The Teflon was suspected as being embedded in/on surfaces. A localized area of the east wall having obvious residue (oxide) on the surface was wiped, abraded with emery cloth, wiped, abraded, and wiped again. The FTIR analysis of the wipes identified a trace of Teflon, a lesser trace of Teflon, and finally no detected Teflon, respectively. Teflon was embedded within the visible oxide layer. This layer was removed by the abrasion.

5) From the discussions of the previous four sections, the conclusion is formed that the cleaning operation was, in part, moving Teflon from area to area. The cleaning aids and solvent were not disposed of frequently and were, hence, a source of contamination

V. Fitch

Concurred by:

F. B. Baugh, Supervisor
Thermal Insulation Design

VWF/pn

A023243a

LABORATORY REPORT

08 Mar. 1990

Originator: Vern Fitch
Ext 6344, M/S L62B

Request: LWR 592584
Laboratory log # 02-21-90-31122

Subject: FTIR Analysis of M-52 Spray Booth for Teflon
CTP-0142

FTIR analysis has been carried out on wipe samples taken from the ceiling and walls of the M-52 spray booth. The samples were taken by wiping an area about ~~5" x 5"~~ 2" x 2" square with a polypropylene wipe wet with Freon TF. The presence of Teflon was detected by the appearance of the C-F absorbance peaks at about 1160 and about 1230 wavenumbers.

Sample Location	Occurrence of Teflon			
	Before 1st Cleaning	2nd Cleaning	3rd Cleaning	
South Wall #1 (High) (East)	Present	Present	None	
South Wall #1 (Low) (East)	----	----	----	None*
South Wall #2 (High) (West)	Present	Trace	None	
South Wall #2 (Low) (West)	----	----	----	None*
North Door East Side	----	----	----	Present*
North Door West Side	----	----	----	Present*
East Ceiling #1 (North)	Trace	Present	None	
East Ceiling #2	Trace	Present	None	
East Ceiling #3	None	Trace	None	
East Ceiling #4 (South)	Present	Present	Trace	

Sample Location	Occurrence of Teflon			
	Before	1st Cleaning	2nd Cleaning	3rd Cleaning
West Ceiling #1 (North)	None	None	None	
West Ceiling #2	Trace	None	Trace	
West Ceiling #3	Trace	None	None	
West Ceiling #4 (South)	None	None	None	
East Wall #1 (High) (North)	Present	None	Trace	
East Wall #1 (Low) (North)	Trace	Trace	Trace	None
East Wall #2 (High)	Present	Present	Trace	
East Wall #2 (Low)	Present	Trace	Present	Trace
East Wall #3 (High)	Present	Present	Present	
East Wall #3 (Low)	Present	Present	Trace	
East Wall #4 (High) (South)	Present	Present	Trace	
East Wall #4 (Low) (South)	Present	Trace	Trace	None
West Wall #1 (High) (North)	Trace	Trace	Trace	
West Wall #1 (Low) (North)	None	Trace	Trace	None
West Wall #2 (High)	None	Trace	None	
West Wall #2 (Low)	——	None	None	
West Wall #3 (High)	——	None	Trace	
West Wall #3 (Low)	——	Present	Trace	Trace
West Wall #4 (High) (South)	——	Present	None	
West Wall #4 (Low)	Trace	Present	Trace	None

* The low south wall and north door samples were only taken after the 3rd cleaning.

In addition to the above test locations, an embedded surface on the east wall was sampled before and after sanding with the following results:

Sample Location	Occurrence of Teflon
East Wall Embedded Surface	
Before Sanding	Trace
After First Sanding	Trace (less than before sanding)
After Second Sanding	None

Also, a number of samples were taken outside of the spray booth with the following results:

Sample Location	Occurrence of Teflon
Spray Booth Ceiling Inside Air Ducts #1	None
Spray Booth Ceiling Inside Air Ducts #2	None
Outside Blower Housing	None
Outside Blower Blades on Roof	None
Outside Roof by Blower Blades to Spray Booth	None
Outside Screen of Blower	None
Control Sample #1	None
Control Sample #2	None
Control Sample #3	None

Copies of the FTIR spectra are attached.

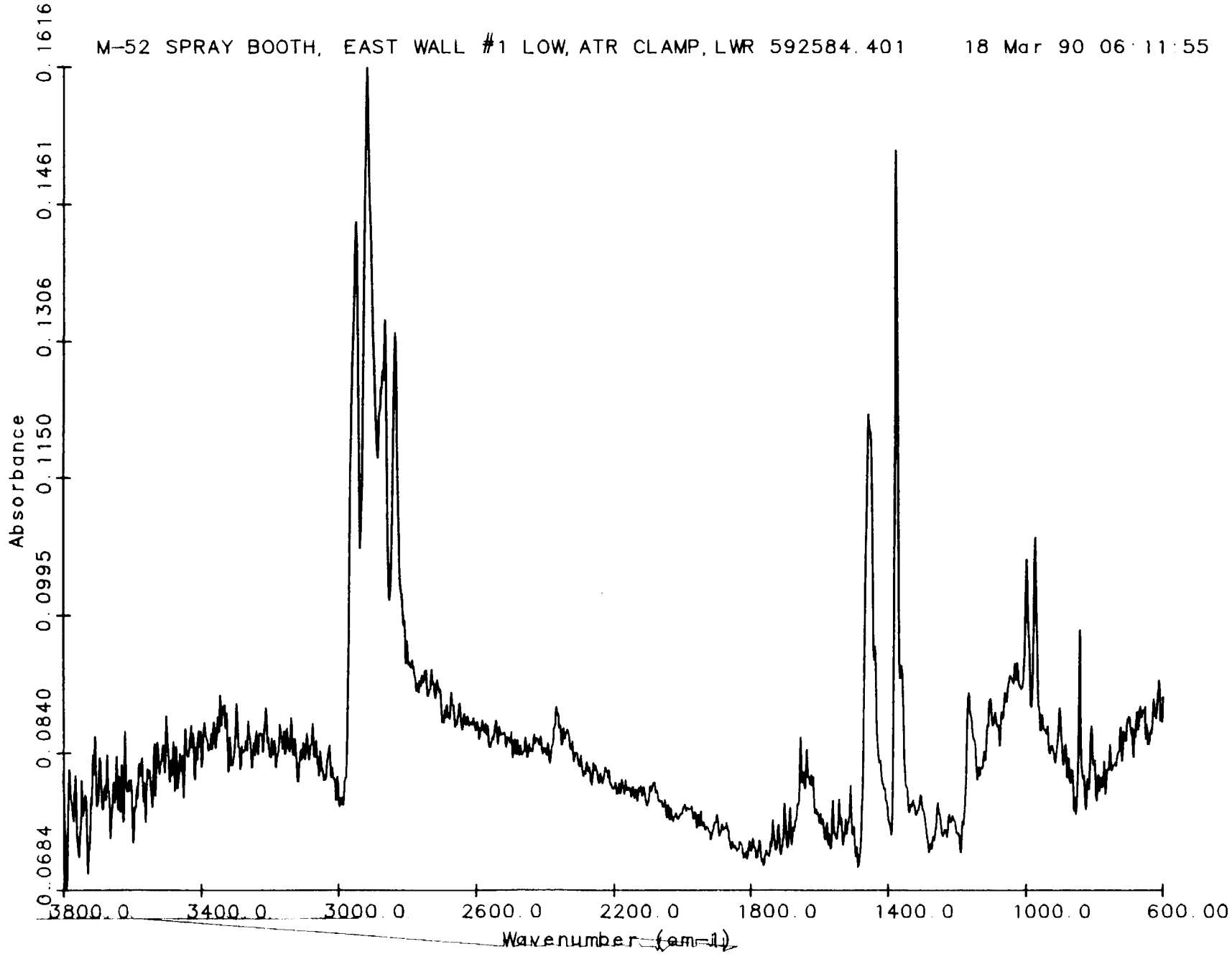
R. C. Raisor, Spectrochemical Analysis
LAB90061
B1222

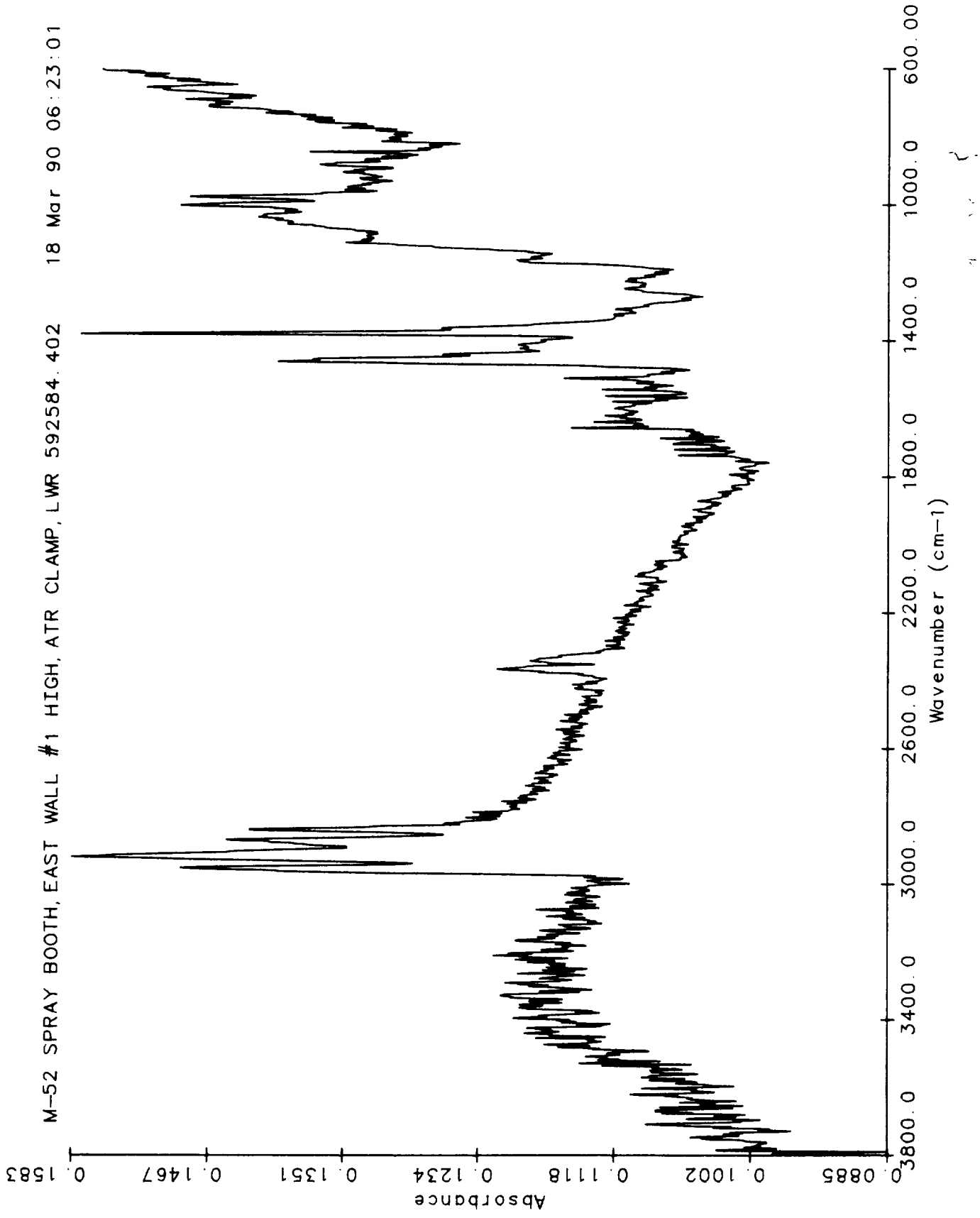
Distribution	M/S
L. Allred	L72A
*R. Andersen	650
F. Baugh	L62B
*D. Call	692
J. Daines	L61
D. Earl	692
N. Eddy	L62B
*V. Fitch	L62B
S. Foth	811
R. Furrows	L72
*L. Manuel	L71
R. Marsh	E63
S. Mildenhall	L90
B. Nelson	L82
*P. Petty	L82
*R. Raisor	245
C. Whitworth	L90
R. Wilks	L62

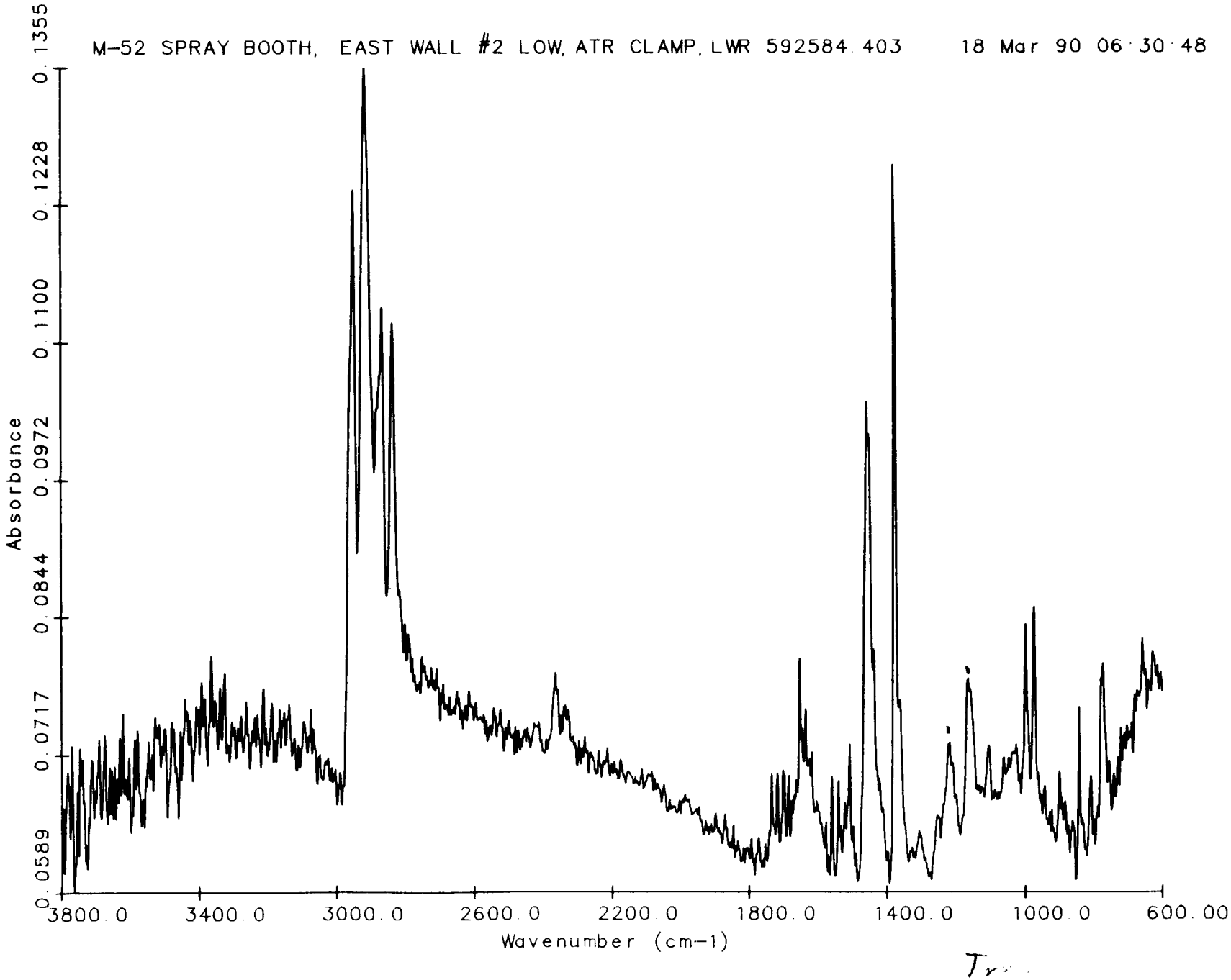
* Attendees

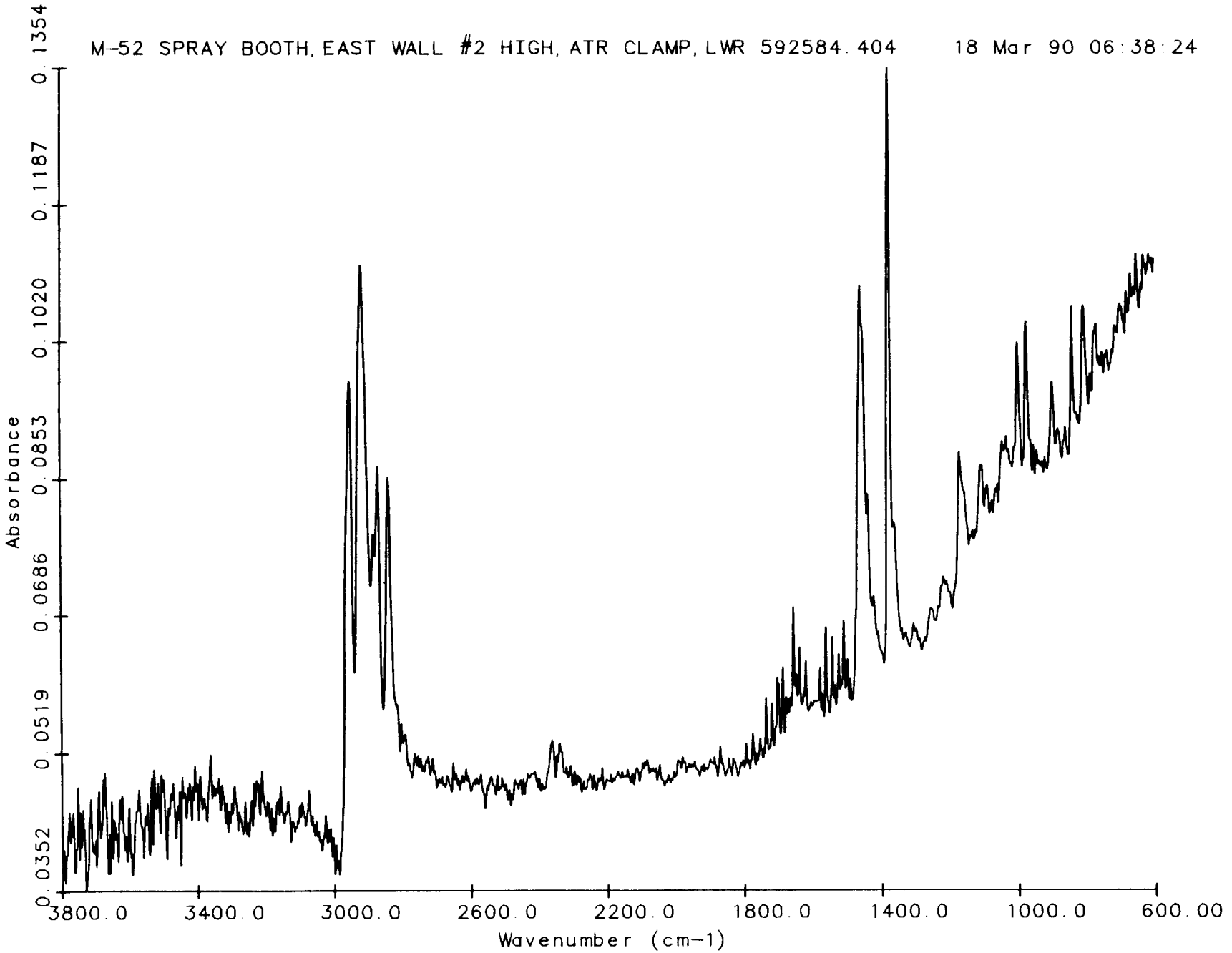
Appendix F

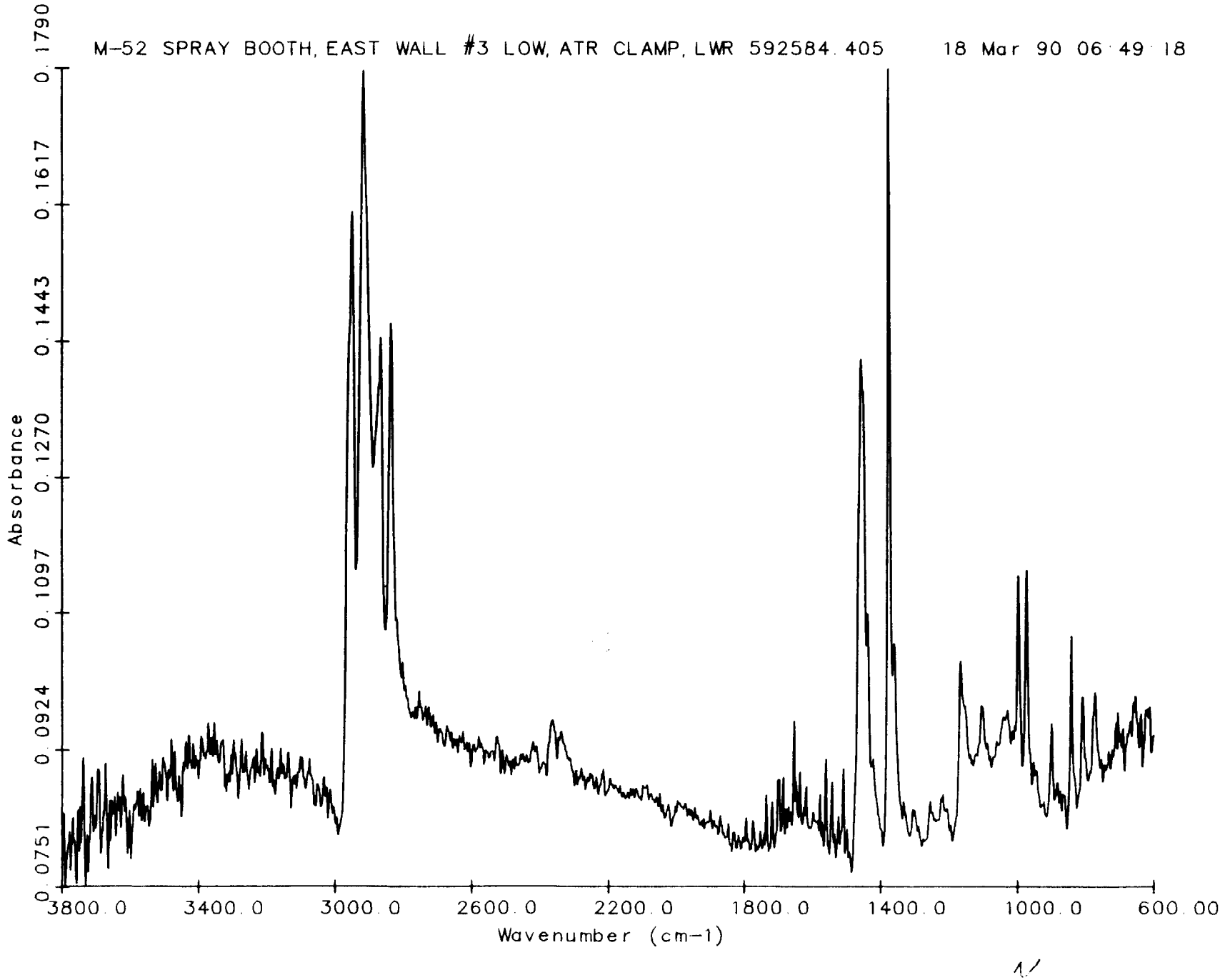
Fifth FTIR Sample Wipes

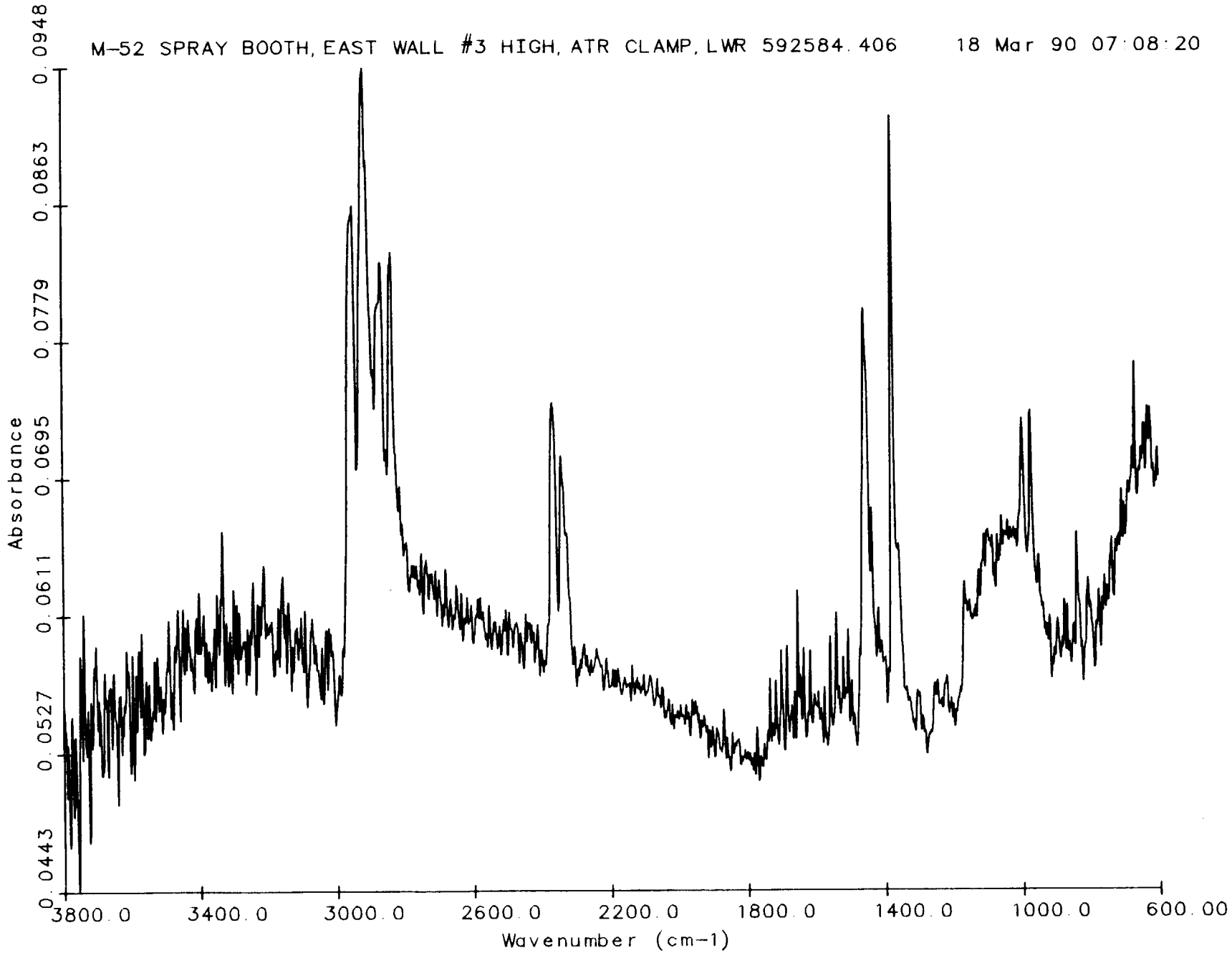

M-52 SPRAY BOOTH, EAST WALL #1 LOW, ATR CLAMP, LWR 592584.401
18 Mar 90 06:11:55
Absorbance
0.1616
0.1461
0.1306
0.1150
0.0995
0.0840
0.0684
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

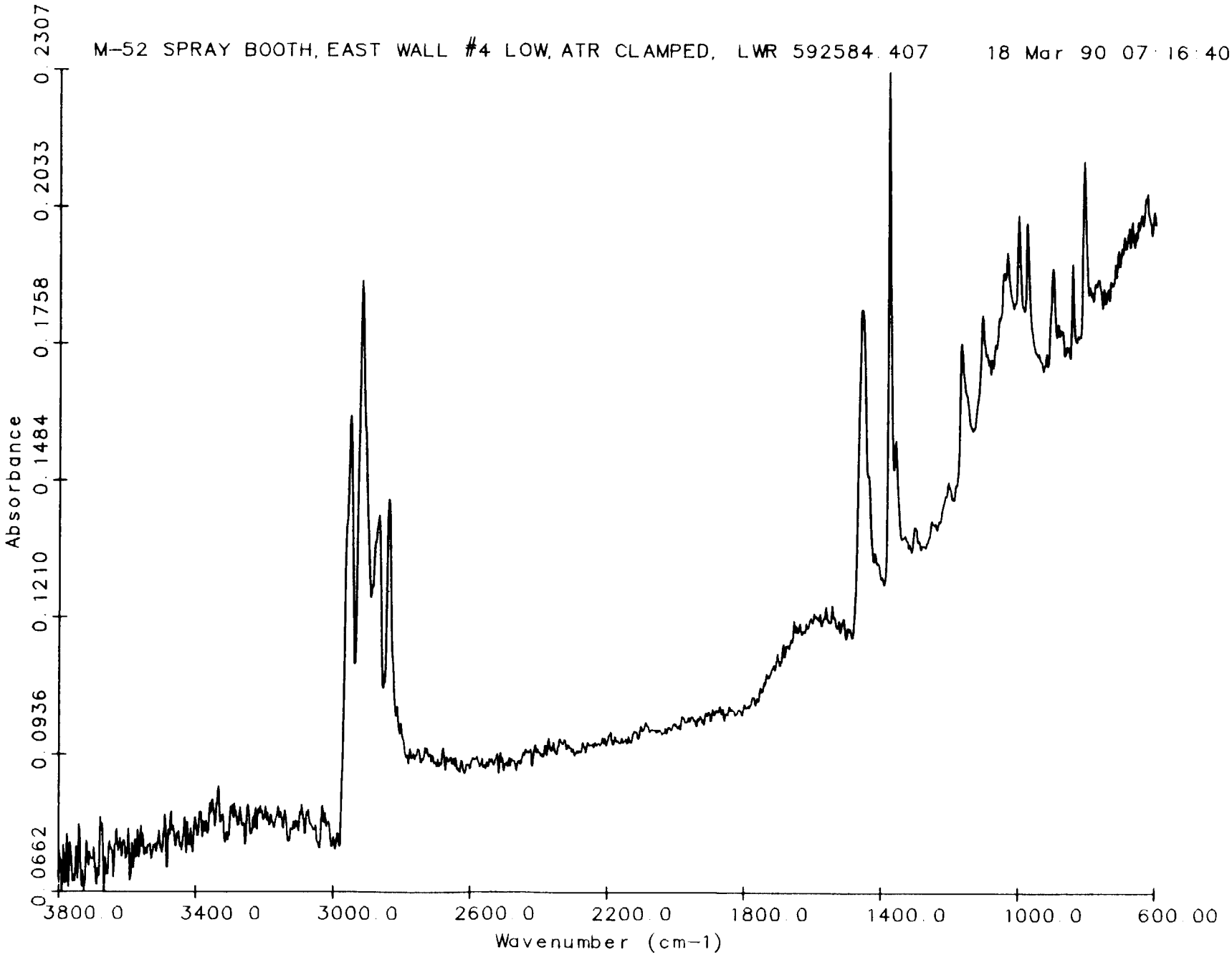

M-52 SPRAY BOOTH, EAST WALL #1 HIGH, ATR CLAMP, LWR 592584.402 18 Mar 90 06:23:01
Absorbance
0.0885
0.1002
0.1118
0.1234
0.1351
0.1467
0.1583
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

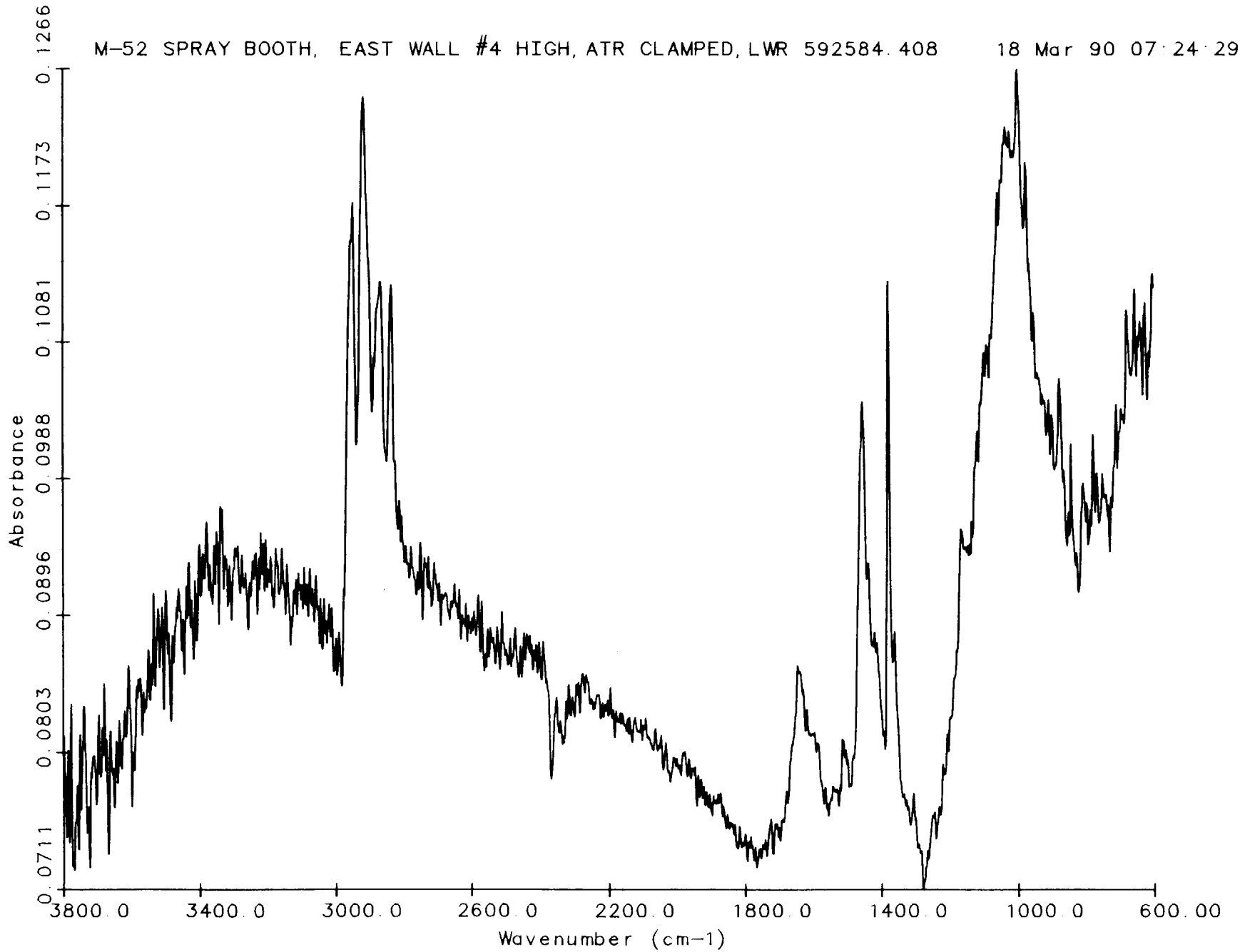

M-52 SPRAY BOOTH, EAST WALL #2 LOW, ATR CLAMP, LWR 592584.403
18 Mar 90 06:30:48
Absorbance
0.1355
0.1228
0.1100
0.0972
0.0844
0.0717
0.0589
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

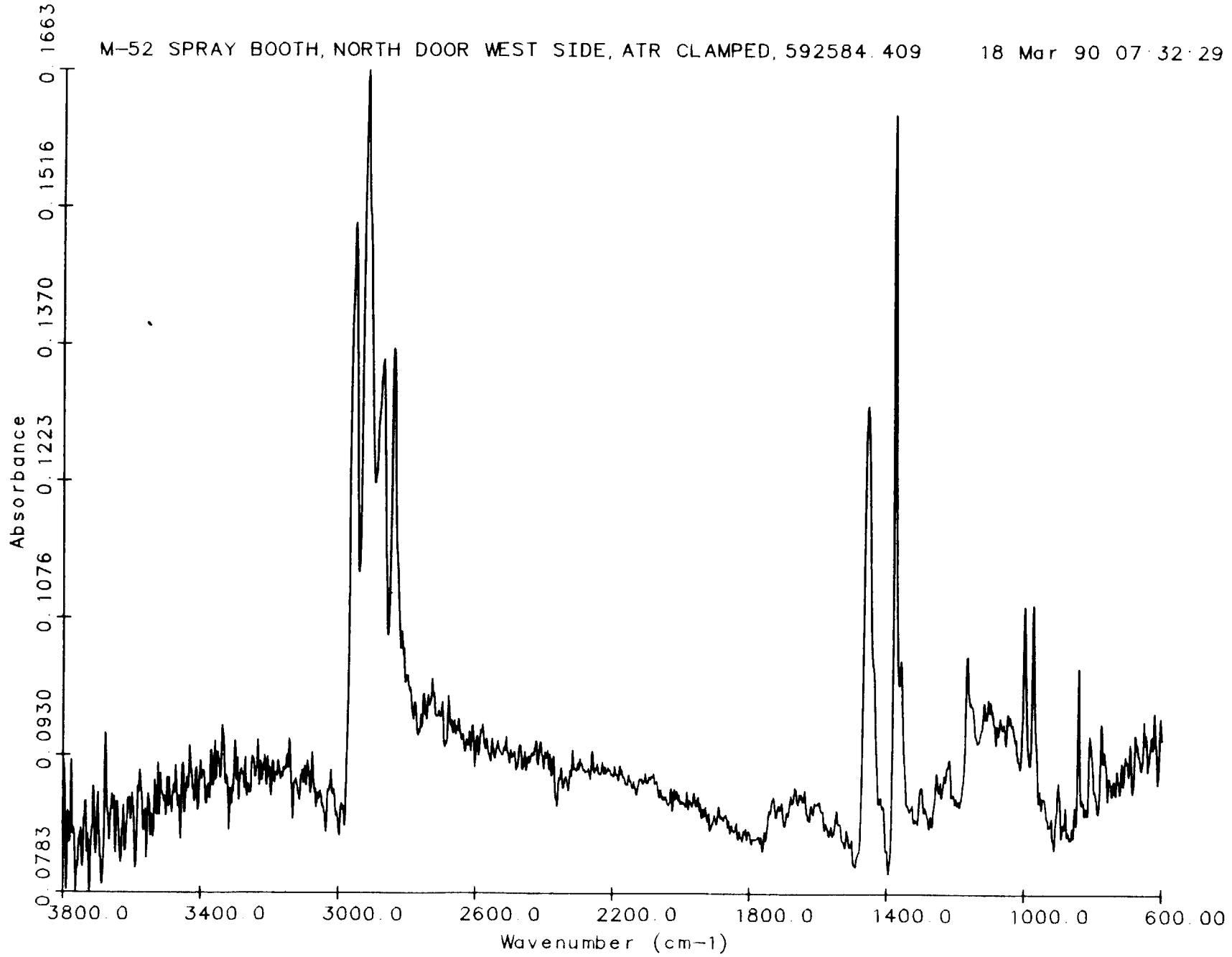

M-52 SPRAY BOOTH, EAST WALL #2 HIGH, ATR CLAMP, LWR 592584.404
18 Mar 90 06:38:24
Absorbance
0.1354
0.1187
0.1020
0.0853
0.0686
0.0519
0.0352
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

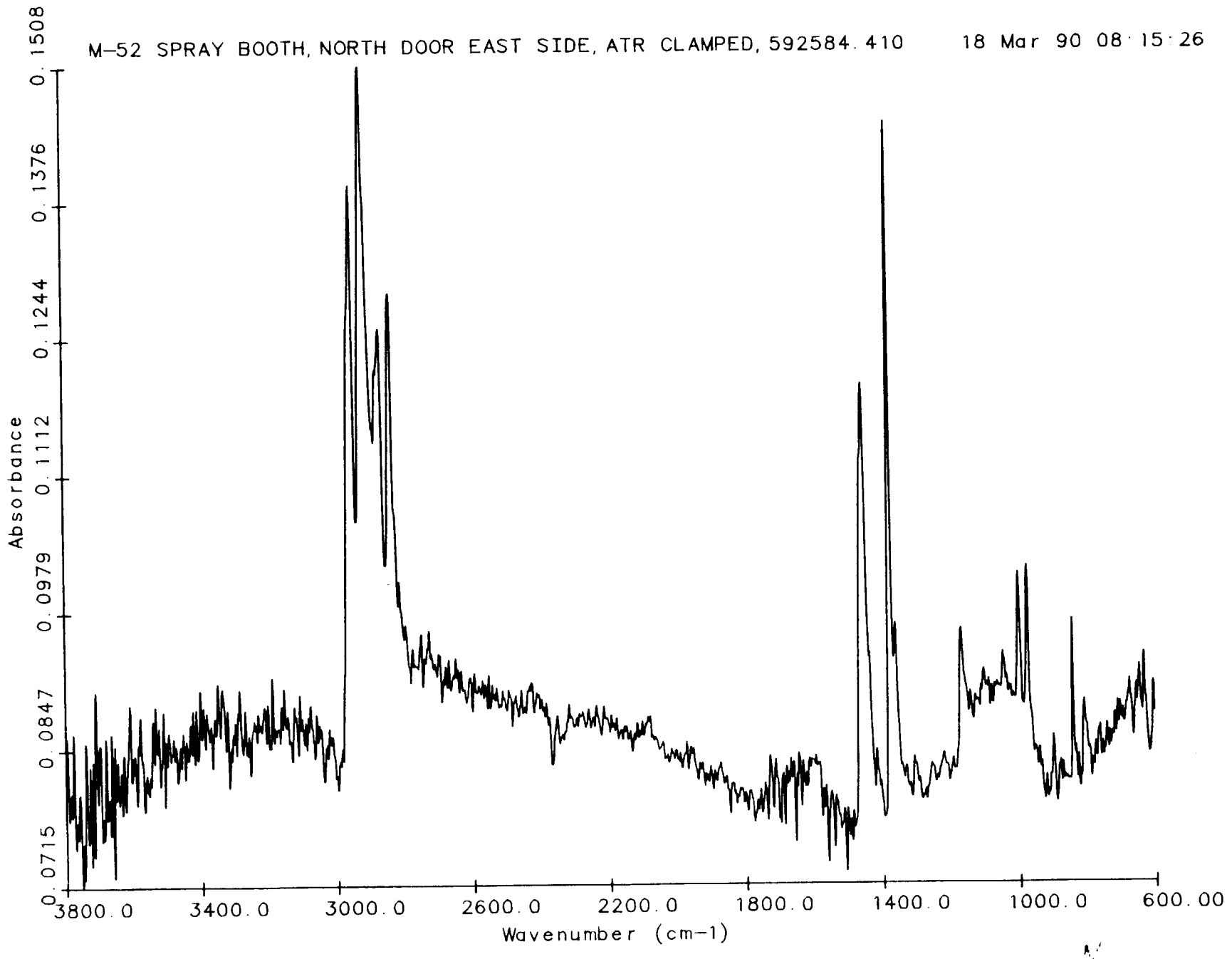

M-52 SPRAY BOOTH, EAST WALL #3 LOW, ATR CLAMP, LWR 592584.405
18 Mar 90 06:49:18
Absorbance
0.1790
0.1617
0.1443
0.1270
0.1097
0.0924
0.0751
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

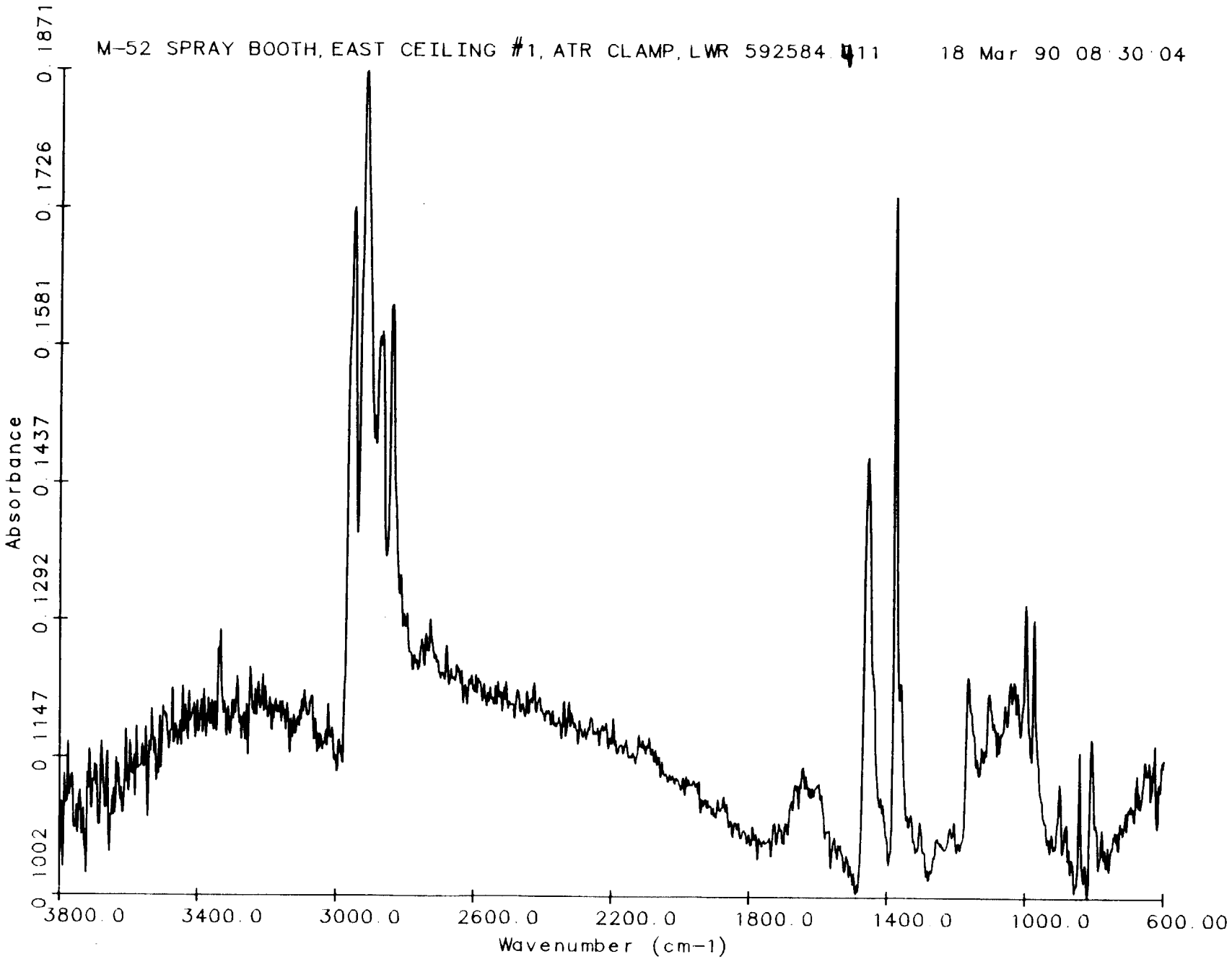

M-52 SPRAY BOOTH, EAST WALL #3 HIGH, ATR CLAMP, LWR 592584.406
18 Mar 90 07:08:20
Absorbance
0.0948
0.0863
0.0779
0.0695
0.0611
0.0527
0.0443
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

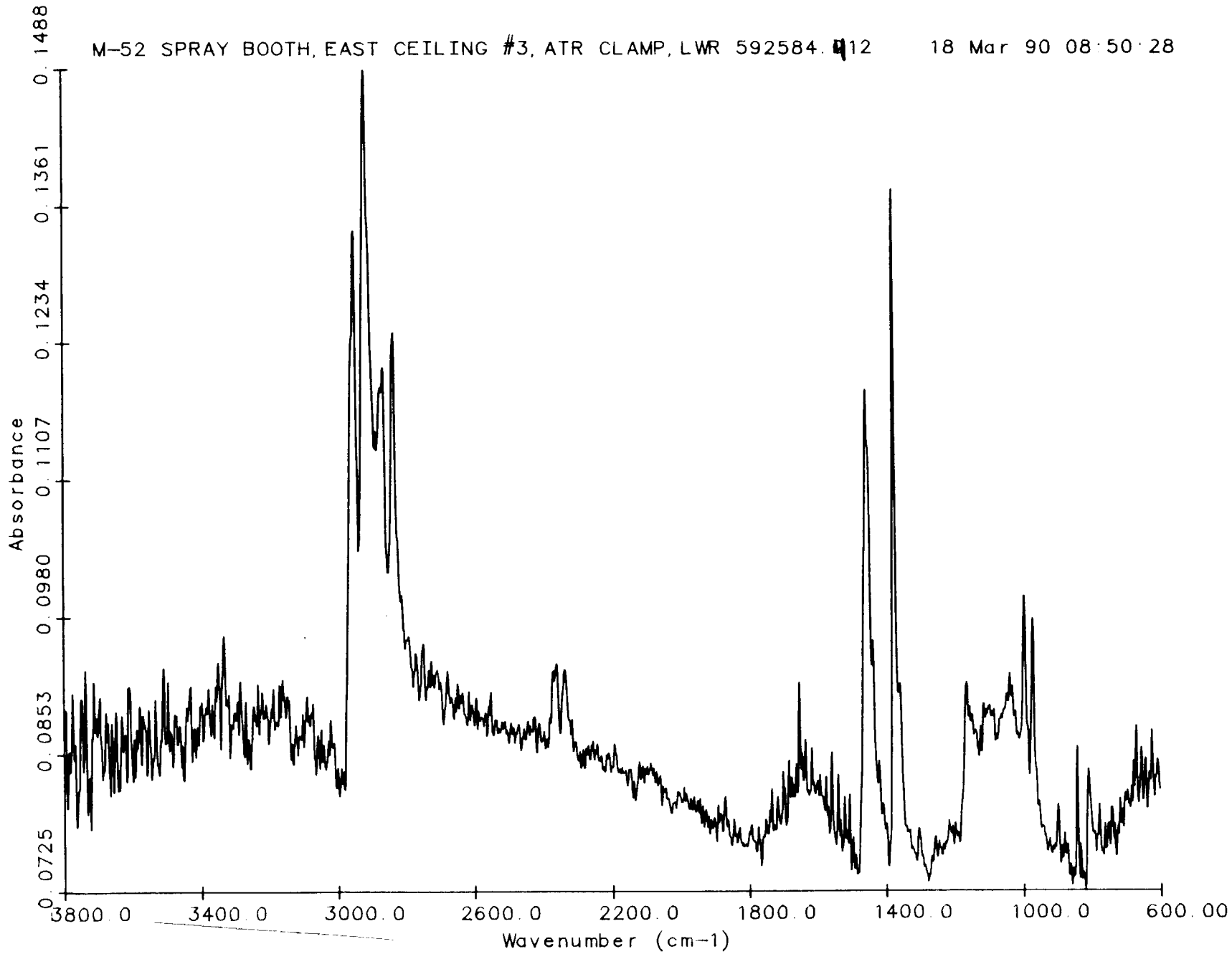

M-52 SPRAY BOOTH, EAST WALL #4 LOW, ATR CLAMPED, LWR 592584.407
18 Mar 90 07:16:40
Absorbance
0.2307
0.2033
0.1758
0.1484
0.1210
0.0936
0.0662
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

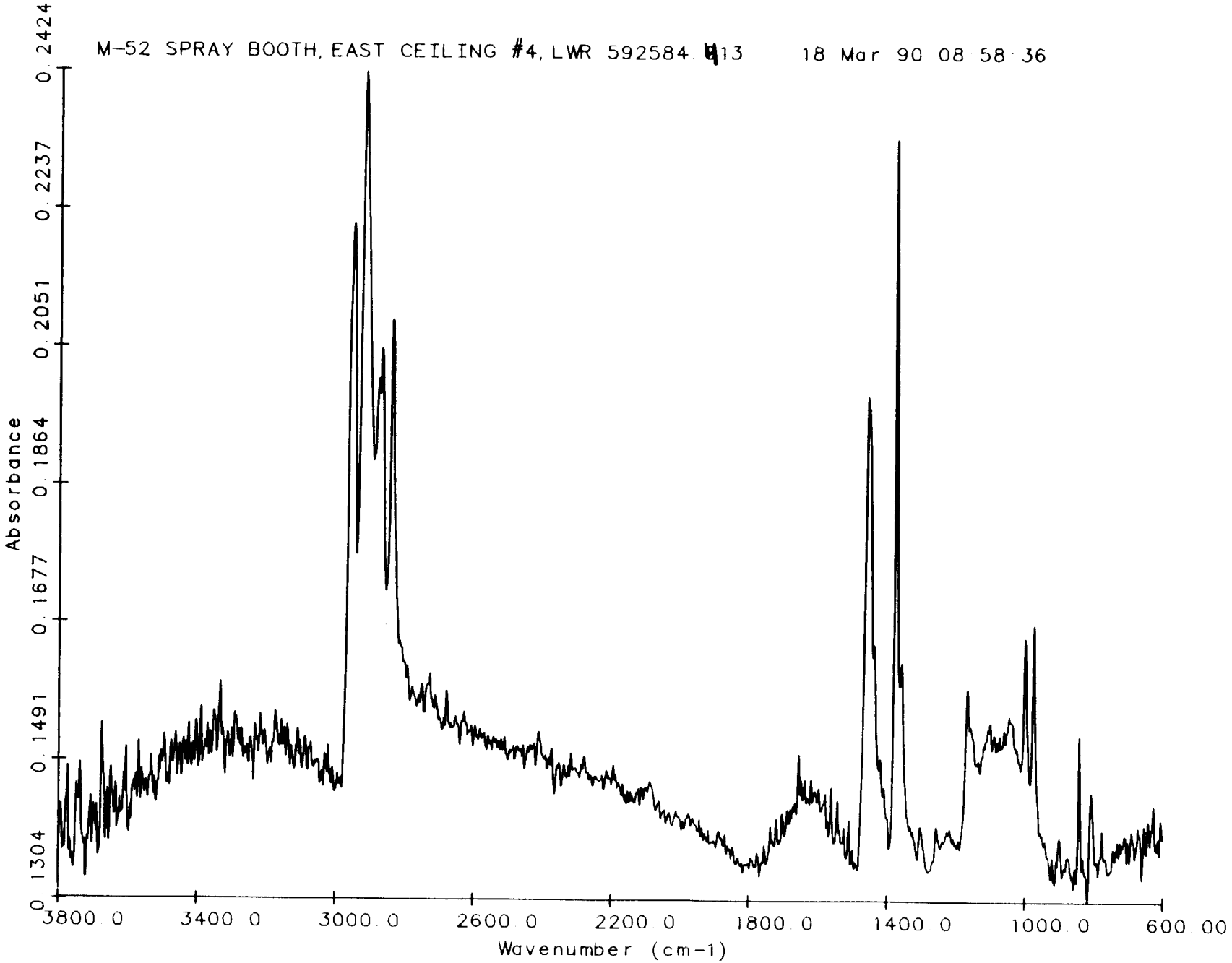

M-52 SPRAY BOOTH, EAST WALL #4 HIGH, ATR CLAMPED, LWR 592584.408
18 Mar 90 07:24:29
Absorbance
0.1266
0.1173
0.1081
0.0988
0.0896
0.0803
0.0711
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

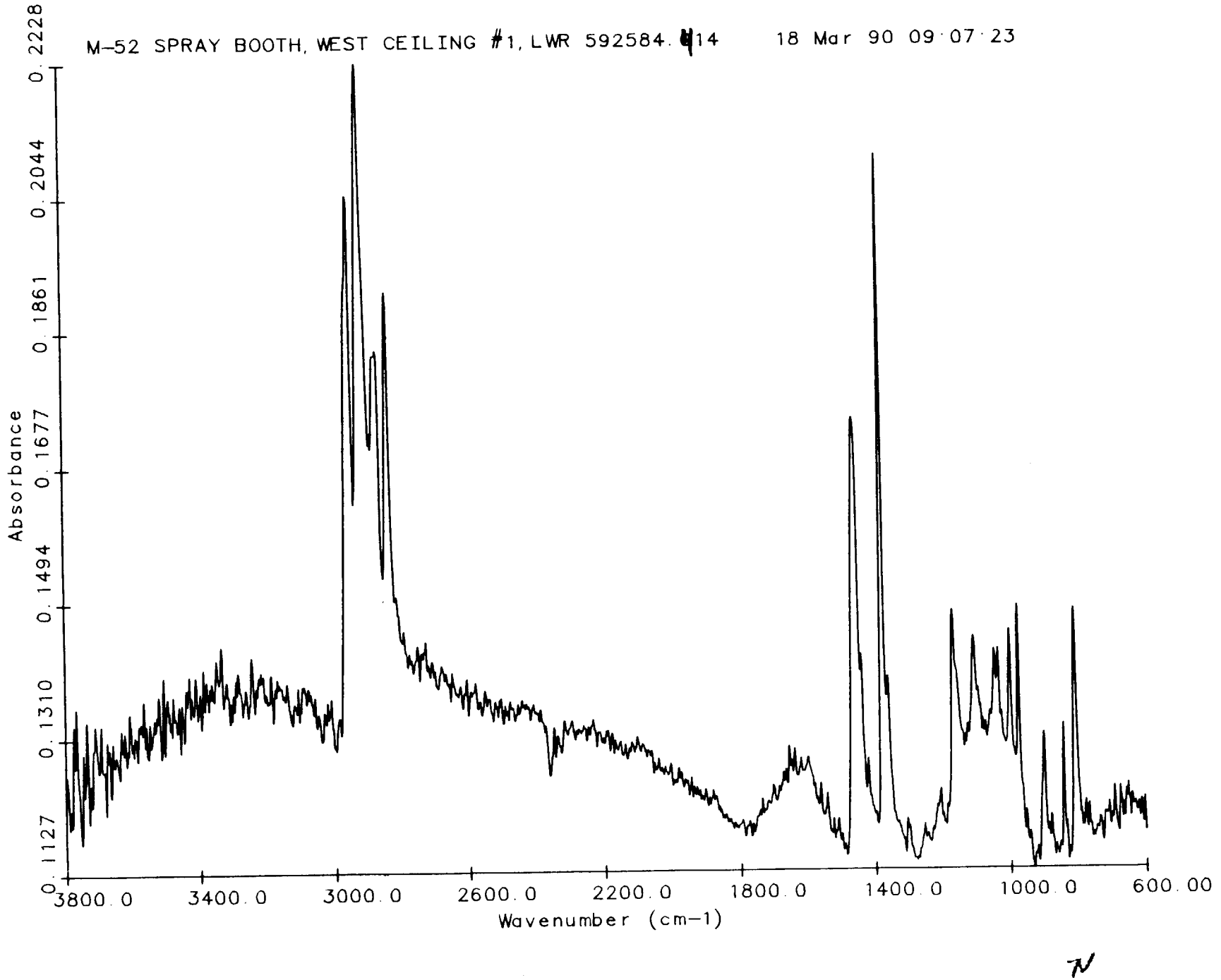

M-52 SPRAY BOOTH, NORTH DOOR WEST SIDE, ATR CLAMPED, 592584.409
18 Mar 90 07:32:29
Absorbance
0.1663
0.1516
0.1370
0.1223
0.1076
0.0930
0.0783
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

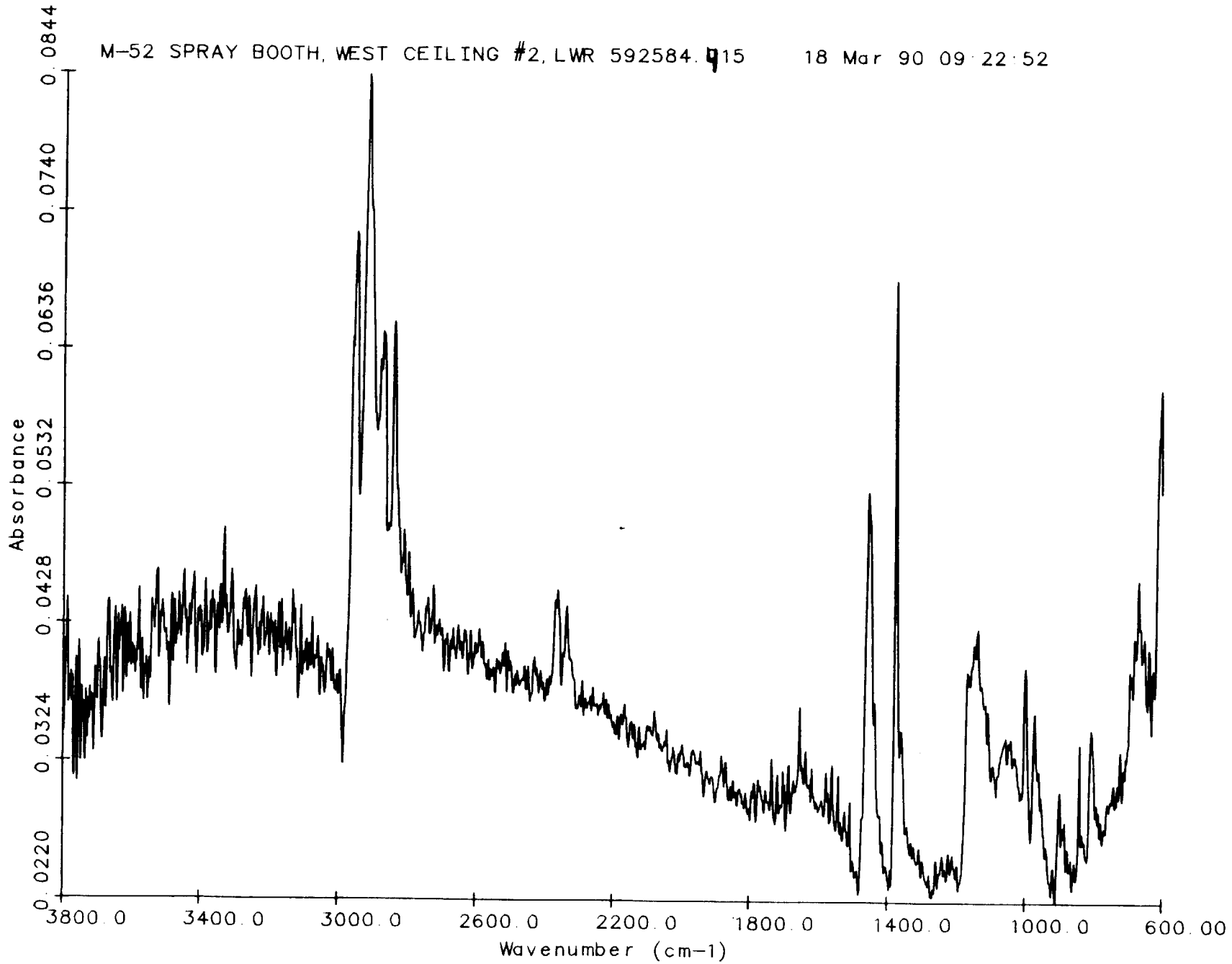

M-52 SPRAY BOOTH, NORTH DOOR EAST SIDE, ATR CLAMPED, 592584.410
18 Mar 90 08:15:26
Absorbance
0.1508
0.1376
0.1244
0.1112
0.0979
0.0847
0.0715
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, EAST CEILING #1, ATR CLAMP, LWR 592584 #11
18 Mar 90 08:30:04
Absorbance
0.1871
0.1726
0.1581
0.1437
0.1292
0.1147
0.1002
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

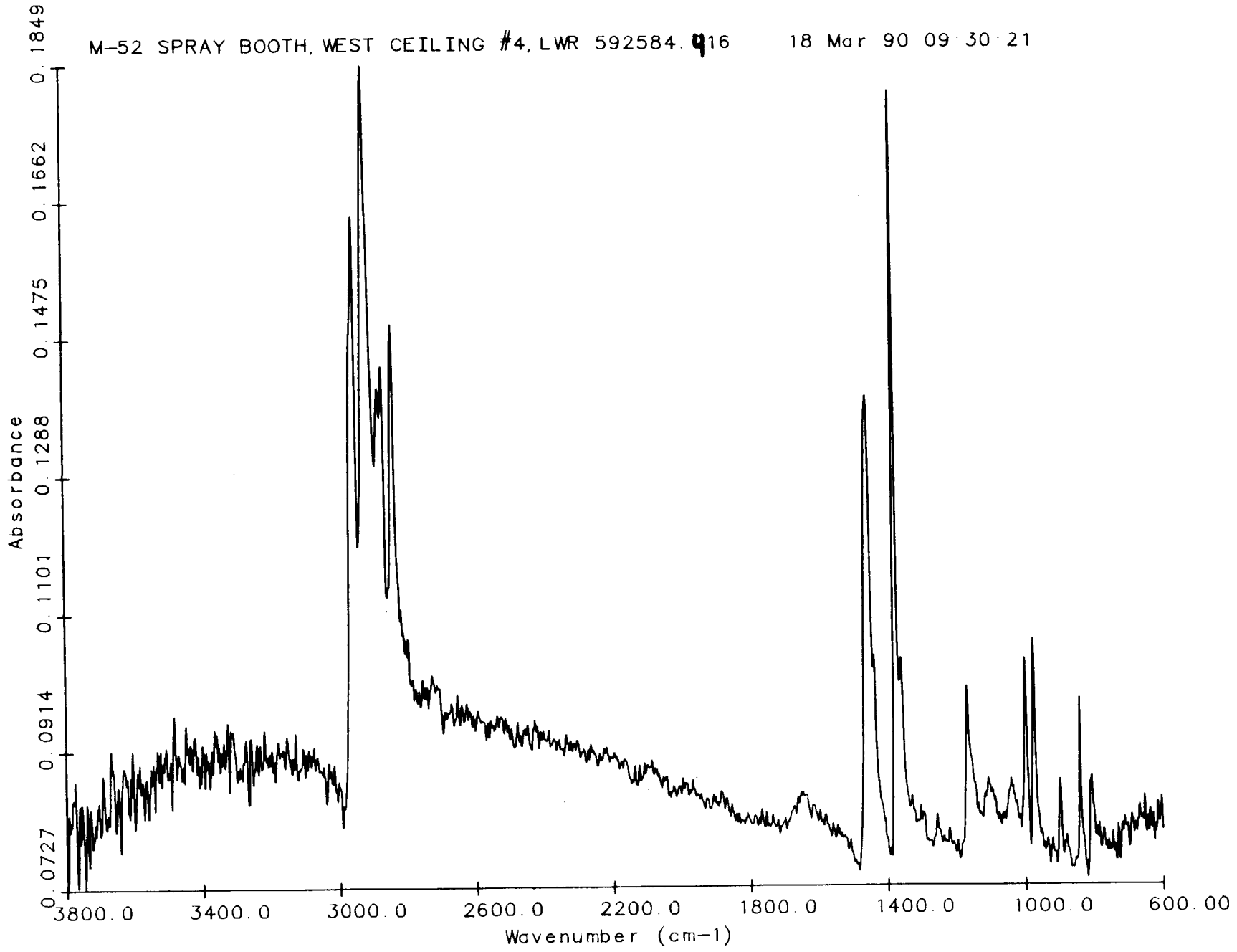

M-52 SPRAY BOOTH, EAST CEILING #3, ATR CLAMP, LWR 592584.912
18 Mar 90 08:50:28
Absorbance
0.1488
0.1361
0.1234
0.1107
0.0980
0.0853
0.0725
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

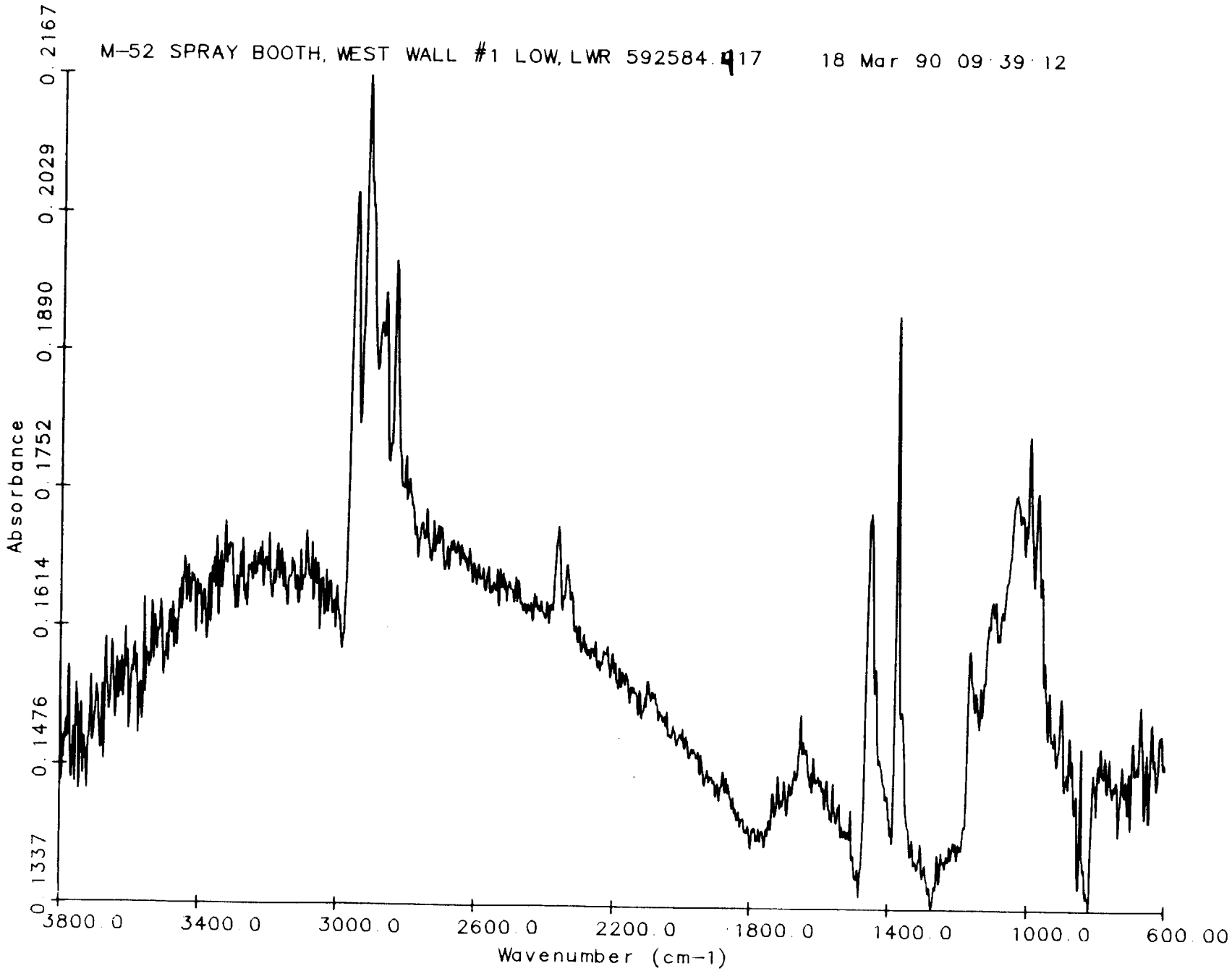

M-52 SPRAY BOOTH, EAST CEILING #4, LWR 592584.013
18 Mar 90 08:58:36
Absorbance
0.2424
0.2237
0.2051
0.1864
0.1677
0.1491
0.1304
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

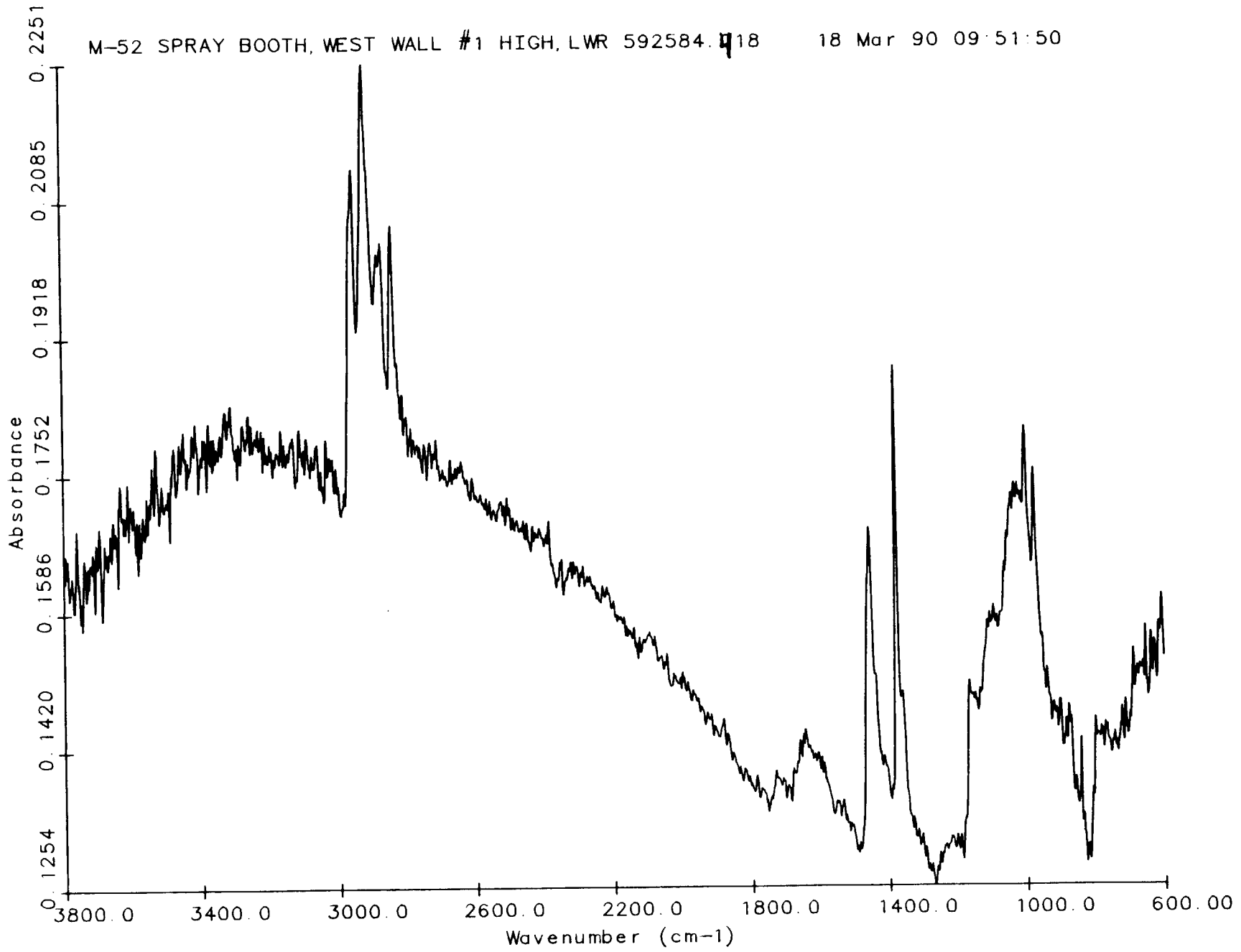

M-52 SPRAY BOOTH, WEST CEILING #1, LWR 592584.014
18 Mar 90 09:07:23
Absorbance
0.2228
0.2044
0.1861
0.1677
0.1494
0.1310
0.1127
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

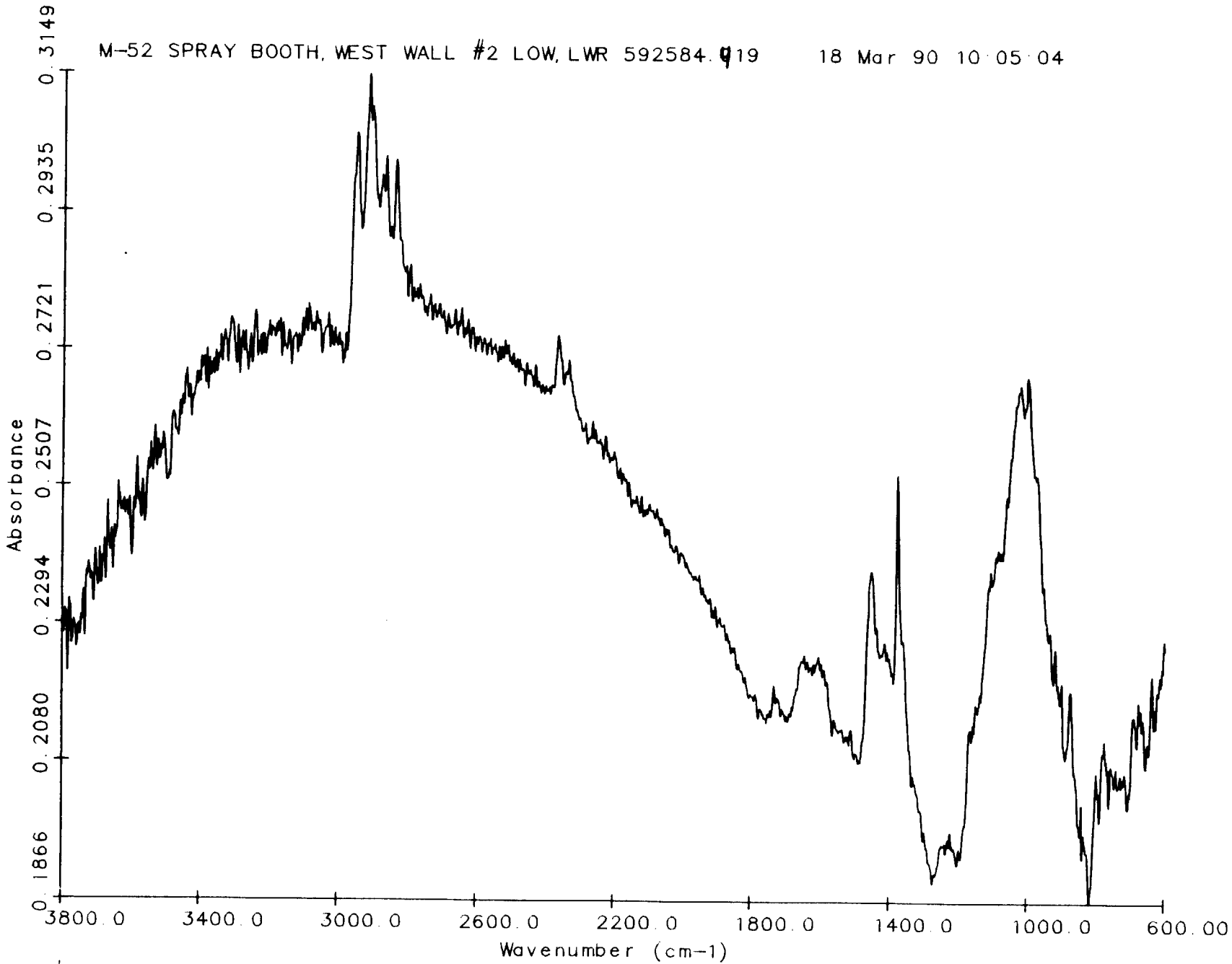

M-52 SPRAY BOOTH, WEST CEILING #2, LWR 592584.915
18 Mar 90 09:22:52
Absorbance
0.0844
0.0740
0.0636
0.0532
0.0428
0.0324
0.0220
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

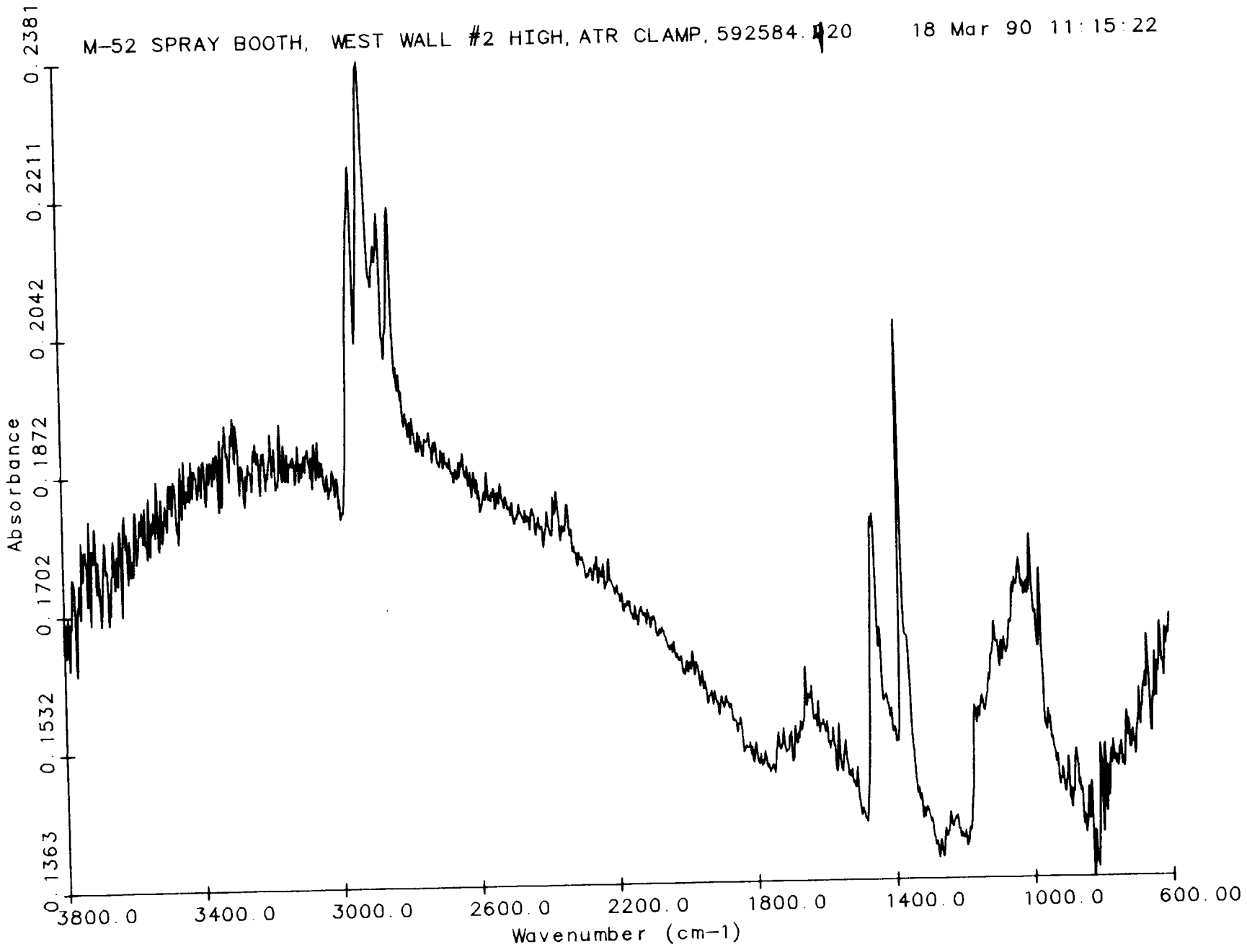
F-16

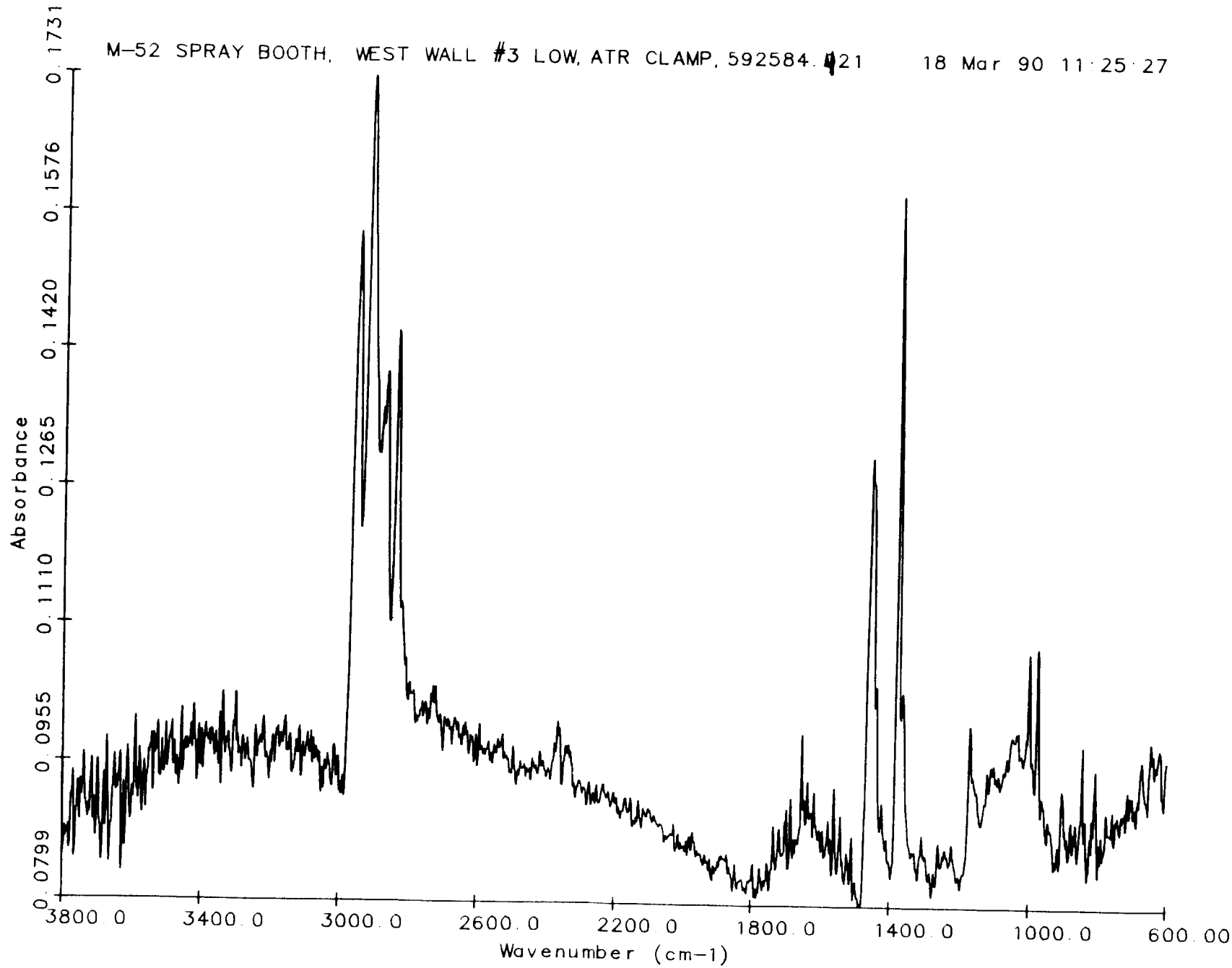

M-52 SPRAY BOOTH, WEST CEILING #4, LWR 592584.916
18 Mar 90 09:30:21
Absorbance
0.1849
0.1662
0.1475
0.1288
0.1101
0.0914
0.0727
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

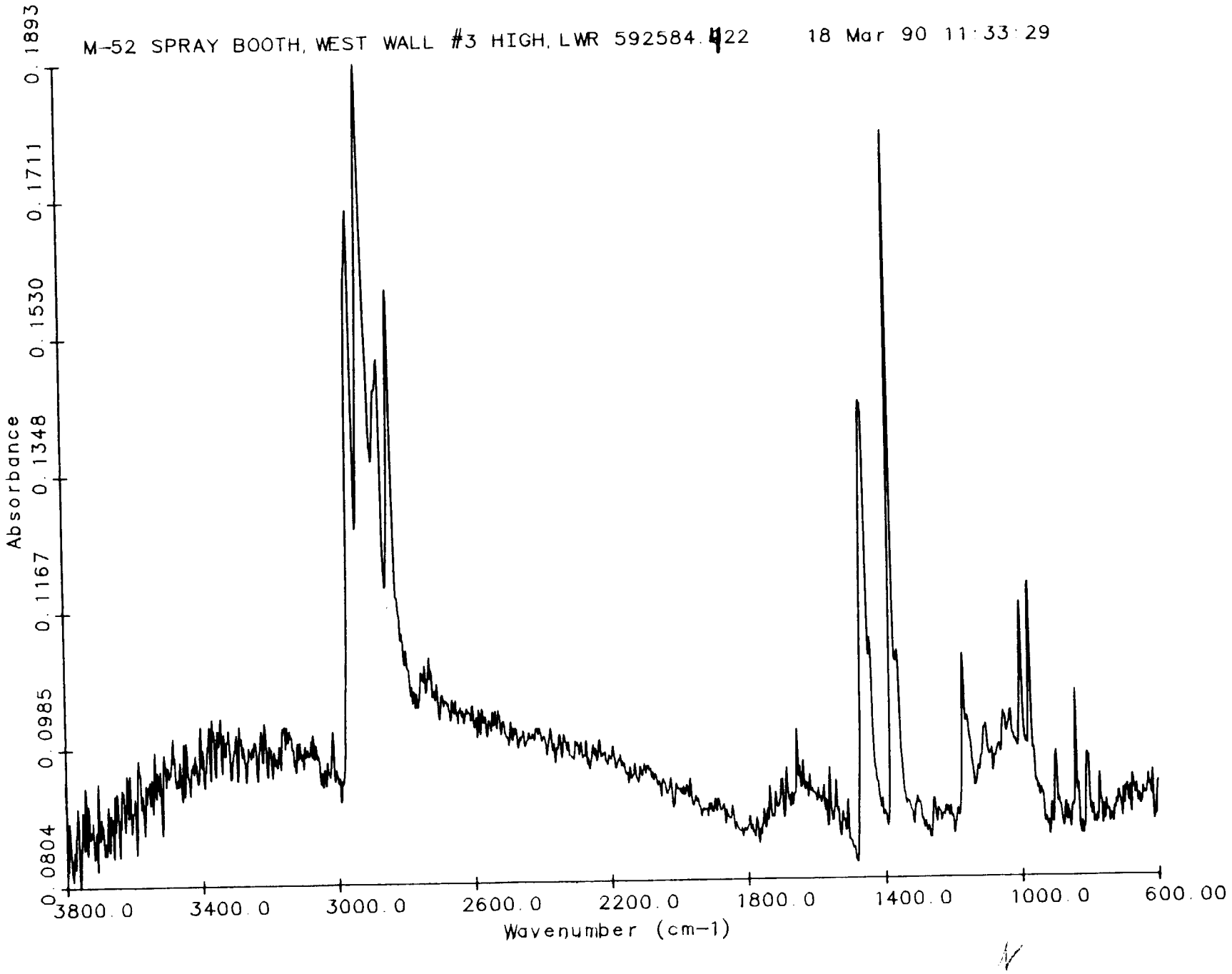

M-52 SPRAY BOOTH, WEST WALL #1 LOW, LWR 592584.417
18 Mar 90 09:39:12
Absorbance
0.2167
0.2029
0.1890
0.1752
0.1614
0.1476
0.1337
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

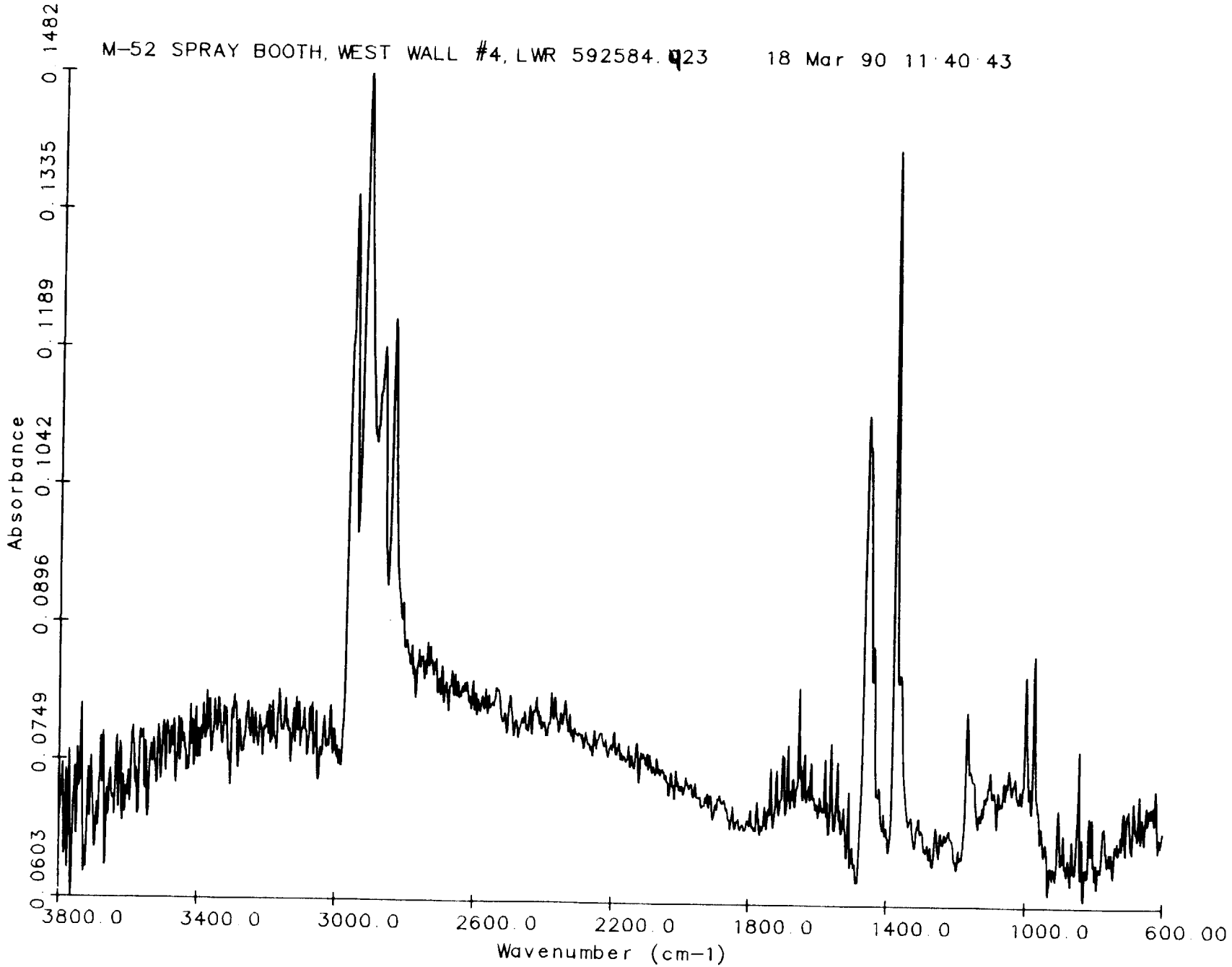

M-52 SPRAY BOOTH, WEST WALL #1 HIGH, LWR 592584.4 18 Mar 90 09:51:50
Absorbance
0.2251
0.2085
0.1918
0.1752
0.1586
0.1420
0.1254
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

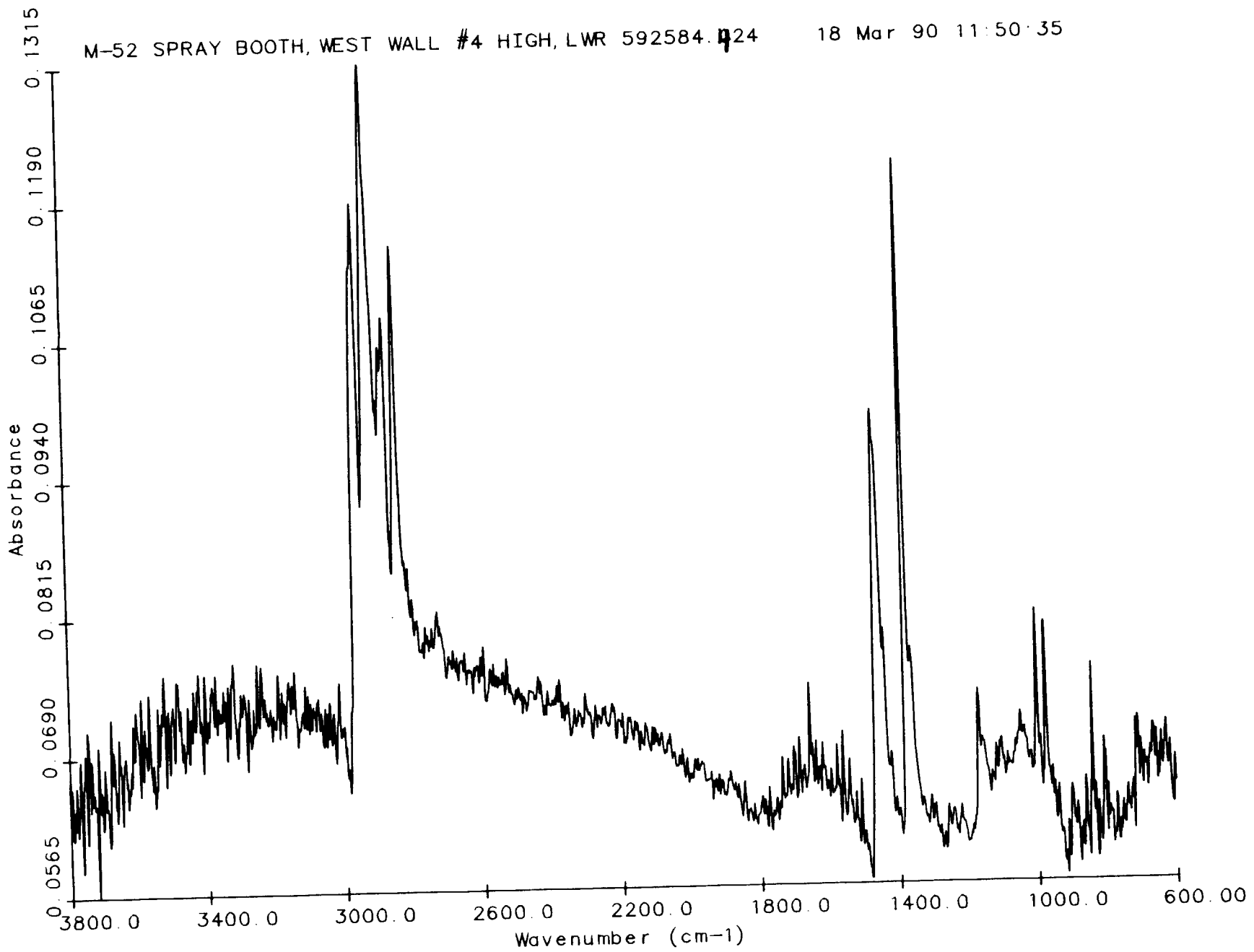

M-52 SPRAY BOOTH, WEST WALL #2 LOW, LWR 592584.919
18 Mar 90 10:05:04
Absorbance
0.3149
0.2935
0.2721
0.2507
0.2294
0.2080
0.1866
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

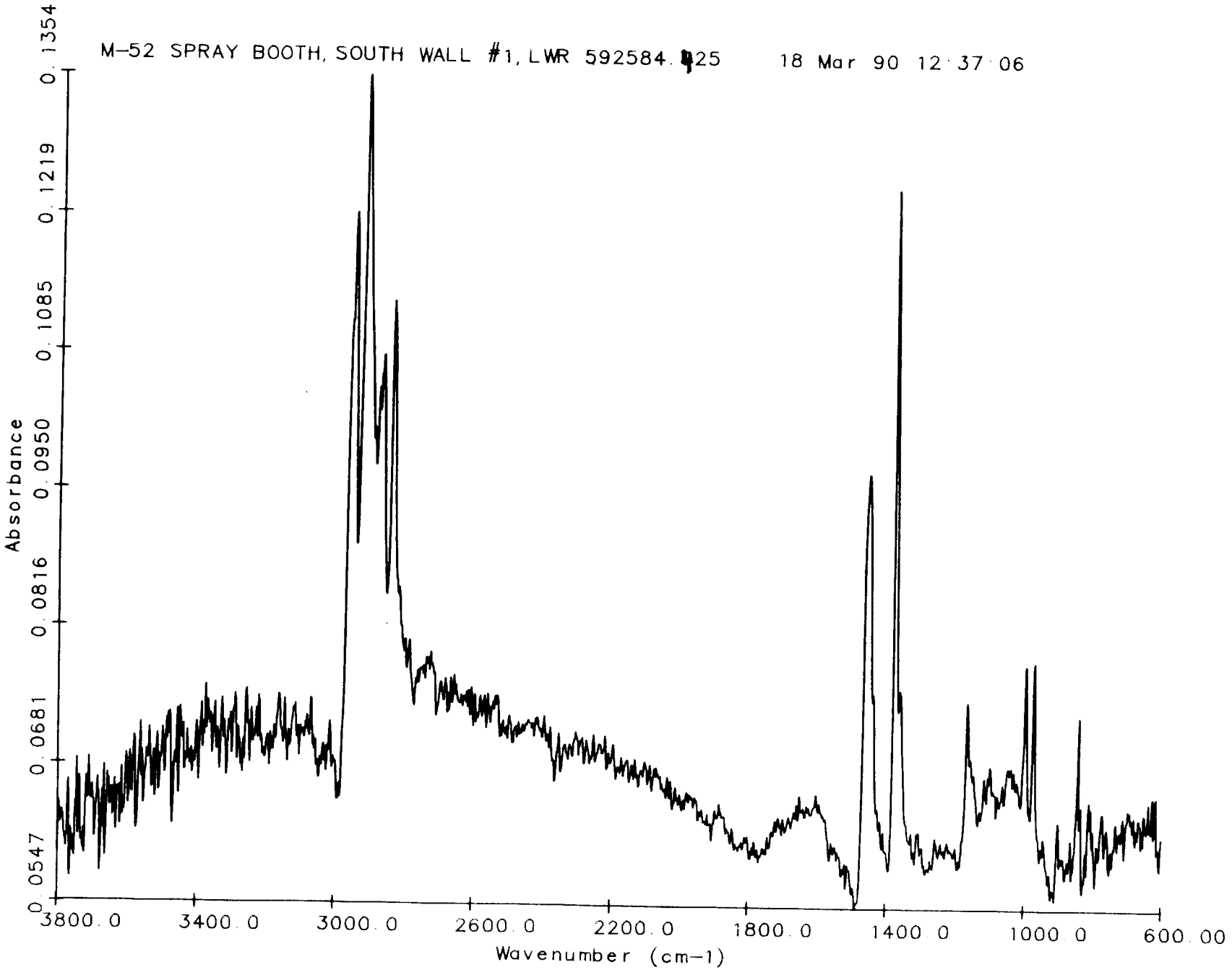

M-52 SPRAY BOOTH, WEST WALL #2 HIGH, ATR CLAMP, 592584.120
18 Mar 90 11:15:22
Absorbance
0.2381
0.2211
0.2042
0.1872
0.1702
0.1532
0.1363
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

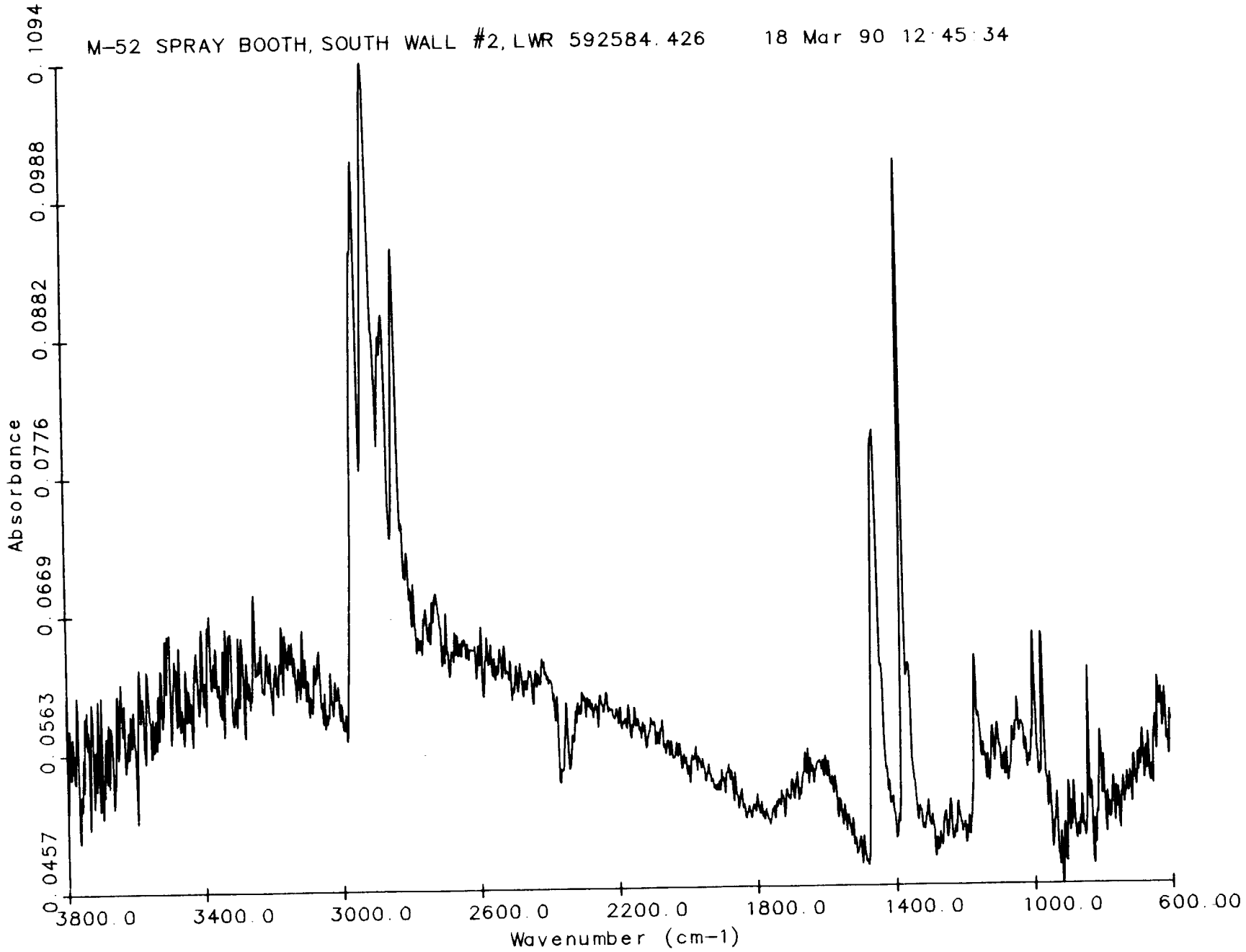

M-52 SPRAY BOOTH, WEST WALL #3 LOW, ATR CLAMP, 592584.421
18 Mar 90 11:25:27
Absorbance
0.1731
0.1576
0.1420
0.1265
0.1110
0.0955
0.0799
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, WEST WALL #3 HIGH, LWR 592584.422
18 Mar 90 11:33:29
Absorbance
0.1893
0.1711
0.1530
0.1348
0.1167
0.0985
0.0804
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, WEST WALL #4, LWR 592584.923
18 Mar 90 11:40:43
Absorbance
0.1482
0.1335
0.1189
0.1042
0.0896
0.0749
0.0603
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

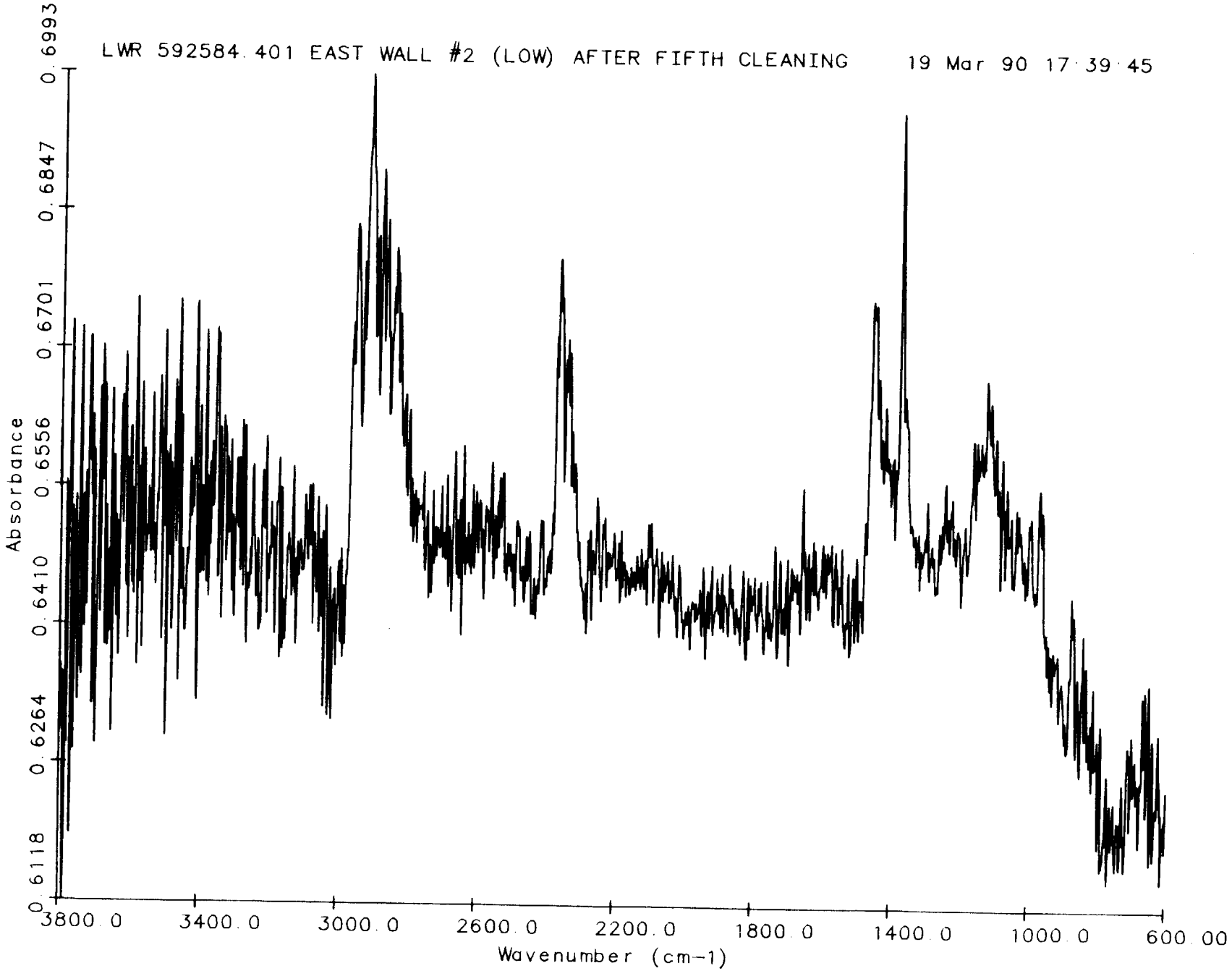

M-52 SPRAY BOOTH, WEST WALL #4 HIGH, LWR 592584.424
18 Mar 90 11:50:35
Absorbance
0.1315
0.1190
0.1065
0.0940
0.0815
0.0690
0.0565
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

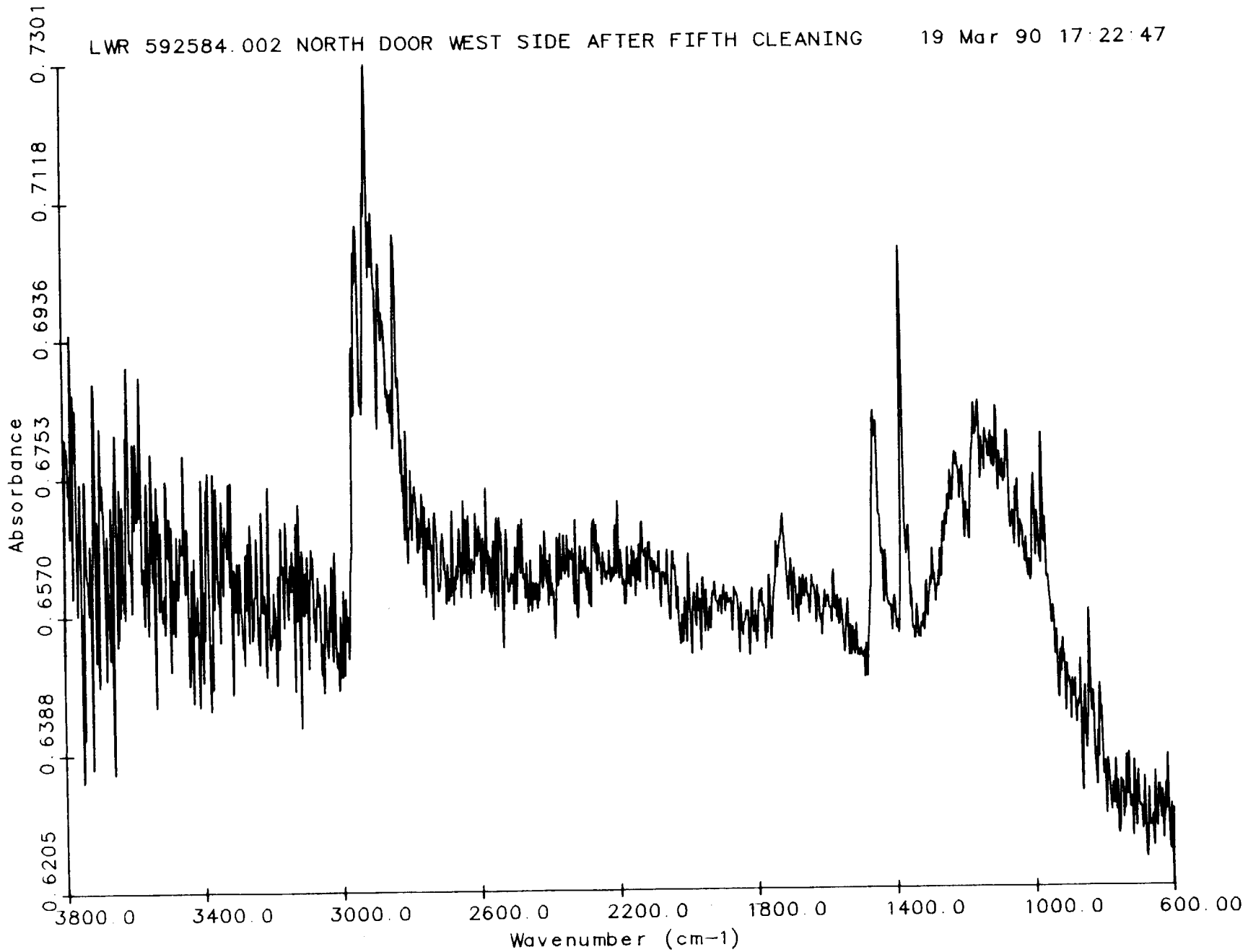

M-52 SPRAY BOOTH, SOUTH WALL #1, LWR 592584.925
18 Mar 90 12:37:06
Absorbance
0.1354
0.1219
0.1085
0.0950
0.0816
0.0681
0.0547
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, SOUTH WALL #2, LWR 592584.426 18 Mar 90 12:45:34
Absorbance
0.1094
0.0988
0.0882
0.0776
0.0669
0.0563
0.0457
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

Appendix G

Sixth FTIR Sample Wipes


LWR 592584.401 EAST WALL #2 (LOW) AFTER FIFTH CLEANING
19 Mar 90 17:39:45
Absorbance
0.6993
0.6847
0.6701
0.6556
0.6410
0.6264
0.6118
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


LWR 592584.002 NORTH DOOR WEST SIDE AFTER FIFTH CLEANING 19 Mar 90 17:22:47
Absorbance
0.7301
0.7118
0.6936
0.6753
0.6570
0.6388
0.6205
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

Appendix H

Final FTIR Sample Wipes

Final Test, After performance [illegible] with done

LABORATORY REPORT

16 Apr. 1990

Originator: Vern Fitch
Ext 6344, M/S L62B

Request: LWR 597701
Laboratory log # 04-11-90-32197

Subject: FTIR Analysis of M-52 Spray Booth Wipe Samples for Teflon Contamination

FTIR analysis has been carried out on wipe samples taken from the ceiling and walls of the M-52 spray booth. The samples were taken by wiping an area approximately 2 feet by 1 foot with a methylchloroform wet wipe. The presence of Teflon was detected by the appearance of the C-F absorbance peaks at about 1160 and about 1230 wavenumbers.

No Teflon was detected in any of the samples.

Samples were taken from the following locations:

Sample Locations

South Wall #1 (East)

South Wall #2 (West)

North Door East Side

North Door West Side

East Ceiling #1 (North)

East Ceiling #2

East Ceiling #3

East Ceiling #4
(South)

Sample Locations

West Ceiling #1 (North)

West Ceiling #2

West Ceiling #3

West Ceiling #4 (South)

East Wall #1 (High) (North)

East Wall #1 (Low) (North)

East Wall #2 (High)

East Wall #2 (Low)

East Wall #3 (High)

East Wall #3 (Low)

East Wall #4 (High) (South)

East Wall #4 (Low) (South)

West Wall #1 (High) (North)

West Wall #1 (Low) (North)

West Wall #2 (High)

West Wall #2 (Low)

West Wall #3 (High)

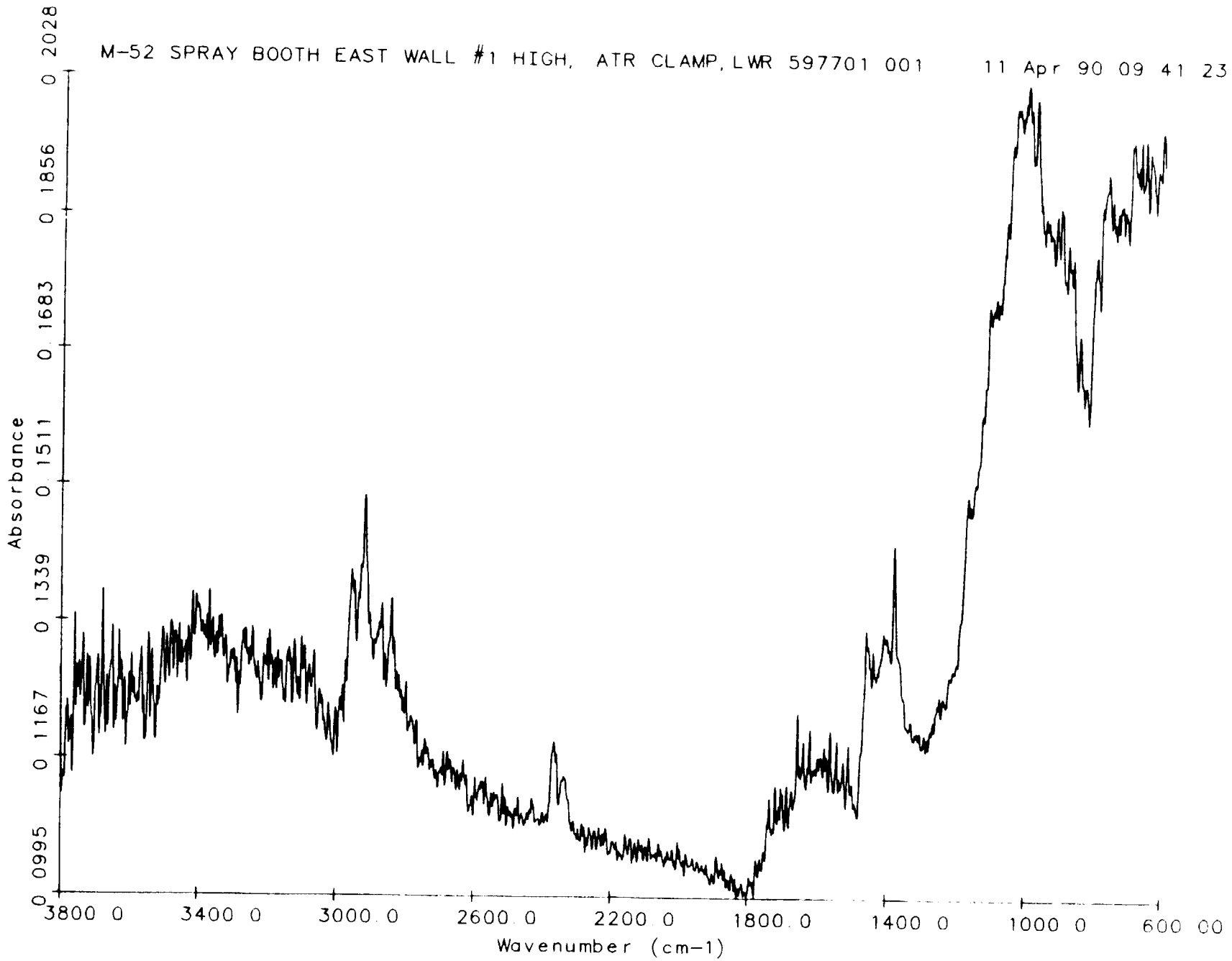
West Wall #3 (Low)

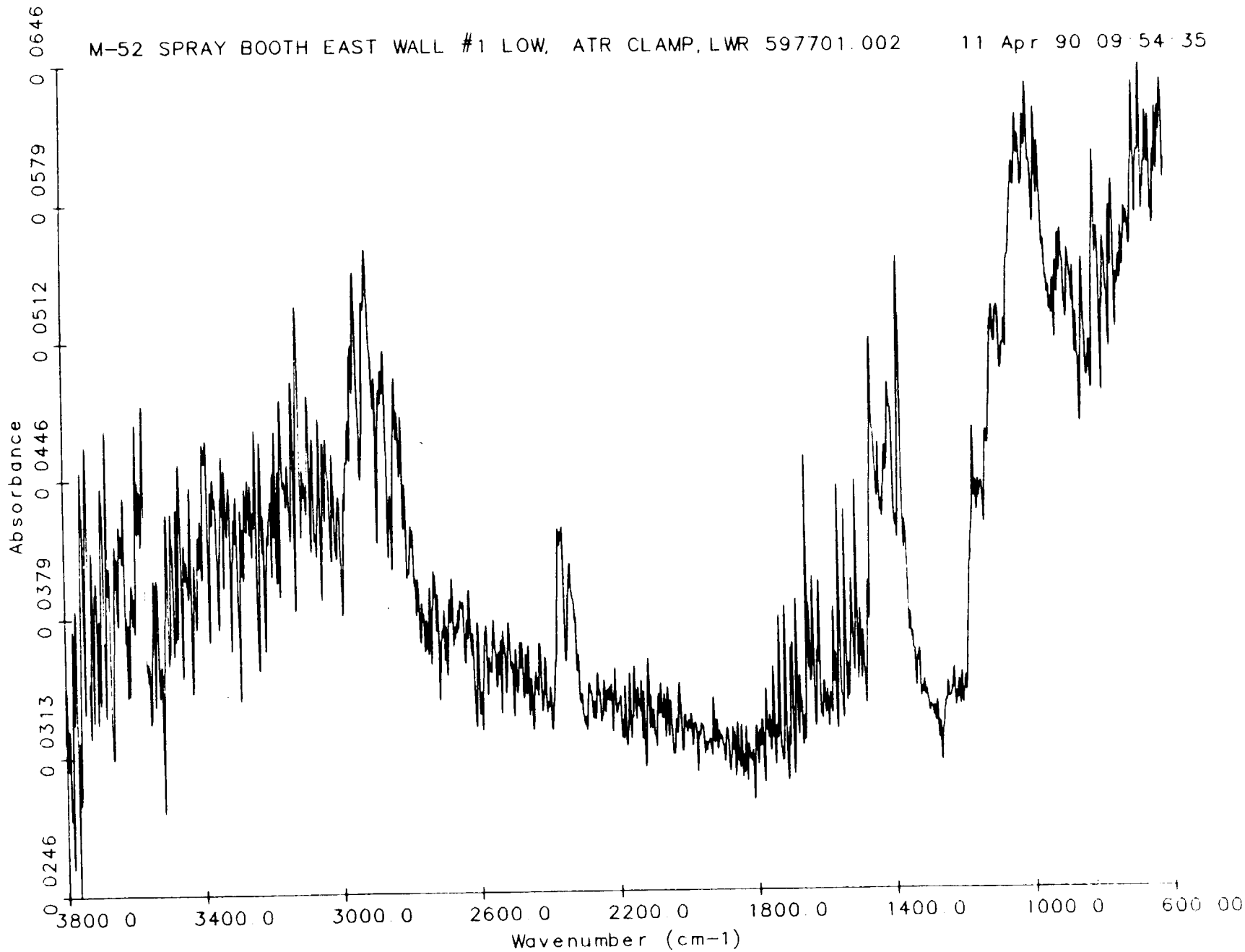
West Wall #4 (High) (South)

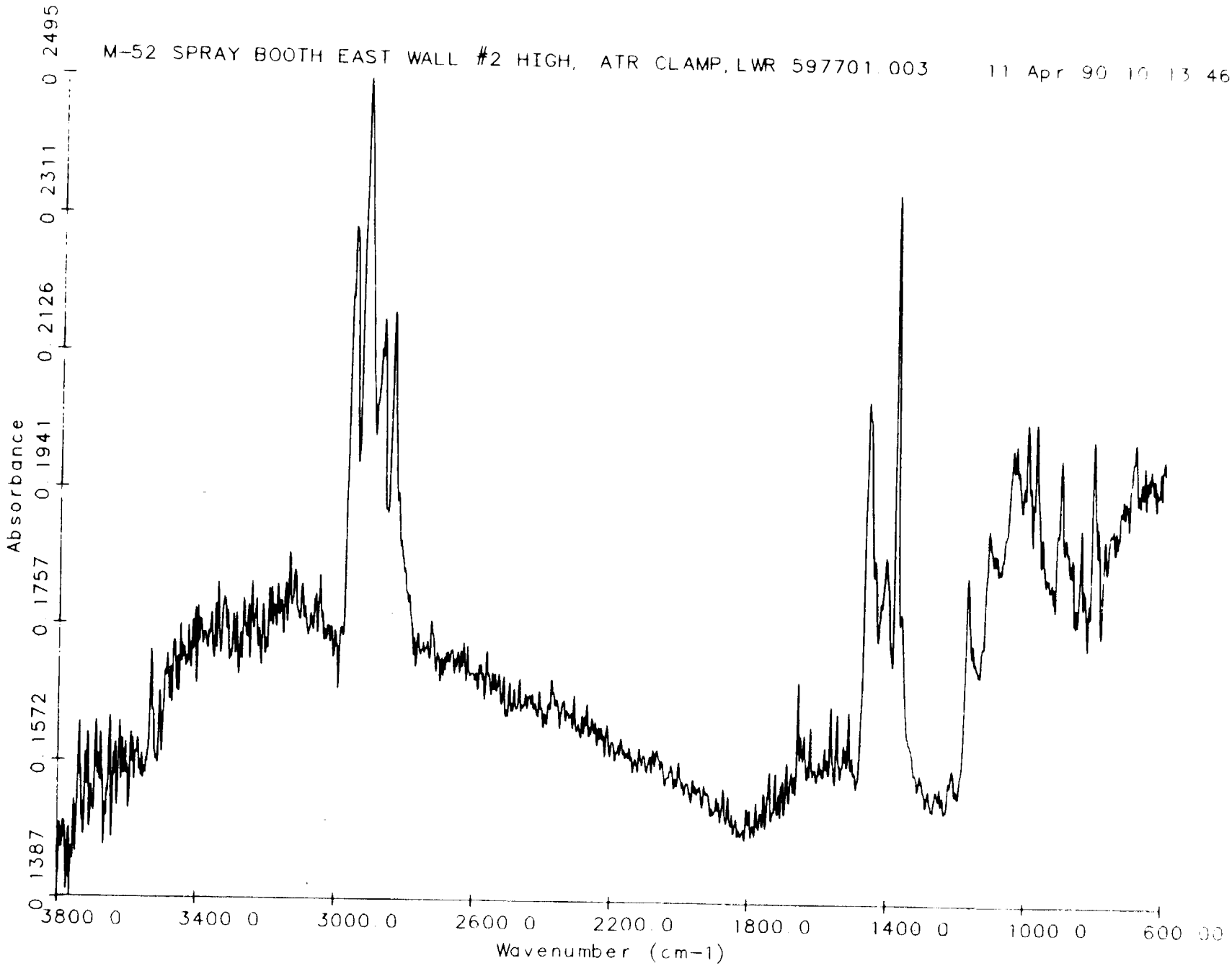
West Wall #4 (Low)

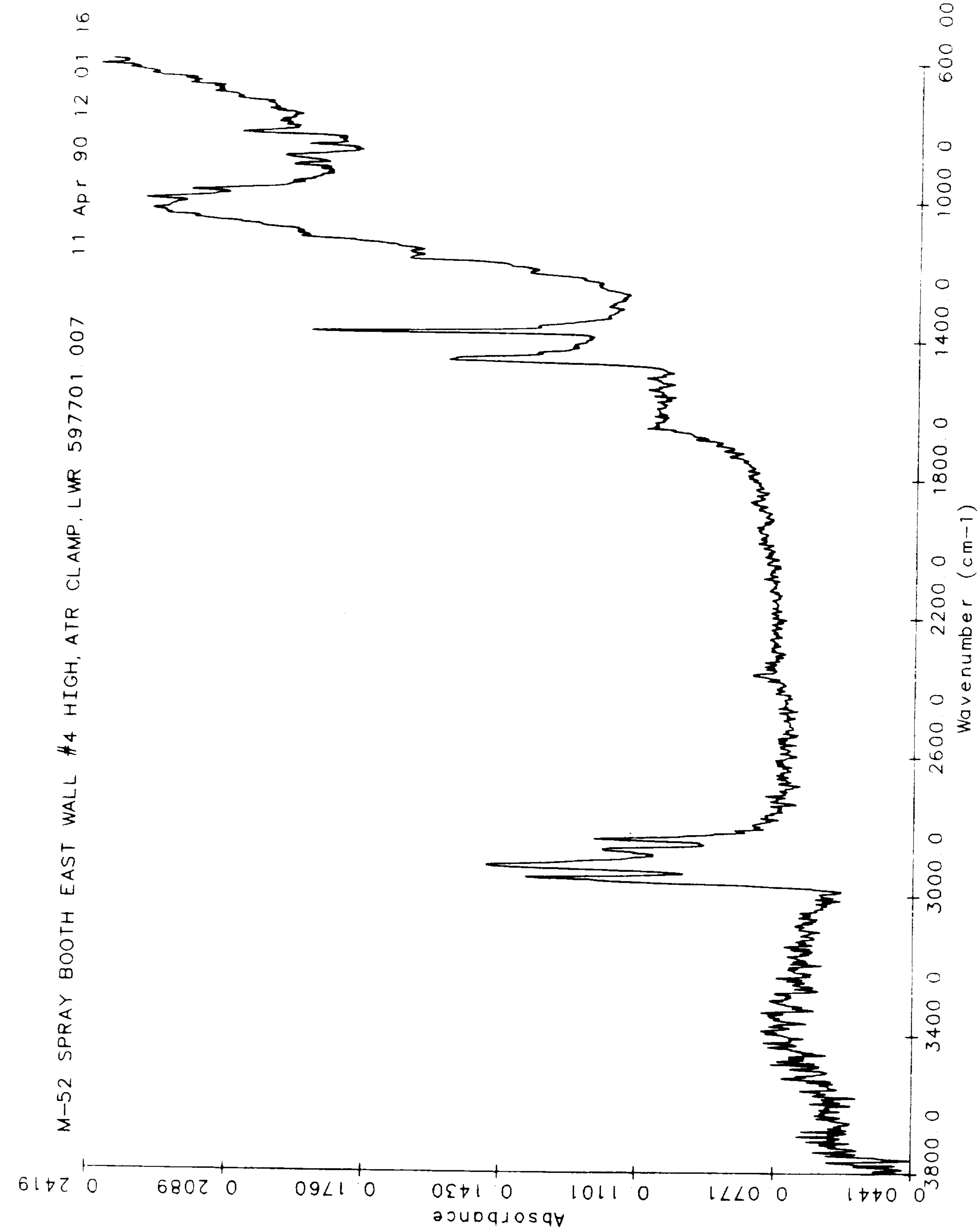
Copies of the FTIR spectra are attached.

R. C. Raisor, Spectrochemical Analysis
LAB90104
B1448


M-52 SPRAY BOOTH EAST WALL #1 HIGH, ATR CLAMP, LWR 597701 001
11 Apr 90 09 41 23
Absorbance
0 2028
0 1856
0 1683
0 1511
0 1339
0 1167
0 0995
3800 0
3400 0
3000 0
2600 0
2200 0
1800 0
1400 0
1000 0
600 00
Wavenumber (cm-1)

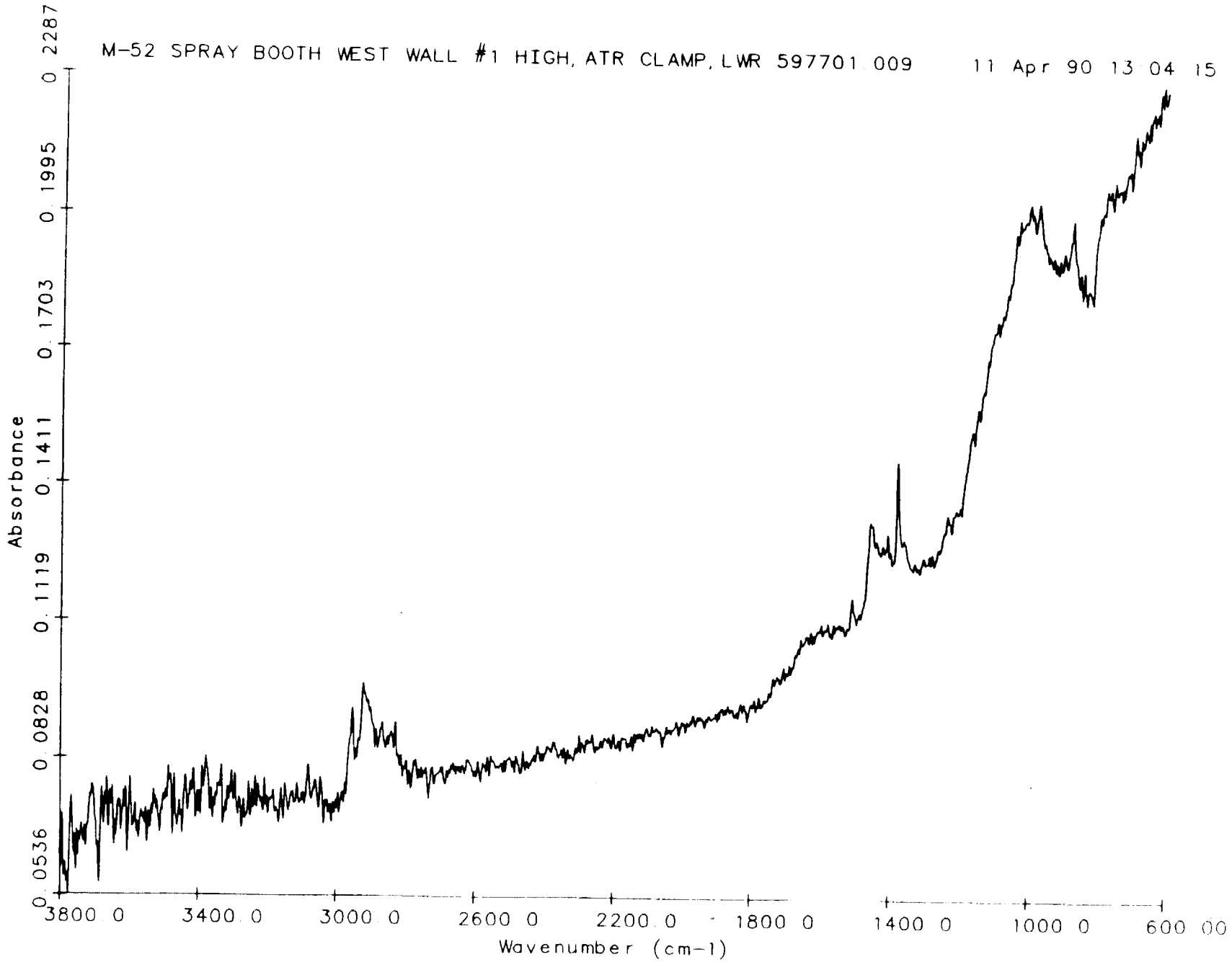

M-52 SPRAY BOOTH EAST WALL #1 LOW, ATR CLAMP, LWR 597701.002
11 Apr 90 09:54:35
Absorbance
0.0646
0.0579
0.0512
0.0446
0.0379
0.0313
0.0246
0
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

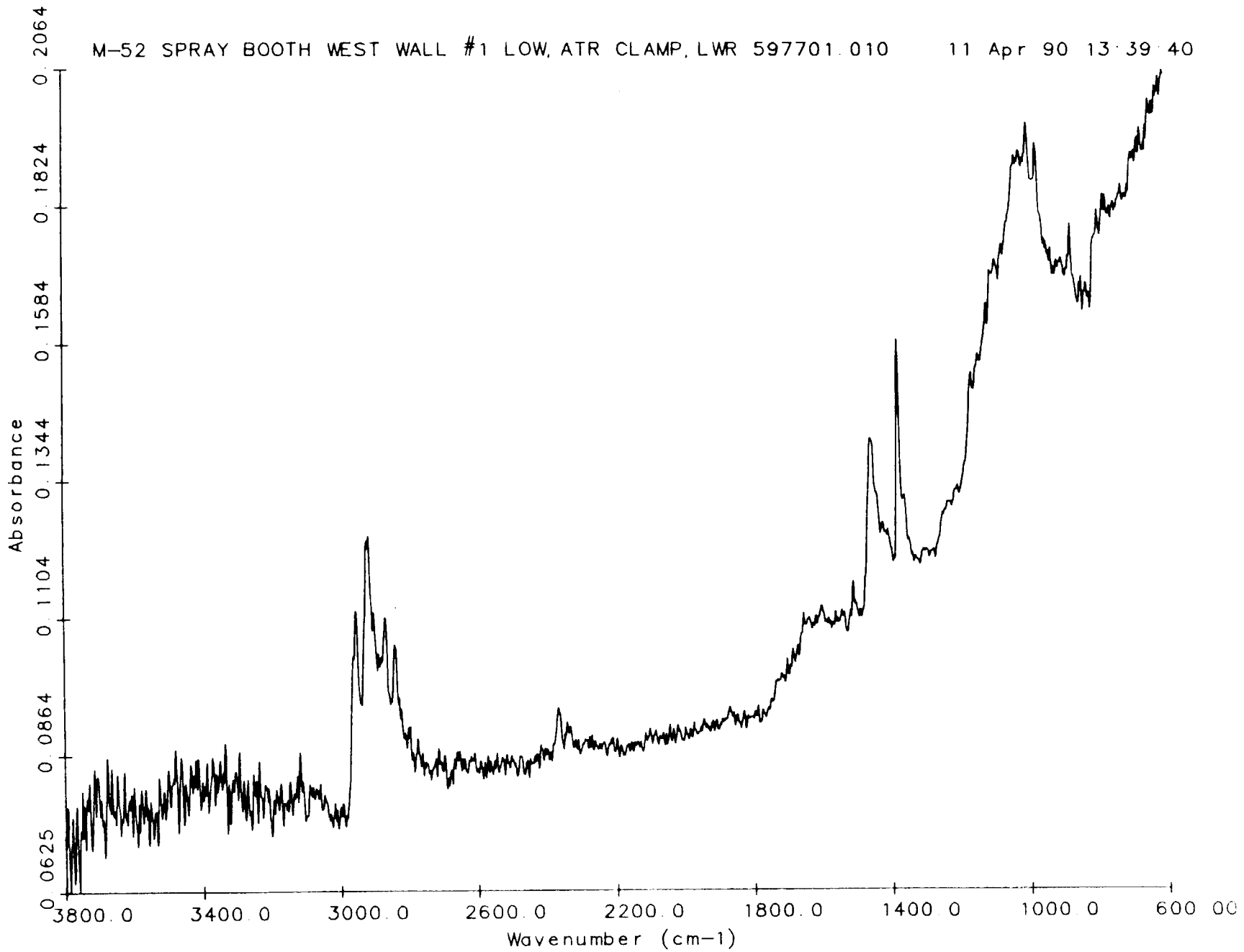

M-52 SPRAY BOOTH EAST WALL #2 HIGH, ATR CLAMP, LWR 597701.003
11 Apr 90 10 13 46
Absorbance
0.2495
0.2311
0.2126
0.1941
0.1757
0.1572
0.1387
0
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

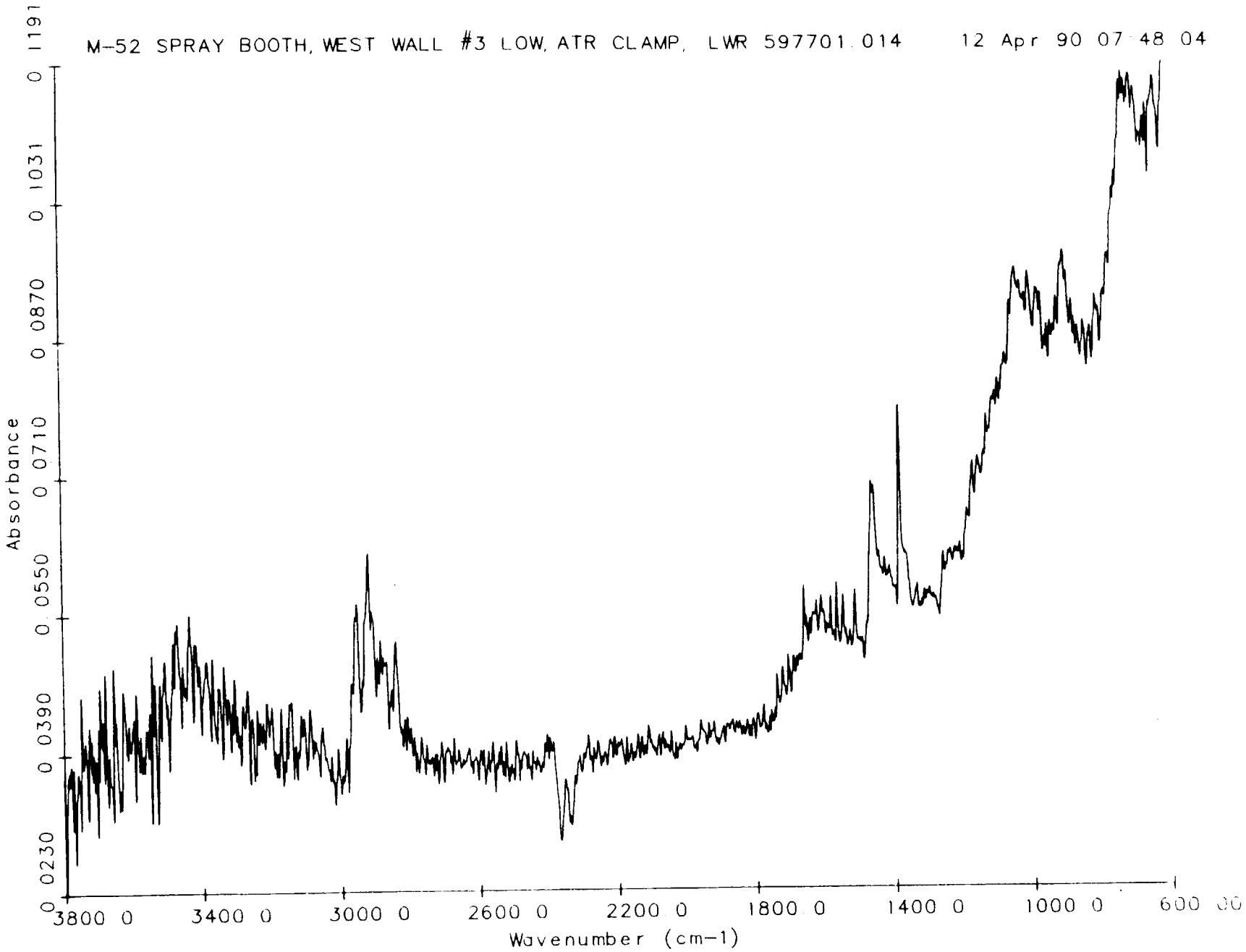


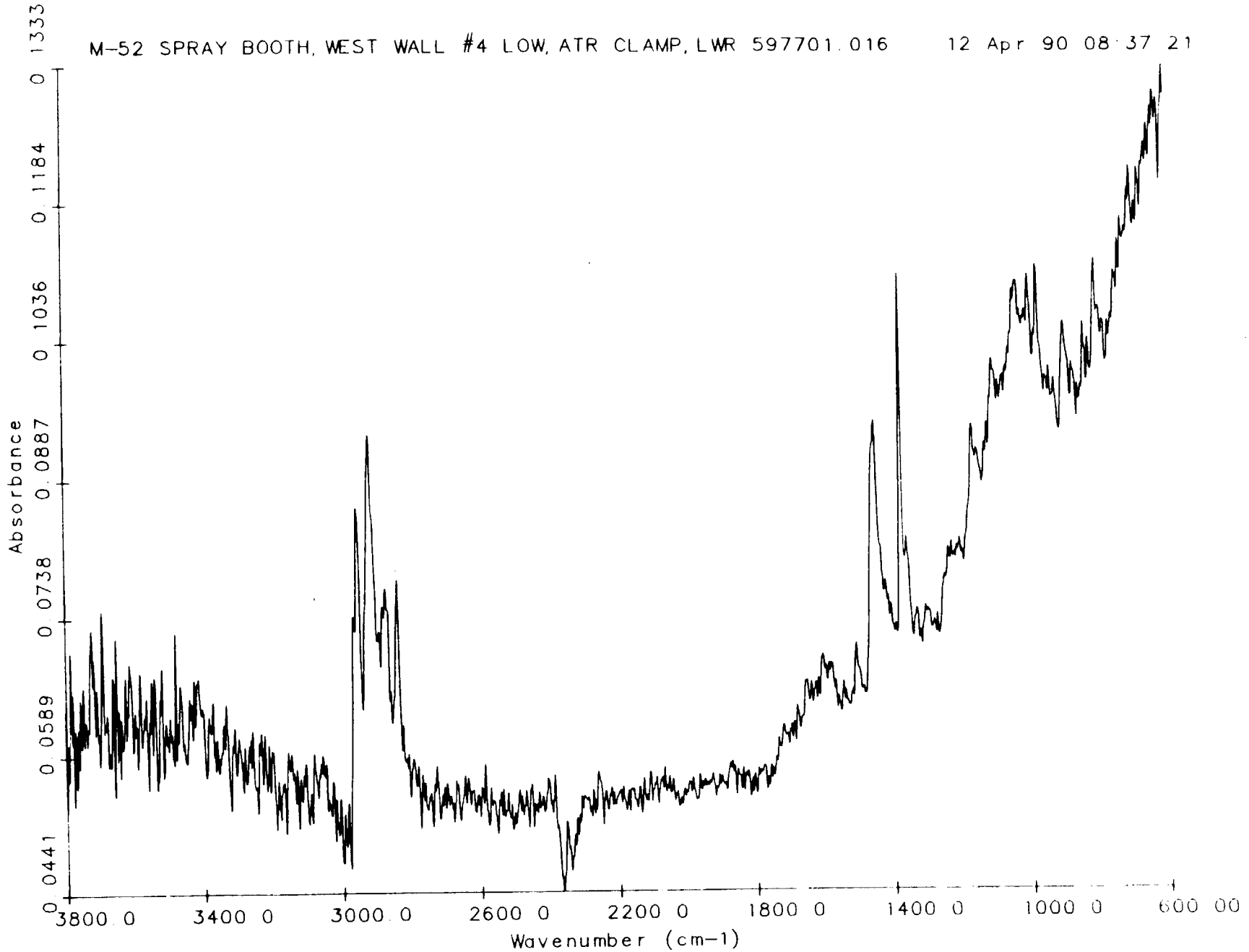
ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

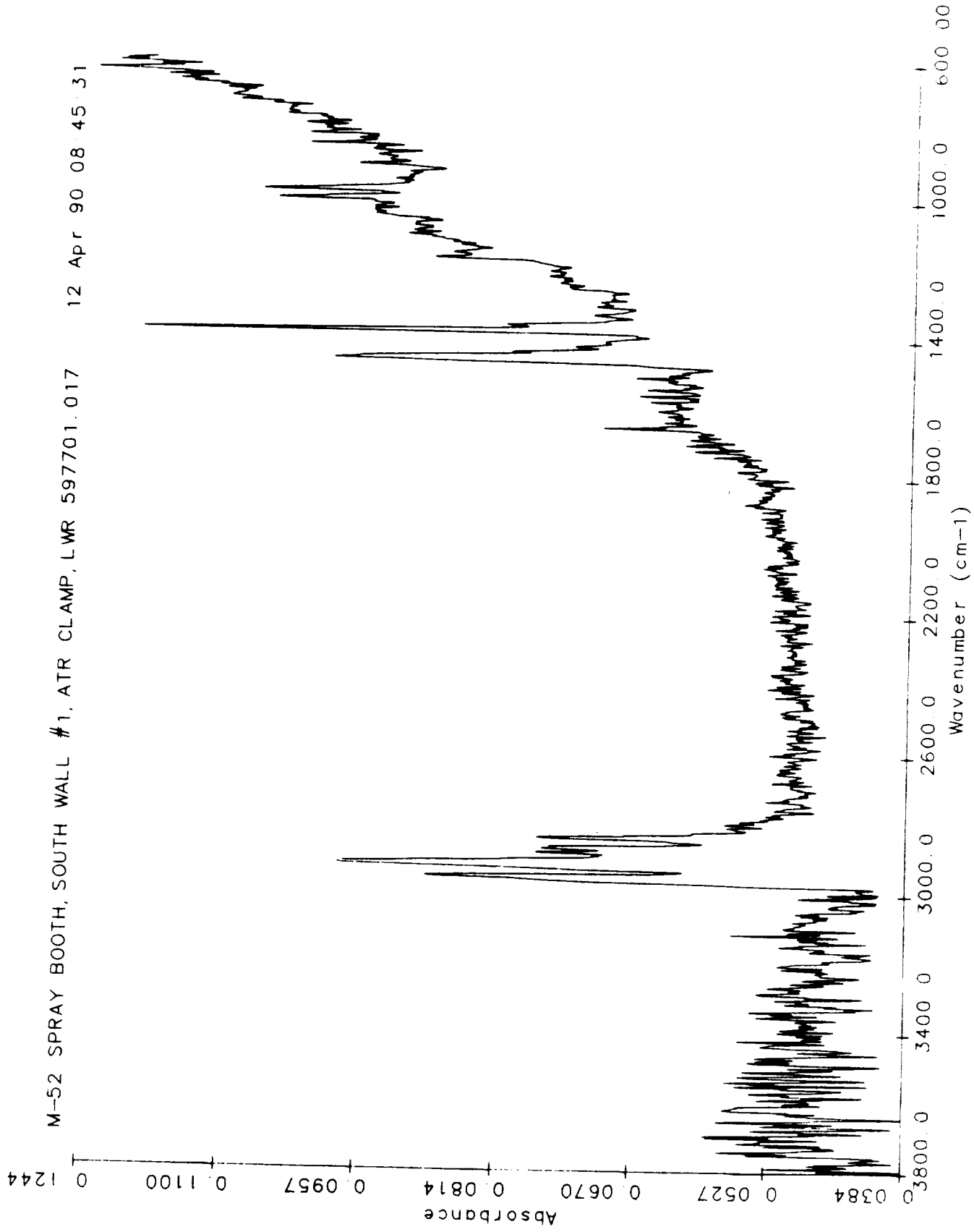




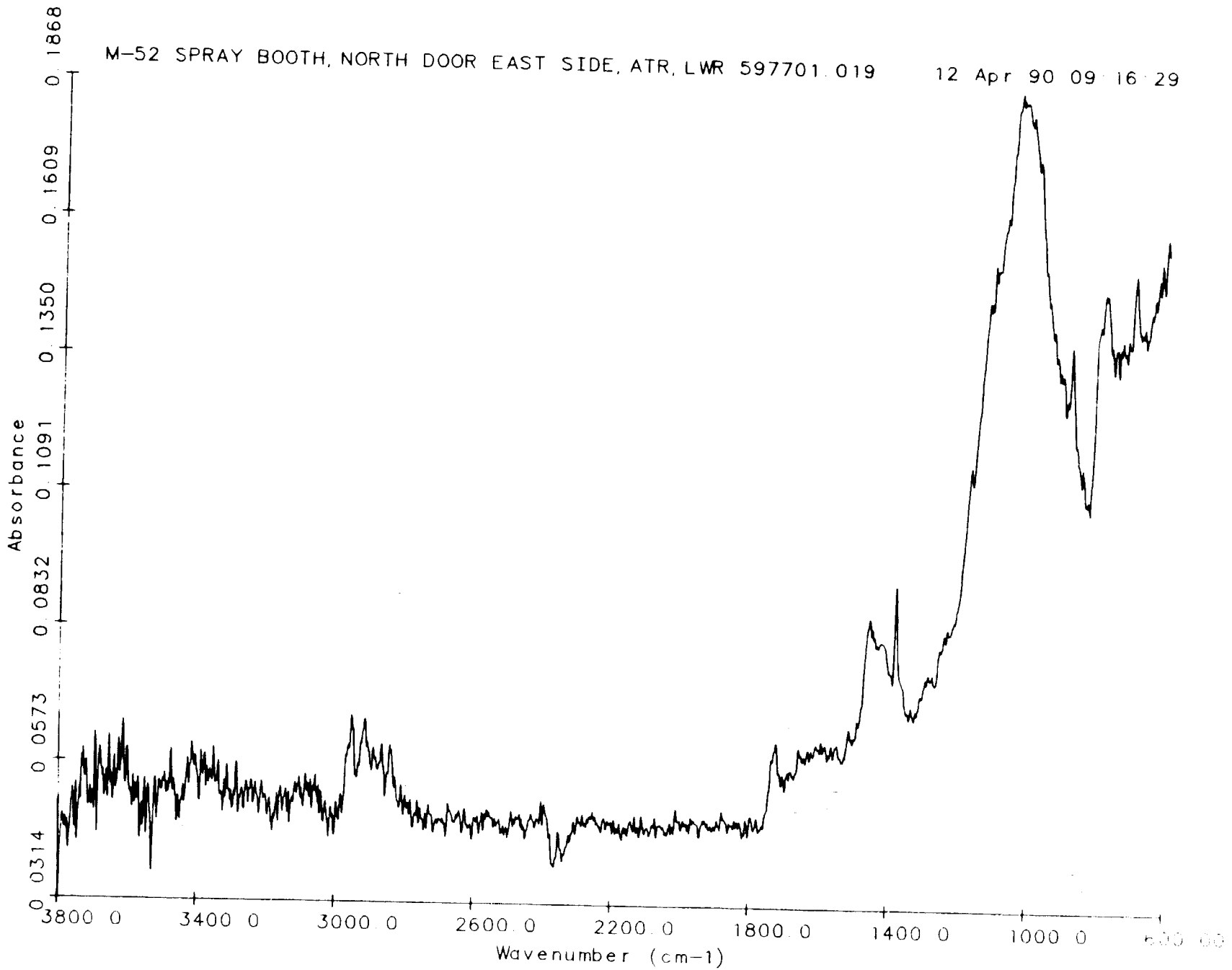




ORIGINAL PAGE IS
OF POOR QUALITY

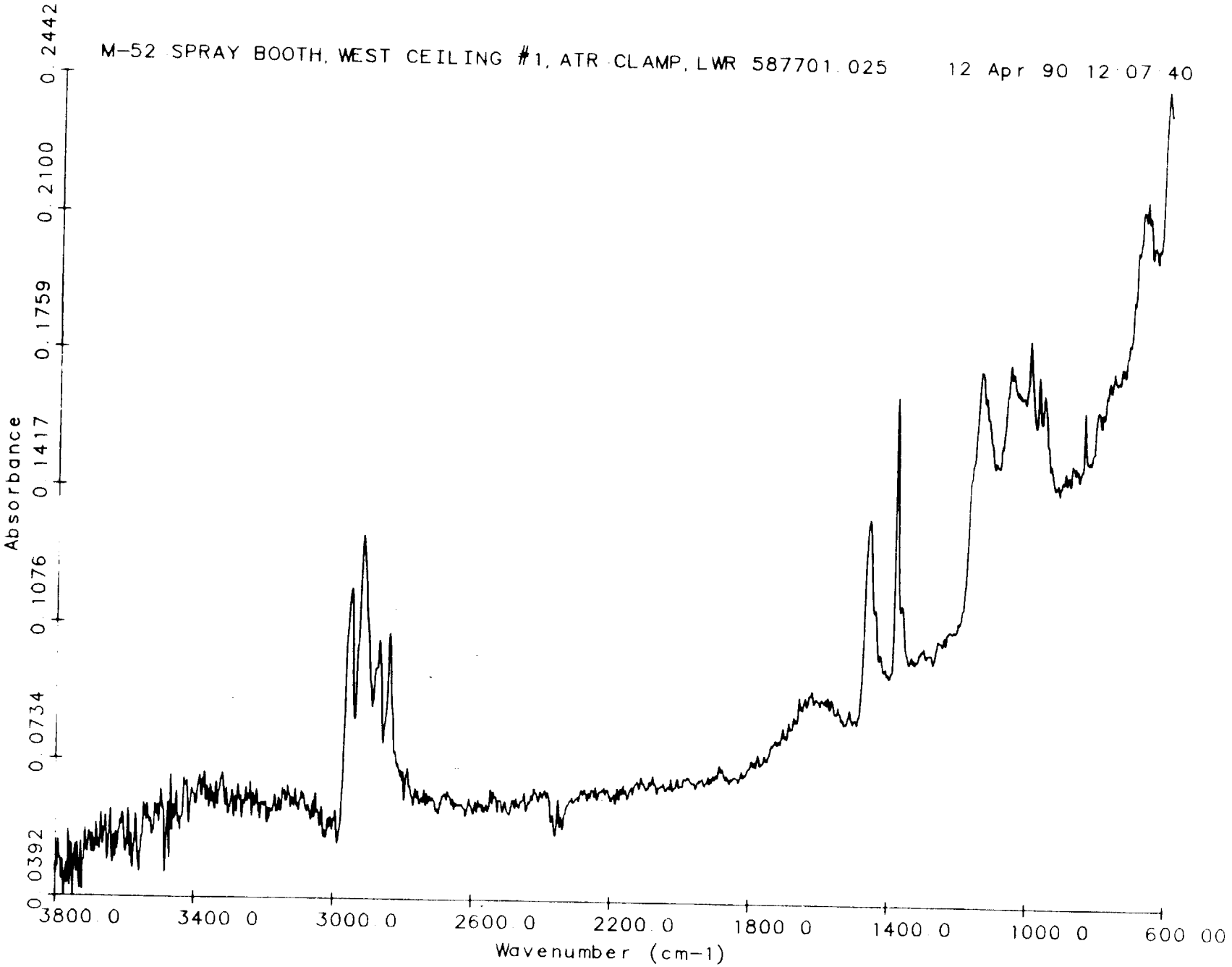


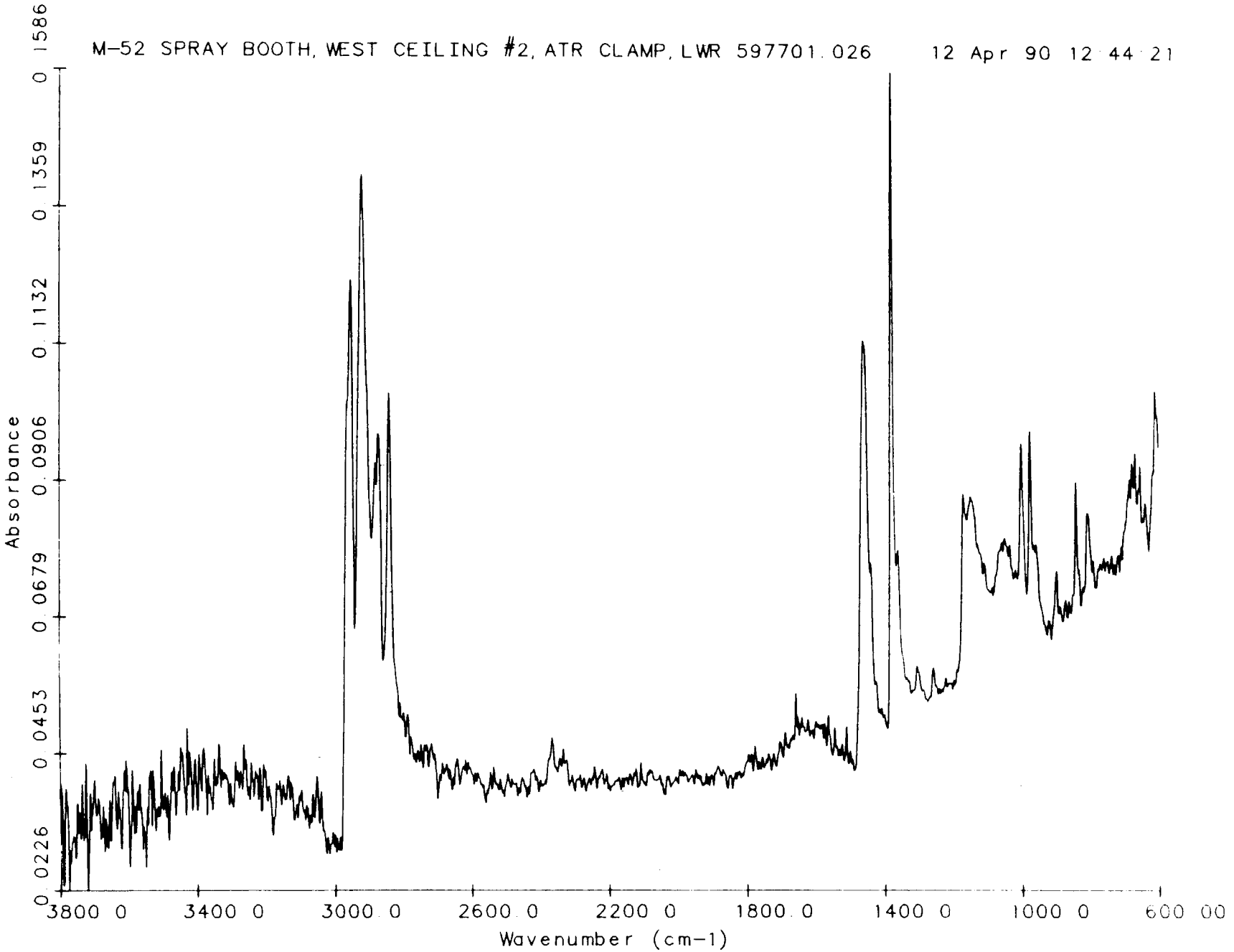
C-3

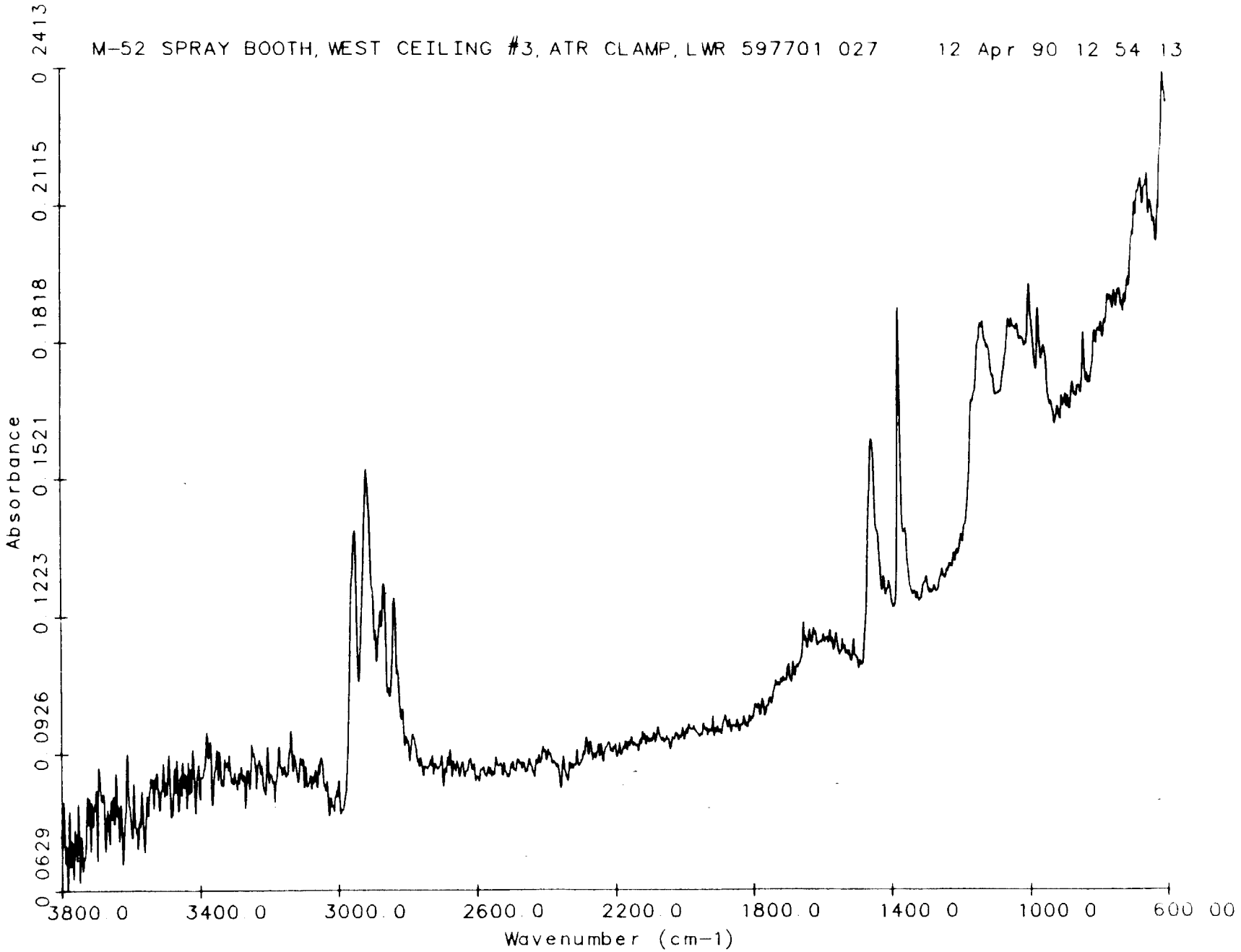


ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY


M-52 SPRAY BOOTH, WEST CEILING #1, ATR CLAMP, LWR 587701.025
12 Apr 90 12:07:40
Absorbance
0.2442
0.2100
0.1759
0.1417
0.1076
0.0734
0.0392
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)




M-52 SPRAY BOOTH, WEST CEILING #3, ATR CLAMP, LWR 597701 027
12 Apr 90 12 54 13
Absorbance
0 2413
0 2115
0 1818
0 1521
0 1223
0 0926
0 0629
3800 0
3400 0
3000 0
2600 0
2200 0
1800 0
1400 0
1000 0
600 00
Wavenumber (cm-1)

Appendix I

Environmental Fallout Panels FTIR Results

LABORATORY REPORT

12 Apr. 1990

Originator: Joel Ward
Ext 5294, M/S 887A

Request: LWR 600037
Laboratory log # 03-22-90-31788

Subject: FTIR Analysis of NVR and Particulate samples from M-52 Spray Booth for the presence of Teflon

FTIR analysis has been carried out on NVR fallout samples and particulate samples from the M-52 spray booth. In particular, each sample was checked for the presence of Teflon residue. The presence of Teflon was determined by the appearance of the C-F absorbance peaks at about 1160 and about 1230 wavenumbers.

Sixteen fallout NVR samples and sixteen filter samples were tested.

No Teflon was detected with any of the samples.

Copies of the FTIR spectra are attached.

R. C. Raisor, Spectrochemical Analysis
LAB90099
B1222

After 1st Clean Air CTP
(2nd total)
(1st booth operational cycle)

After 3rd Clean Air CTP
(4th total)
(2nd booth operational cycle)

M35A LABORATORY

To: Ralph Raisor

From: Joel Ward

Date: 21 March, 1990

Subject: FTIR analysis of NVR from teflon booth

==========

Ralph,

Please perform an FTIR analysis on the following NVR and particulate samples:

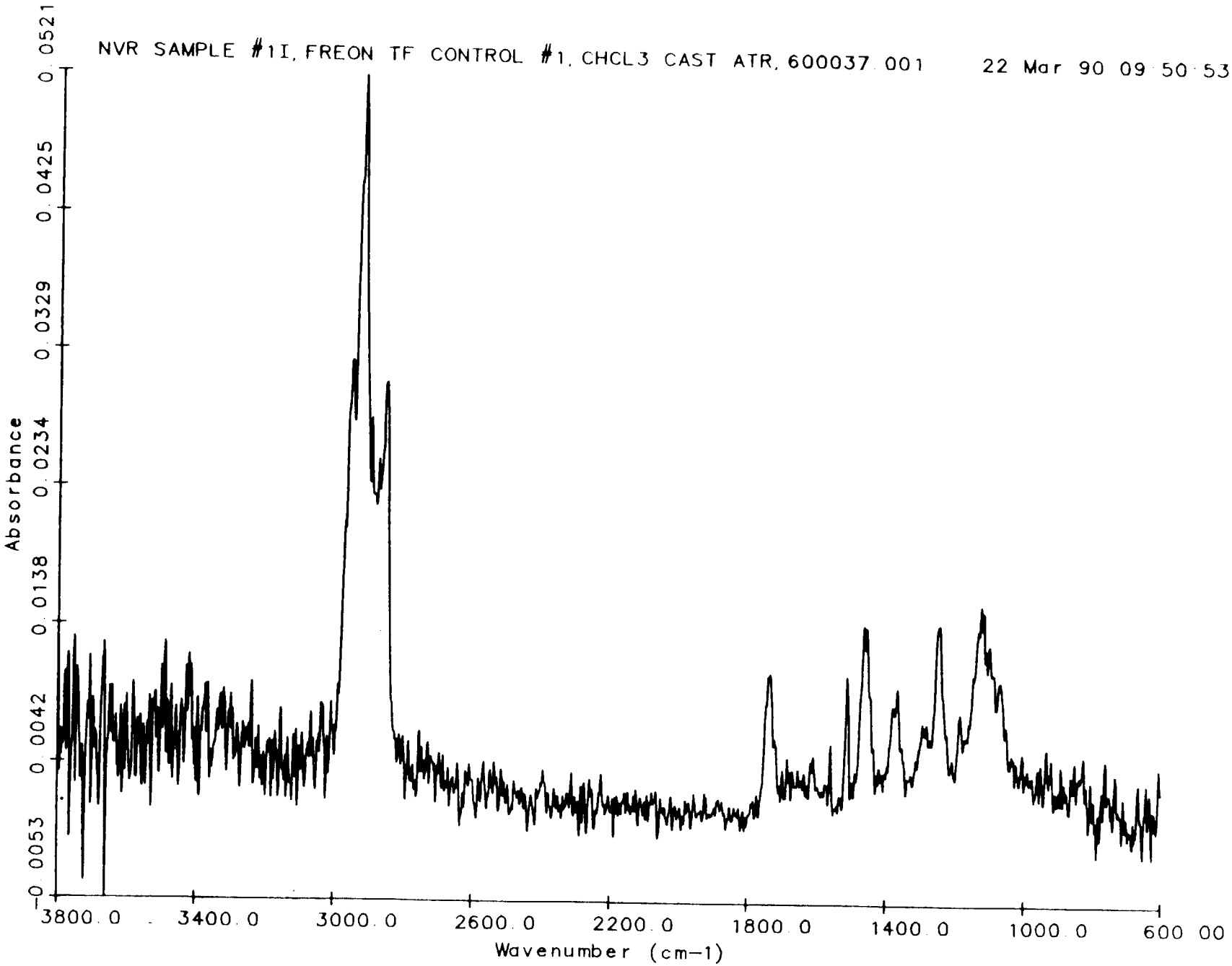
sample number	location
1F	freon TF control 1
2F	teflon booth middle, east side
3F	teflon booth north west corner
4F	teflon booth south west corner
5F	teflon booth middle, west side
6F	teflon booth south east corner
7F	teflon booth north east corner
8F FINAL	freon TF control 2
1I INITIAL	freon TF control 1
2I	teflon booth south east corner
3I	teflon booth south west corner
4I	teflon booth middle, east side
5I	teflon booth middle, west side
6I	teflon booth north east corner
7I	teflon booth north west corner
8I	freon TF control 2

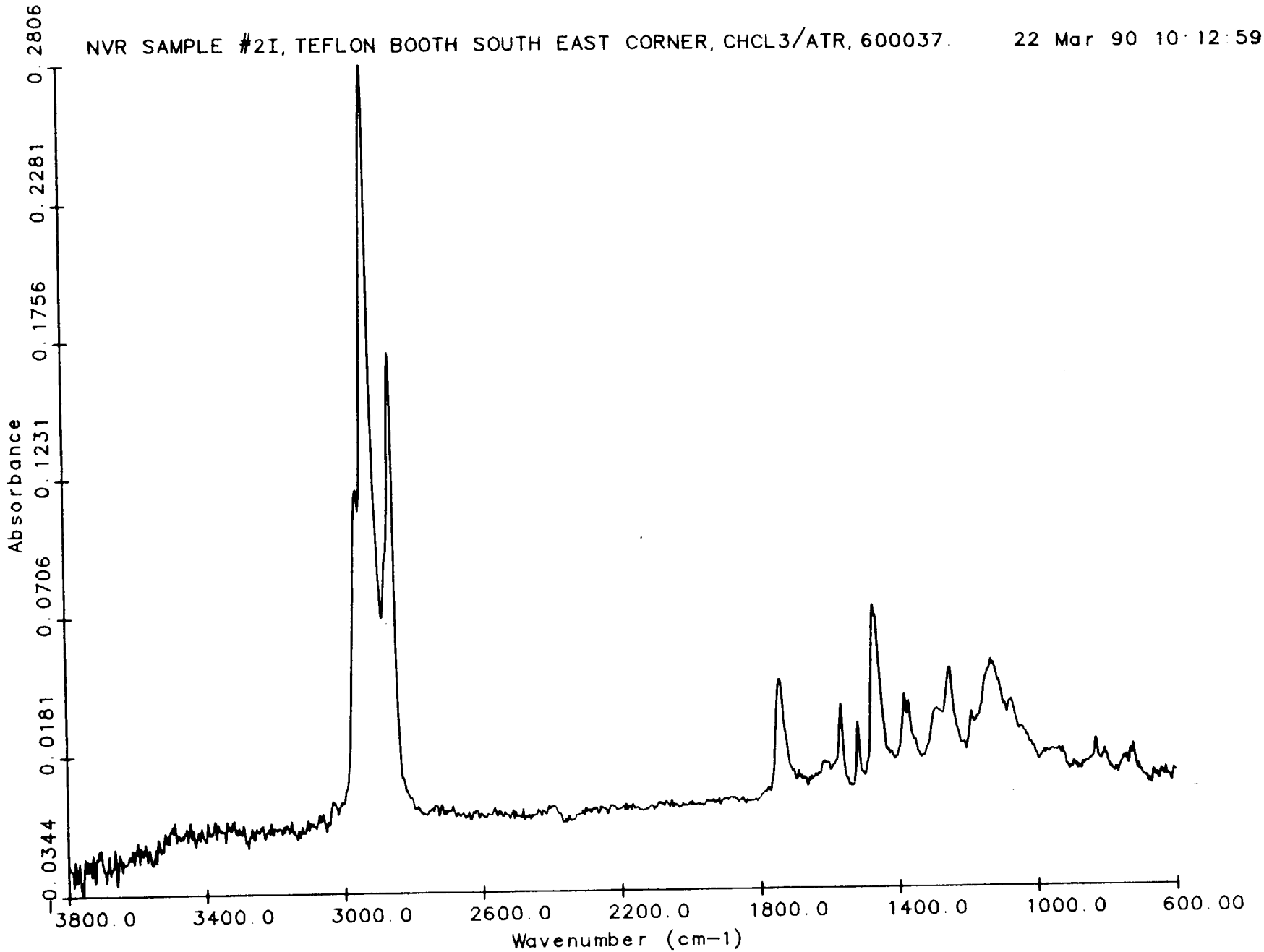
Attach the FTIR spectra to the environmental fallout panel data sheet, return to M-35A ASAP

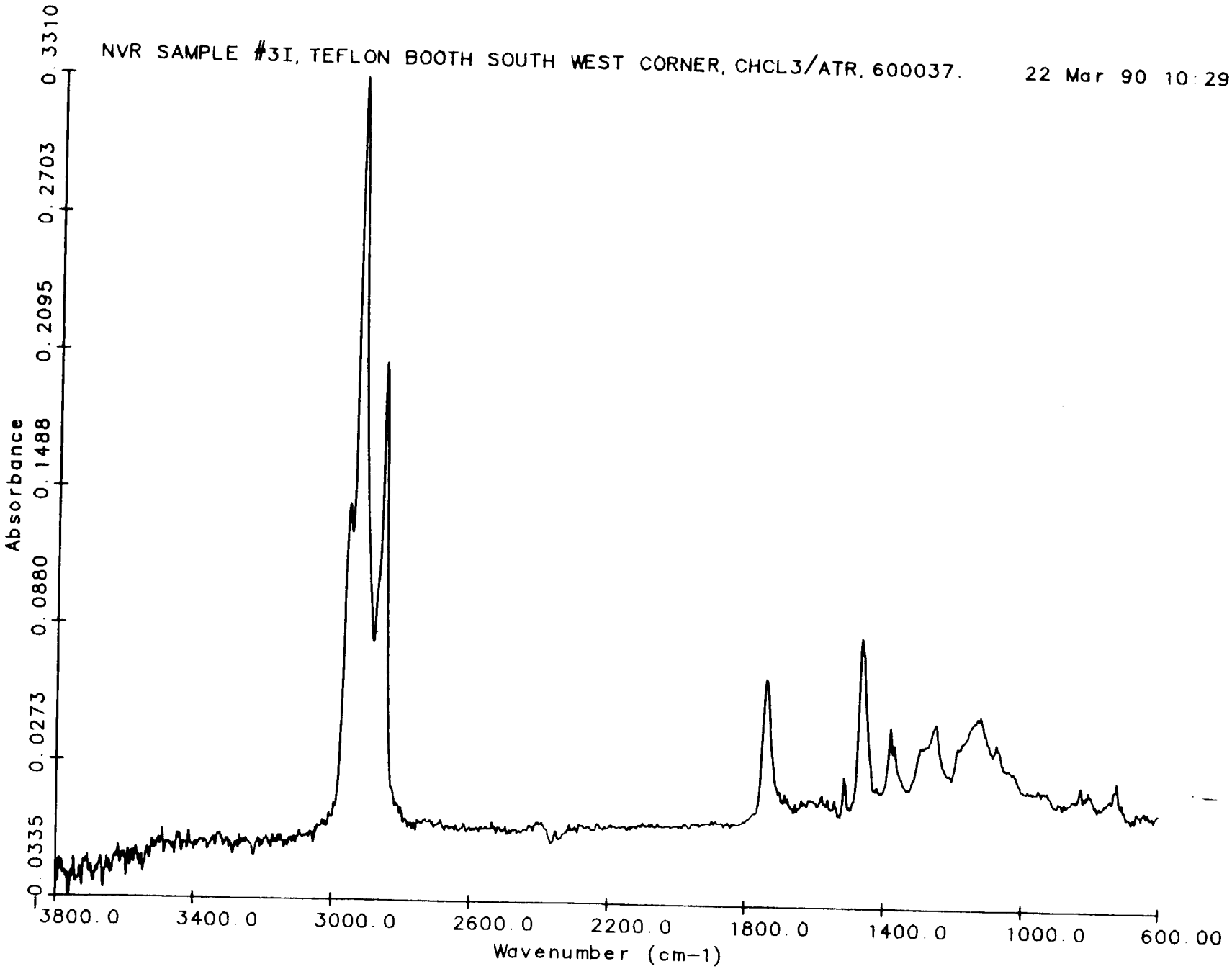
Thank you,

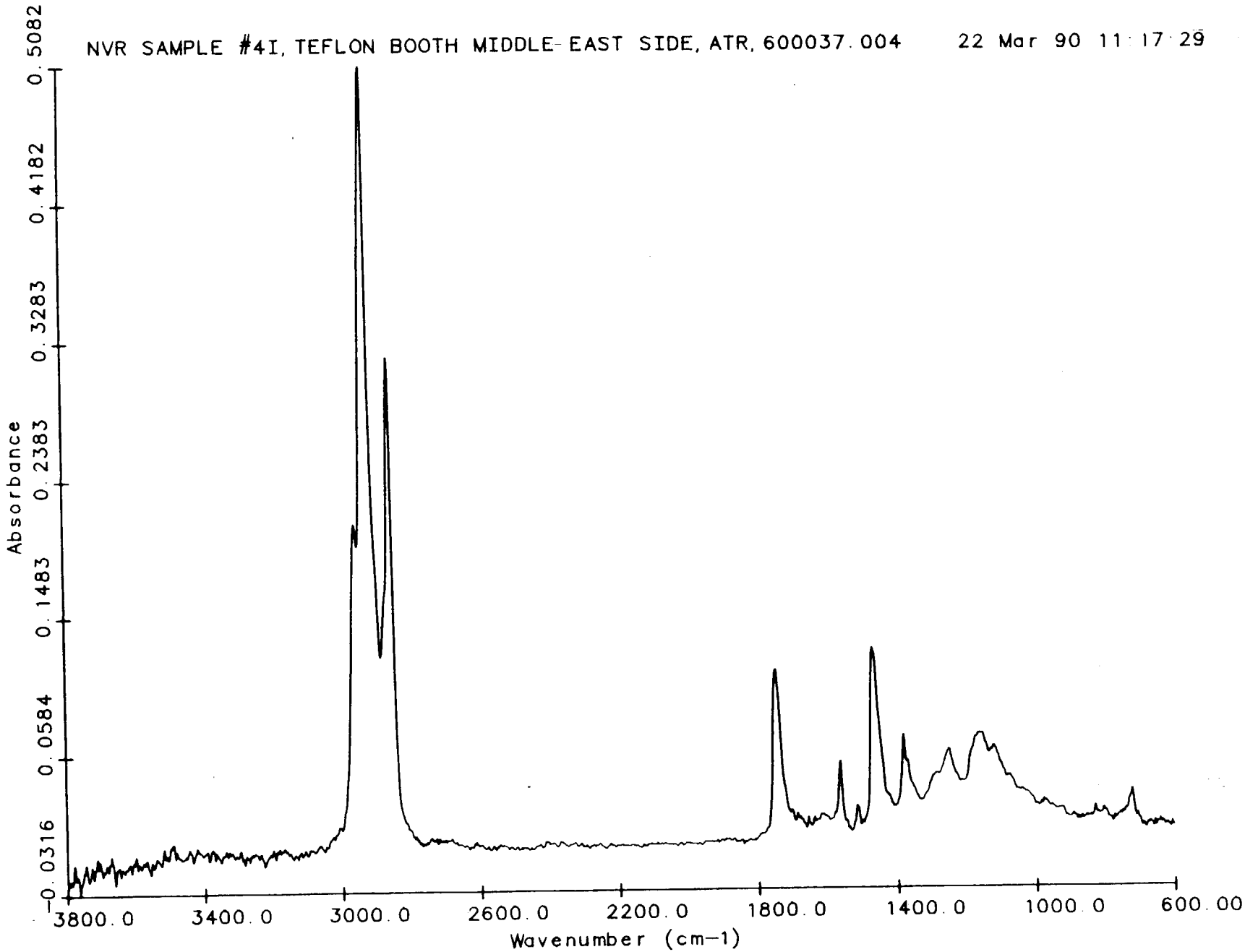
Joel Ward

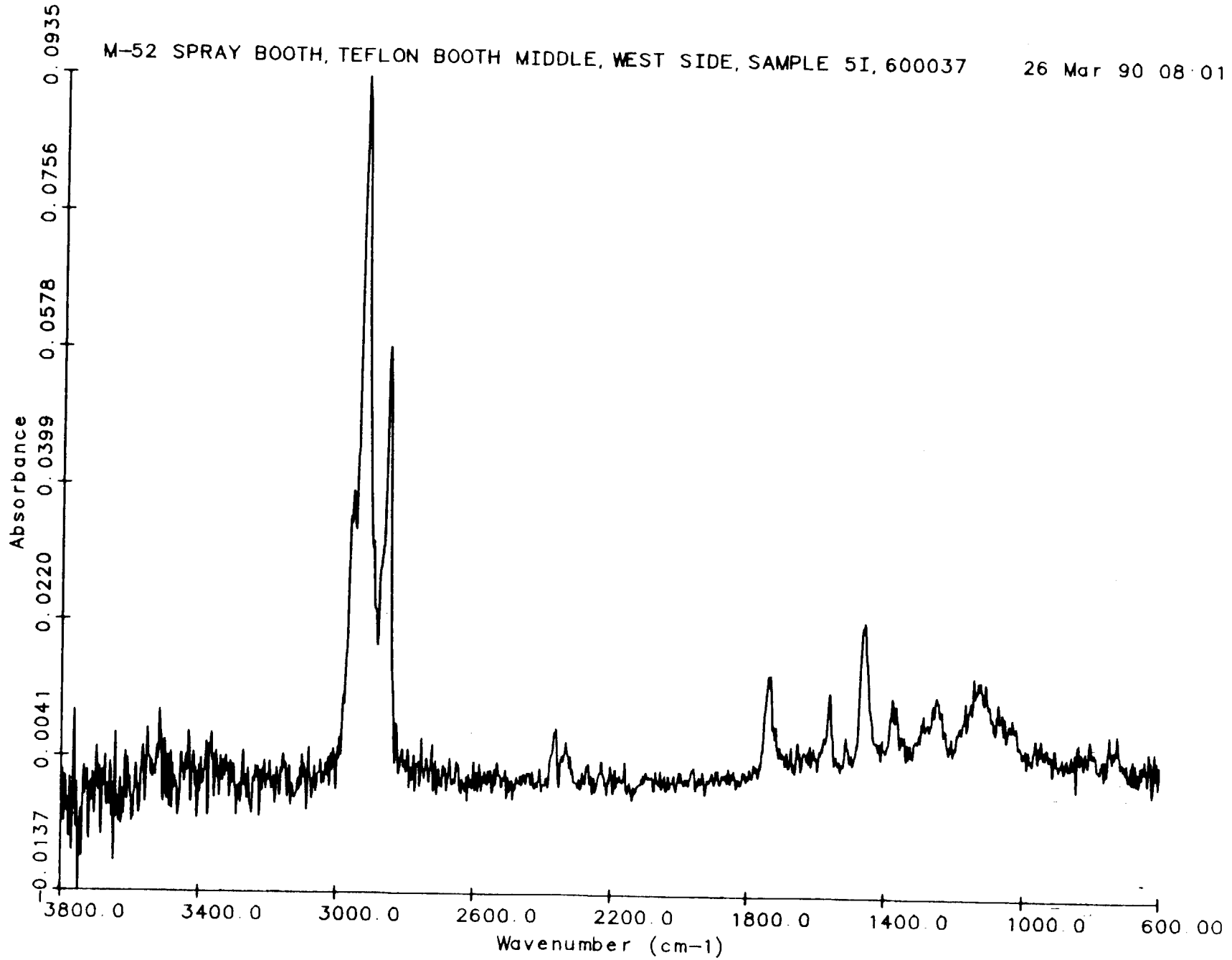
Joel Ward

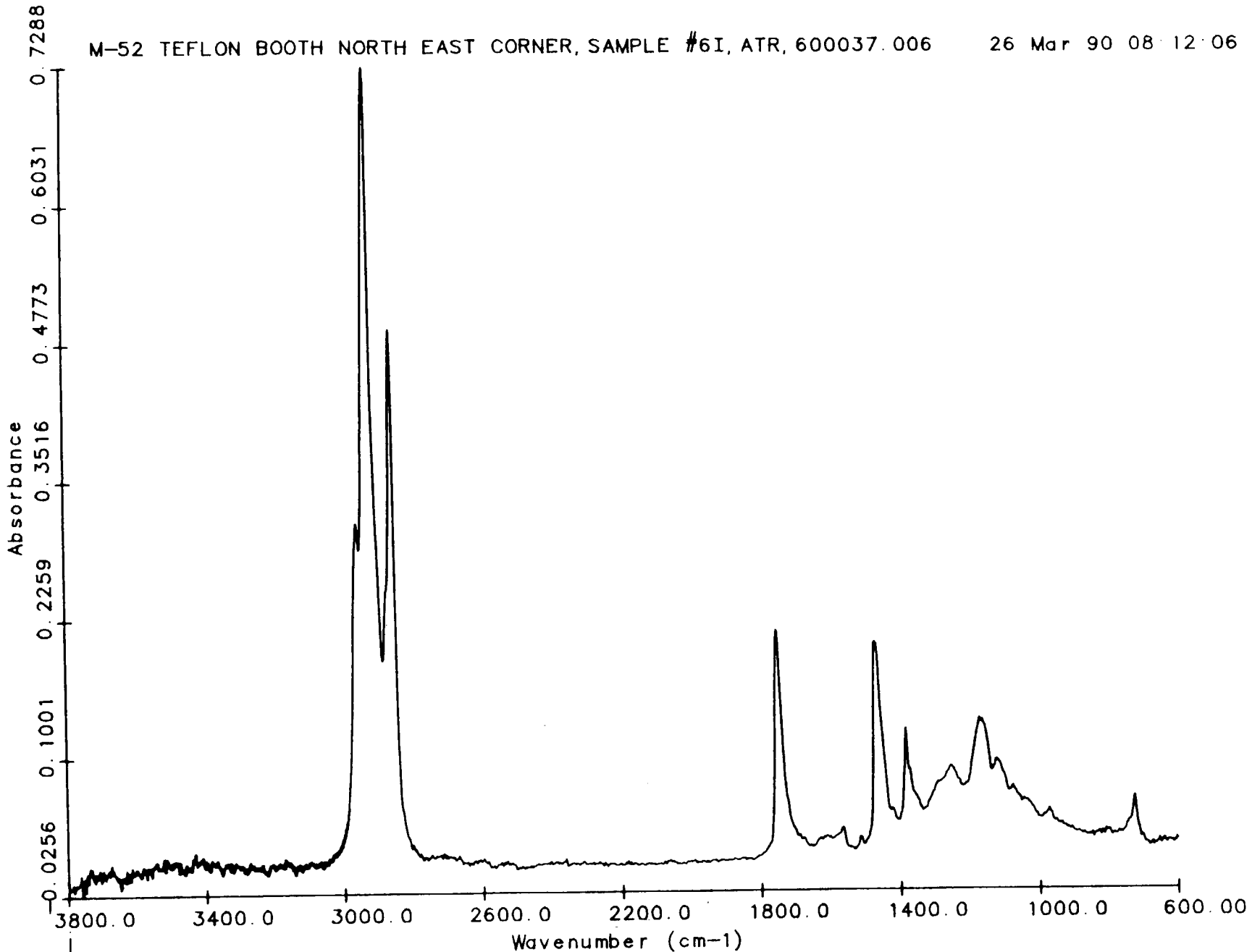

NVR SAMPLE #1I, FREON TF CONTROL #1, CHCL3 CAST ATR, 600037.001
22 Mar 90 09:50:53
Absorbance
0.0521
0.0425
0.0329
0.0234
0.0138
0.0042
-0.0053
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

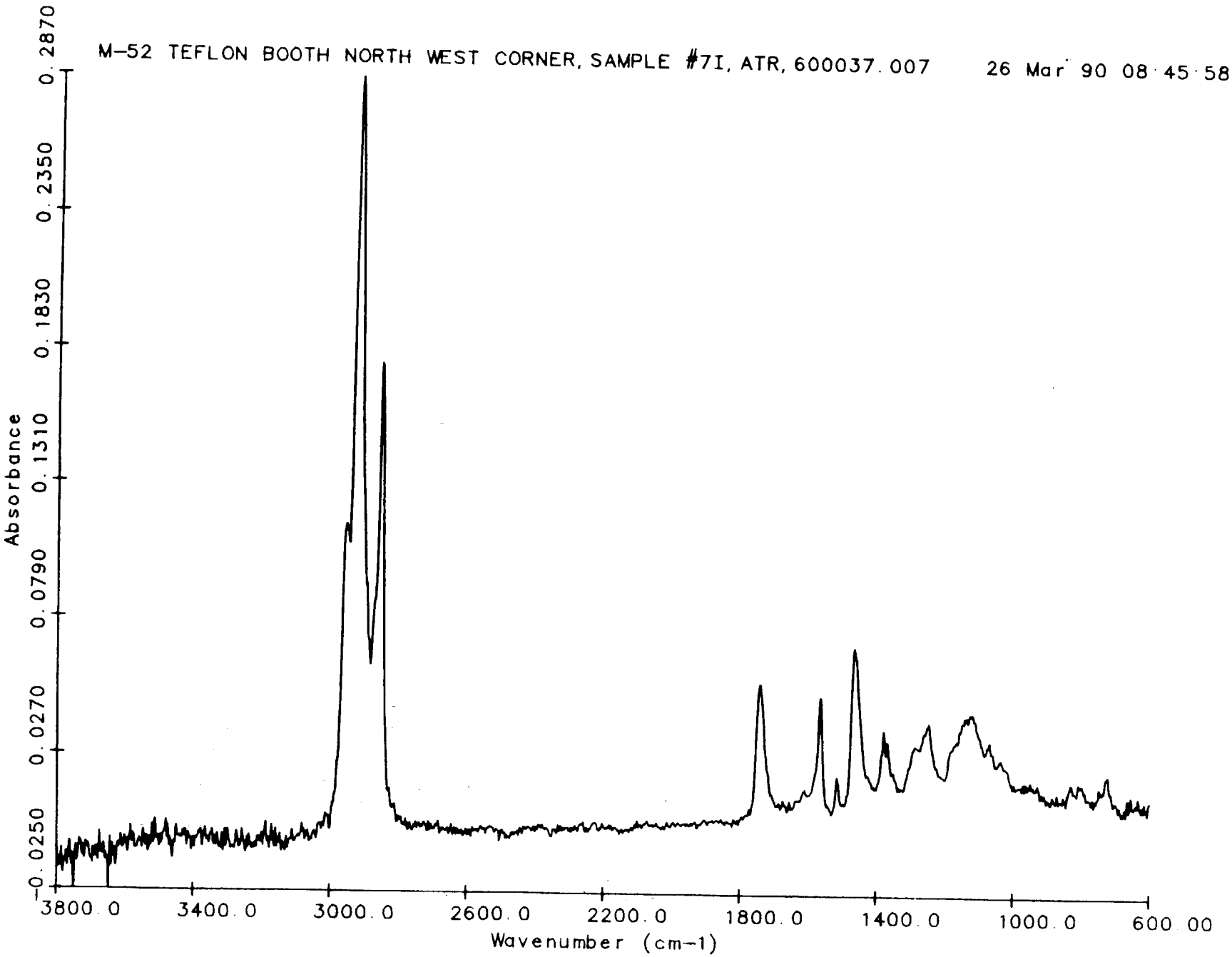

NVR SAMPLE #2I, TEFLON BOOTH SOUTH EAST CORNER, CHCL3/ATR, 600037.
22 Mar 90 10:12:59
Absorbance
0.2806
0.2281
0.1756
0.1231
0.0706
0.0181
-0.0344
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

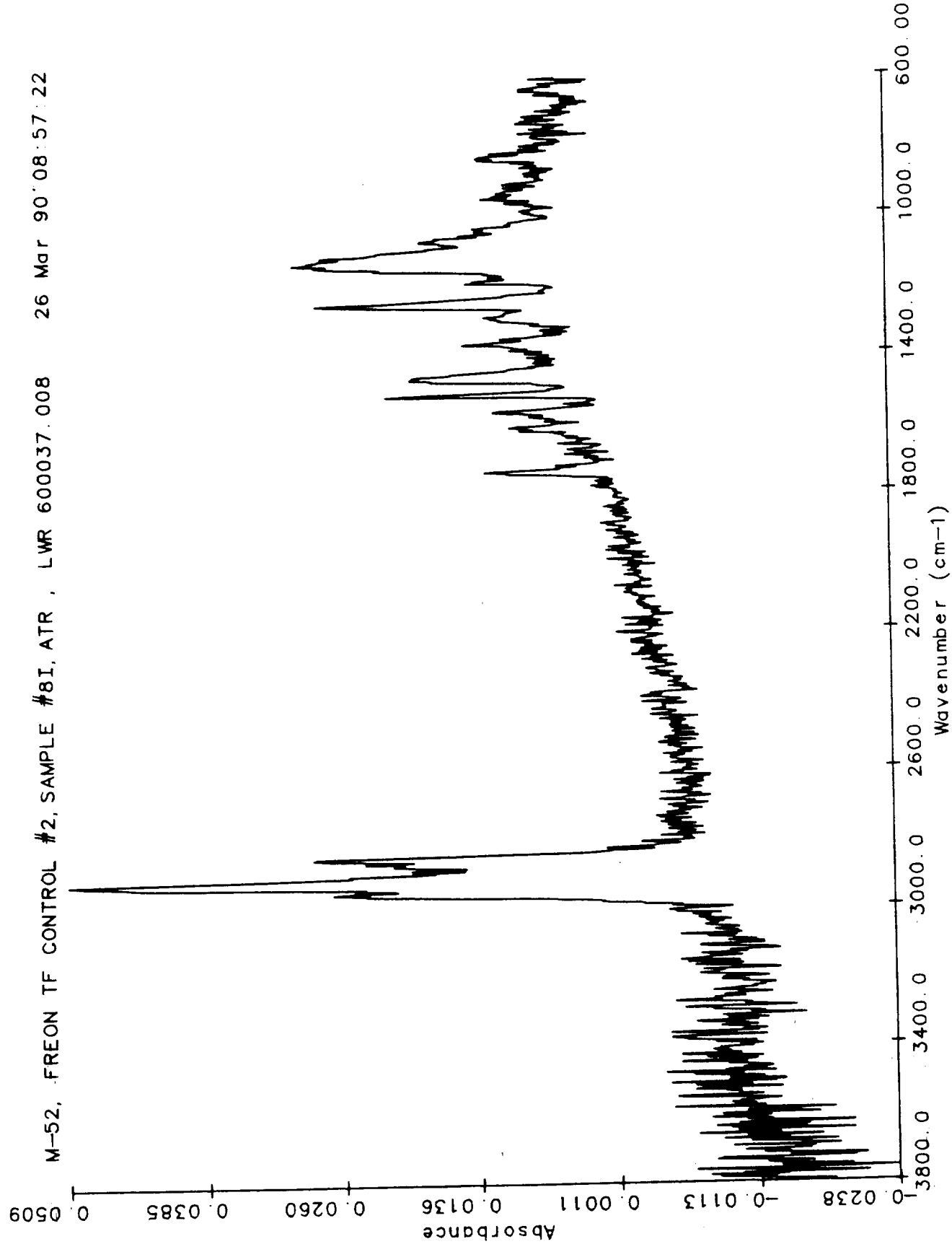

NVR SAMPLE #3I, TEFLON BOOTH SOUTH WEST CORNER, CHCL3/ATR, 600037.
22 Mar 90 10:29:17
Absorbance
0.3310
0.2703
0.2095
0.1488
0.0880
0.0273
-0.0335
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

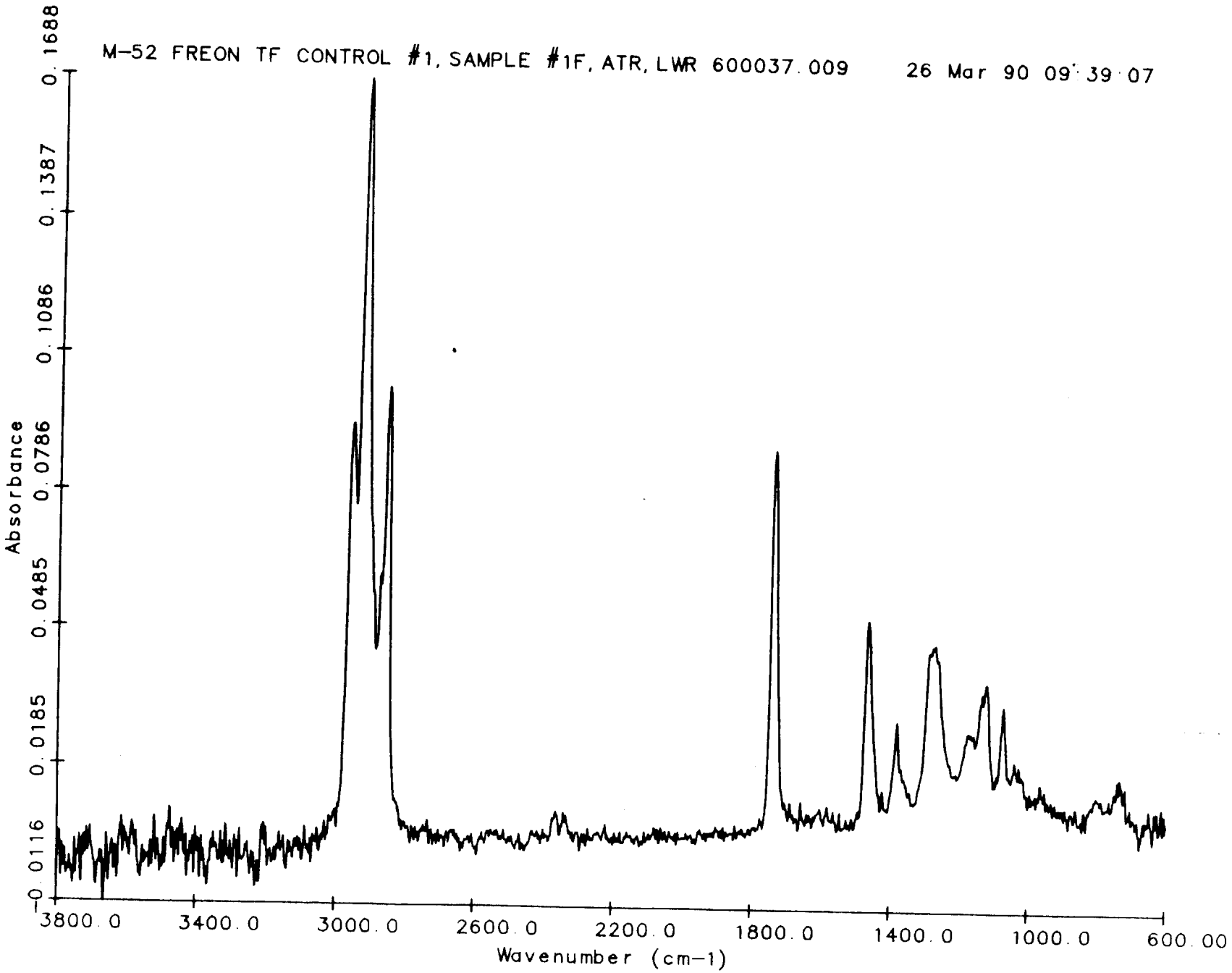

NVR SAMPLE #4I, TEFLON BOOTH MIDDLE-EAST SIDE, ATR, 600037.004
22 Mar 90 11:17:29
Absorbance
0.5082
0.4182
0.3283
0.2383
0.1483
0.0584
-0.0316
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

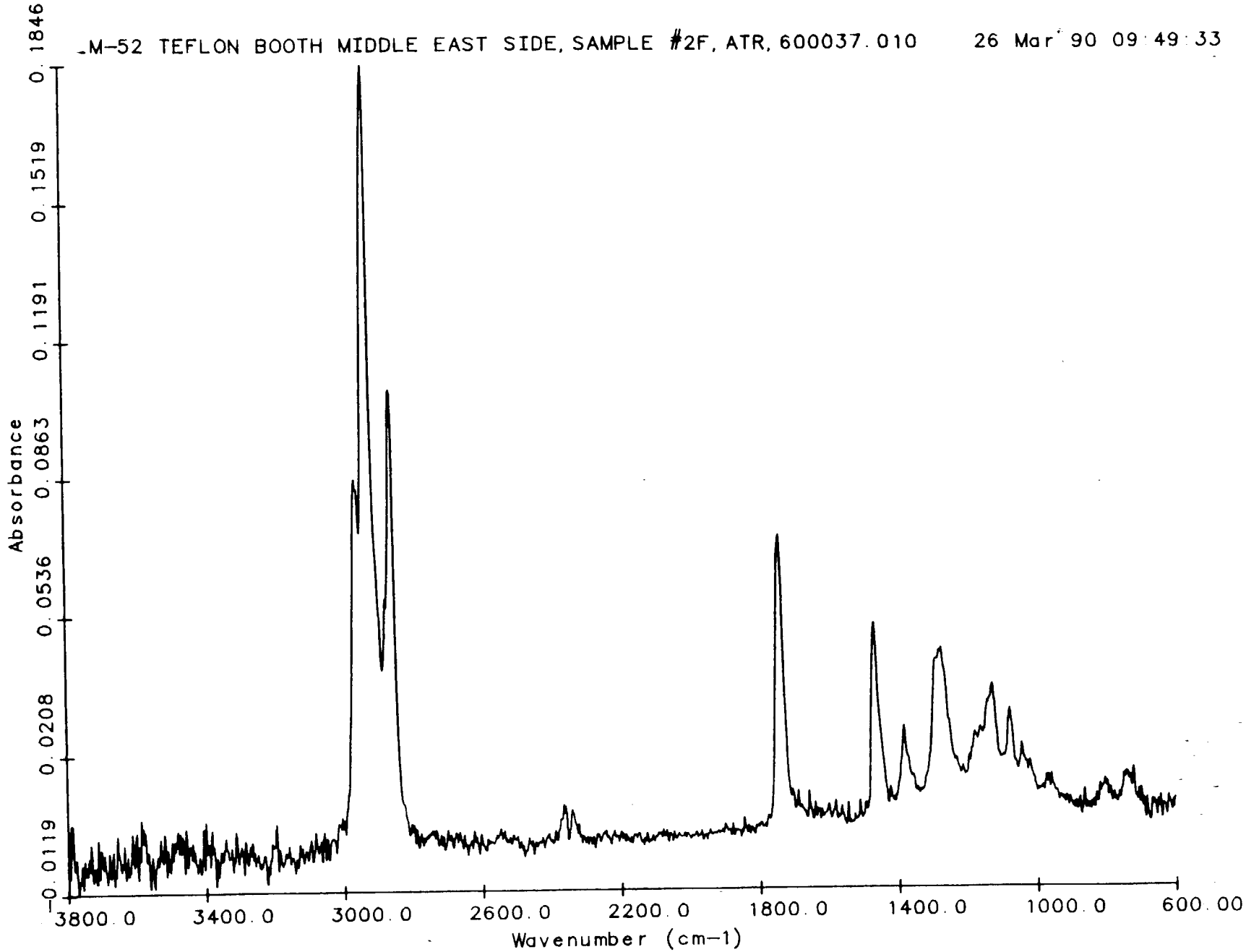

M-52 SPRAY BOOTH, TEFLON BOOTH MIDDLE, WEST SIDE, SAMPLE 5I, 600037
26 Mar 90 08:01:32
Absorbance
0.0935
0.0756
0.0578
0.0399
0.0220
0.0041
-0.0137
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

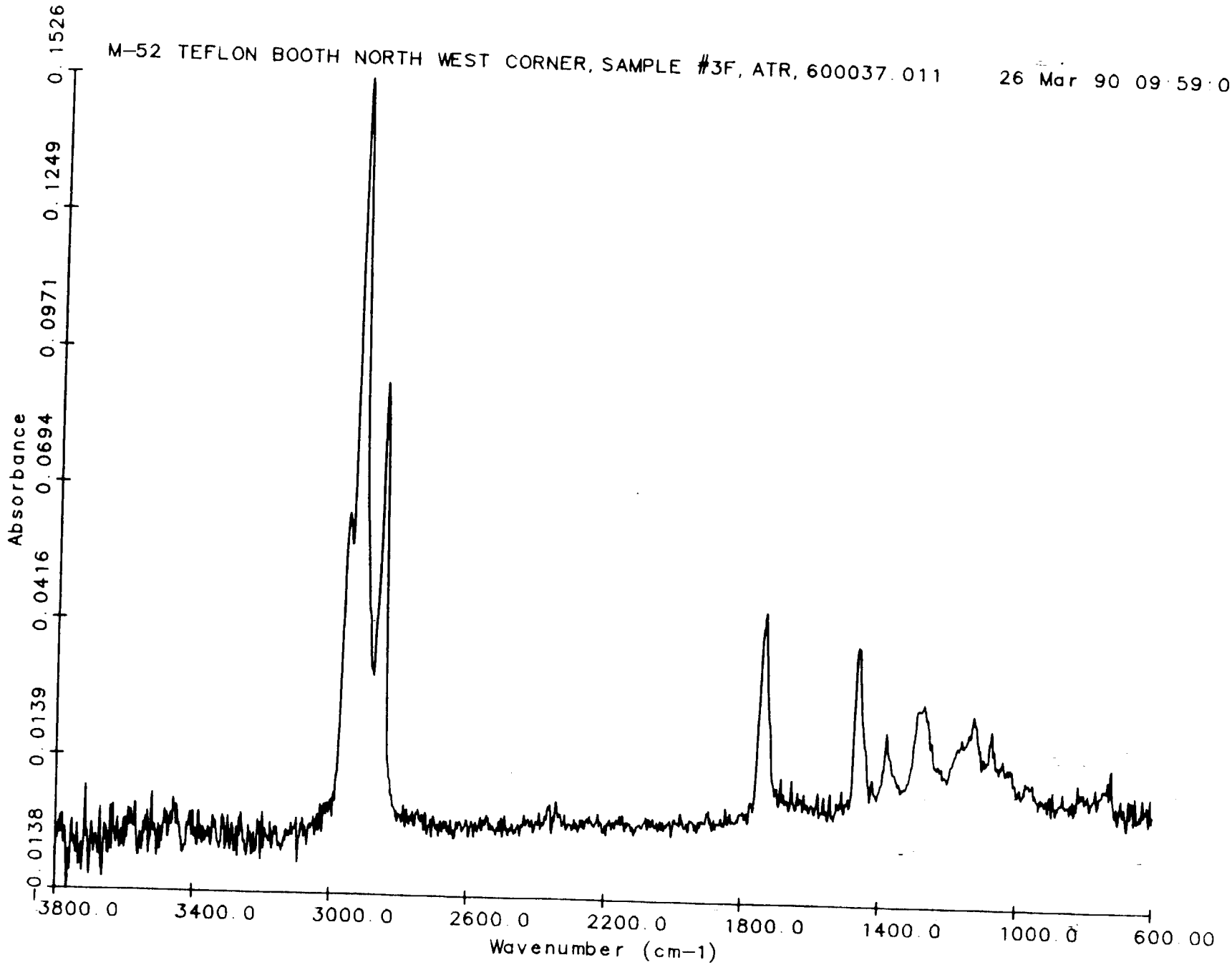

M-52 TEFLON BOOTH NORTH EAST CORNER, SAMPLE #6I, ATR, 600037.006
26 Mar 90 08:12:06
Absorbance
0.7288
0.6031
0.4773
0.3516
0.2259
0.1001
0.0256
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

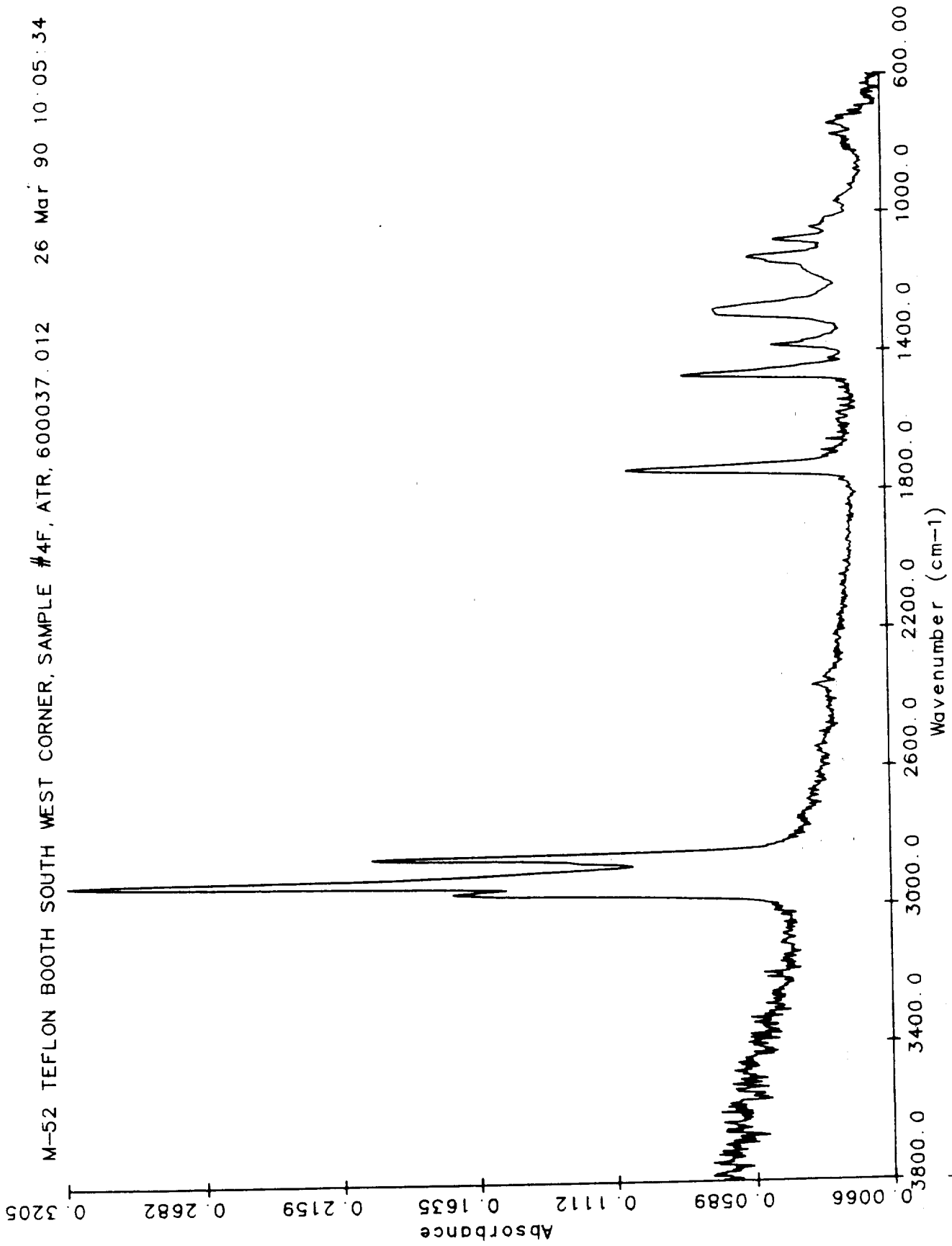

M-52 TEFLON BOOTH NORTH WEST CORNER, SAMPLE #7I, ATR, 600037.007
26 Mar 90 08:45:58
Absorbance
0.2870
0.2350
0.1830
0.1310
0.0790
0.0270
-0.0250
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

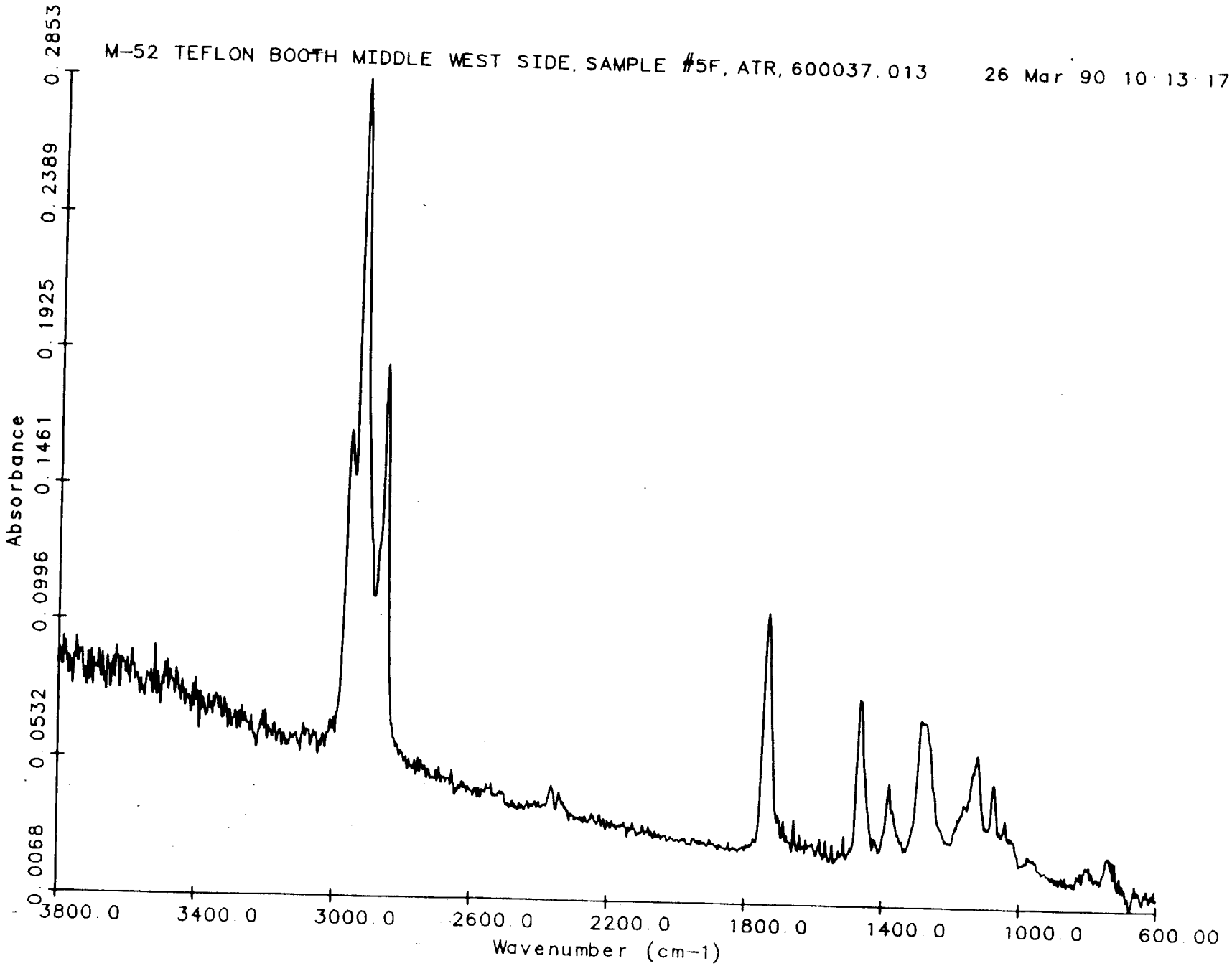

M-52, FREON TF CONTROL #2, SAMPLE #8I, ATR , LWR 600037.008 26 Mar 90 08:57:22
Absorbance
0.0509
0.0385
0.0260
0.0136
0.0011
-0.0113
-0.0238
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

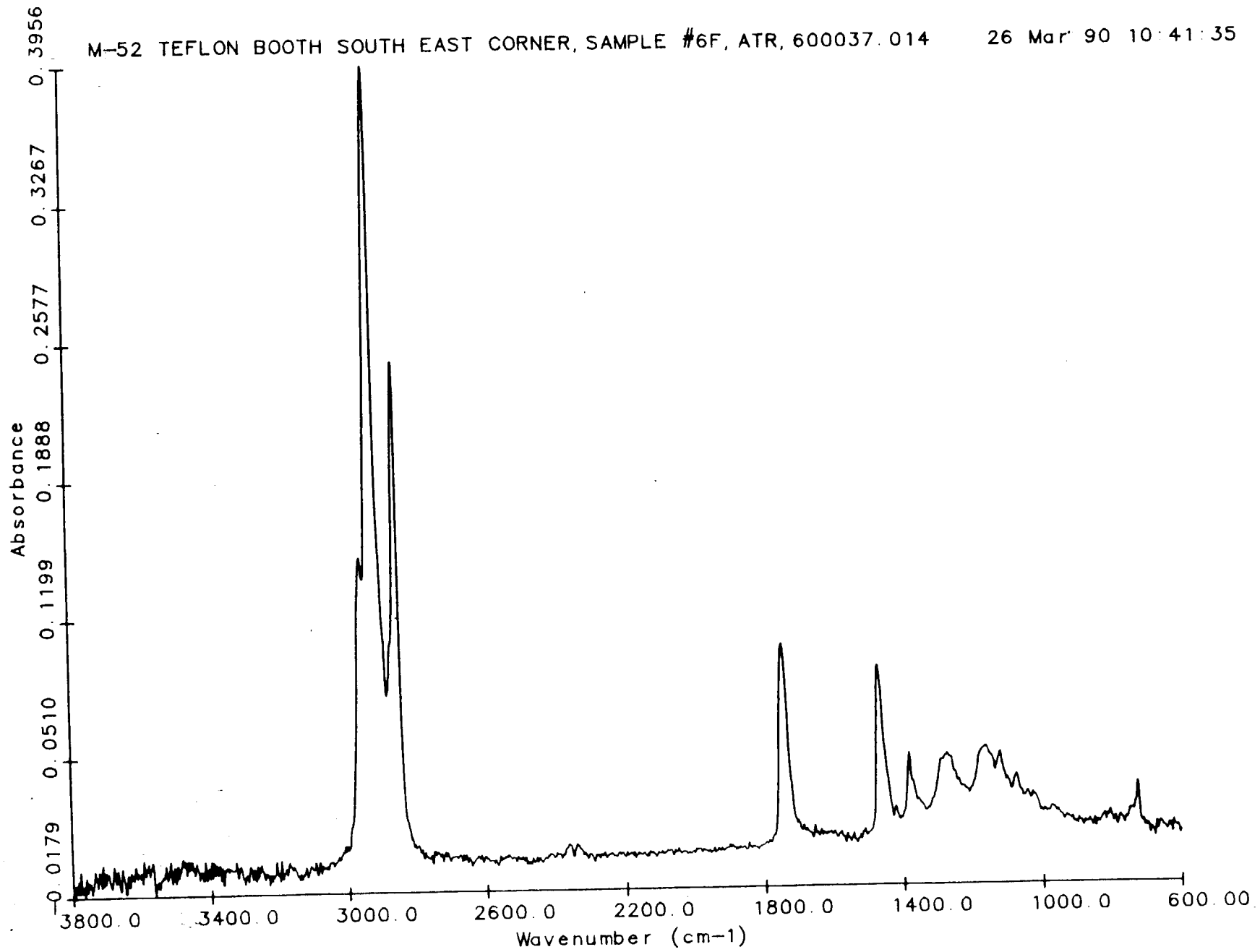

M-52 FREON TF CONTROL #1, SAMPLE #1F, ATR, LWR 600037.009
26 Mar 90 09:39:07
Absorbance
0.1688
0.1387
0.1086
0.0786
0.0485
0.0185
-0.0116
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

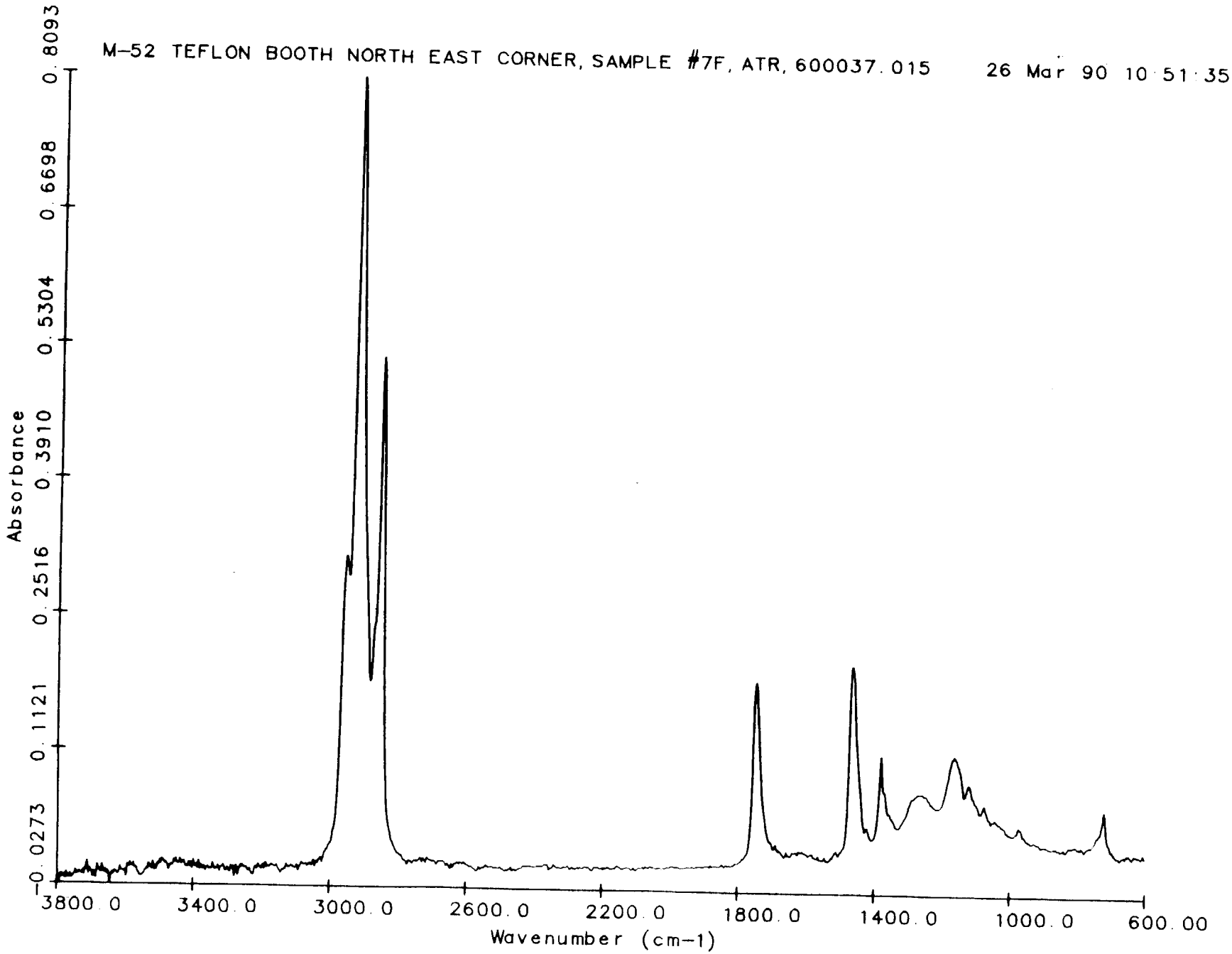

_M-52 TEFLON BOOTH MIDDLE EAST SIDE, SAMPLE #2F, ATR, 600037.010
26 Mar 90 09:49:33
Absorbance
0.1846
0.1519
0.1191
0.0863
0.0536
0.0208
-0.0119
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

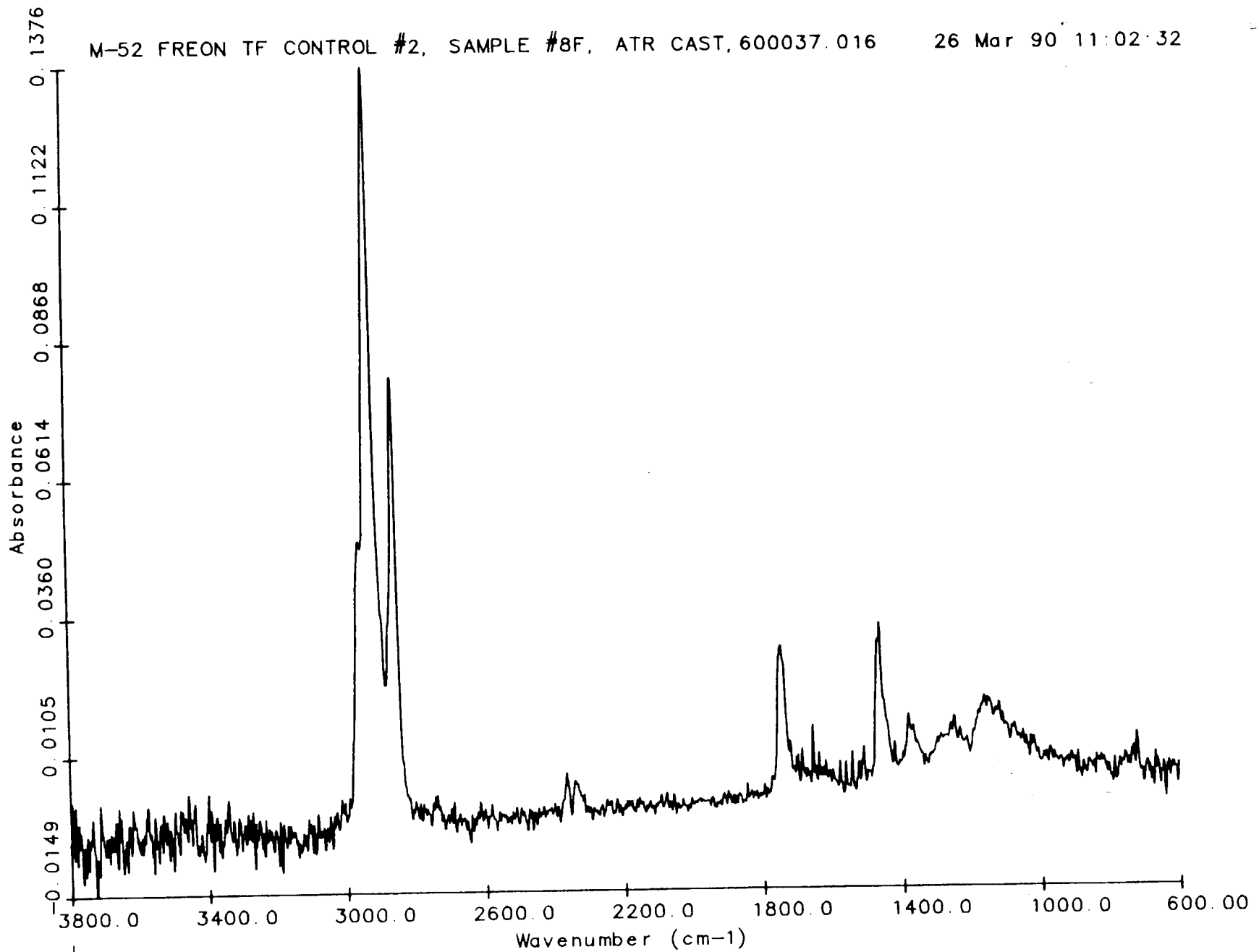

M-52 TEFLON BOOTH NORTH WEST CORNER, SAMPLE #3F, ATR, 600037.011
26 Mar 90 09:59:06
Absorbance
0.1526
0.1249
0.0971
0.0694
0.0416
0.0139
-0.0138
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

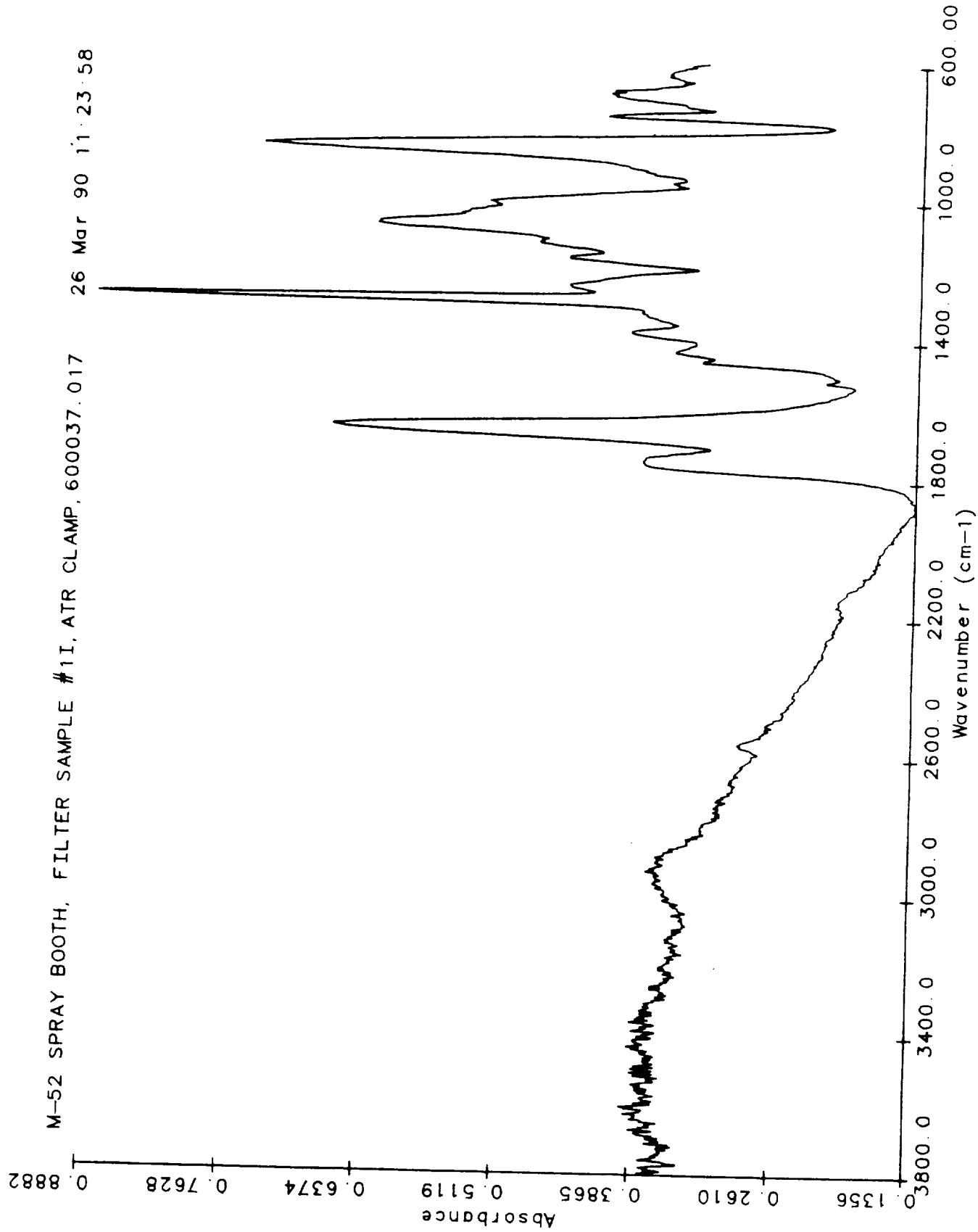

M-52 TEFLON BOOTH SOUTH WEST CORNER, SAMPLE #4F, ATR, 600037.012 26 Mar 90 10:05:34
Absorbance
0.0066
0.0589
0.1112
0.1635
0.2159
0.2682
0.3205
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

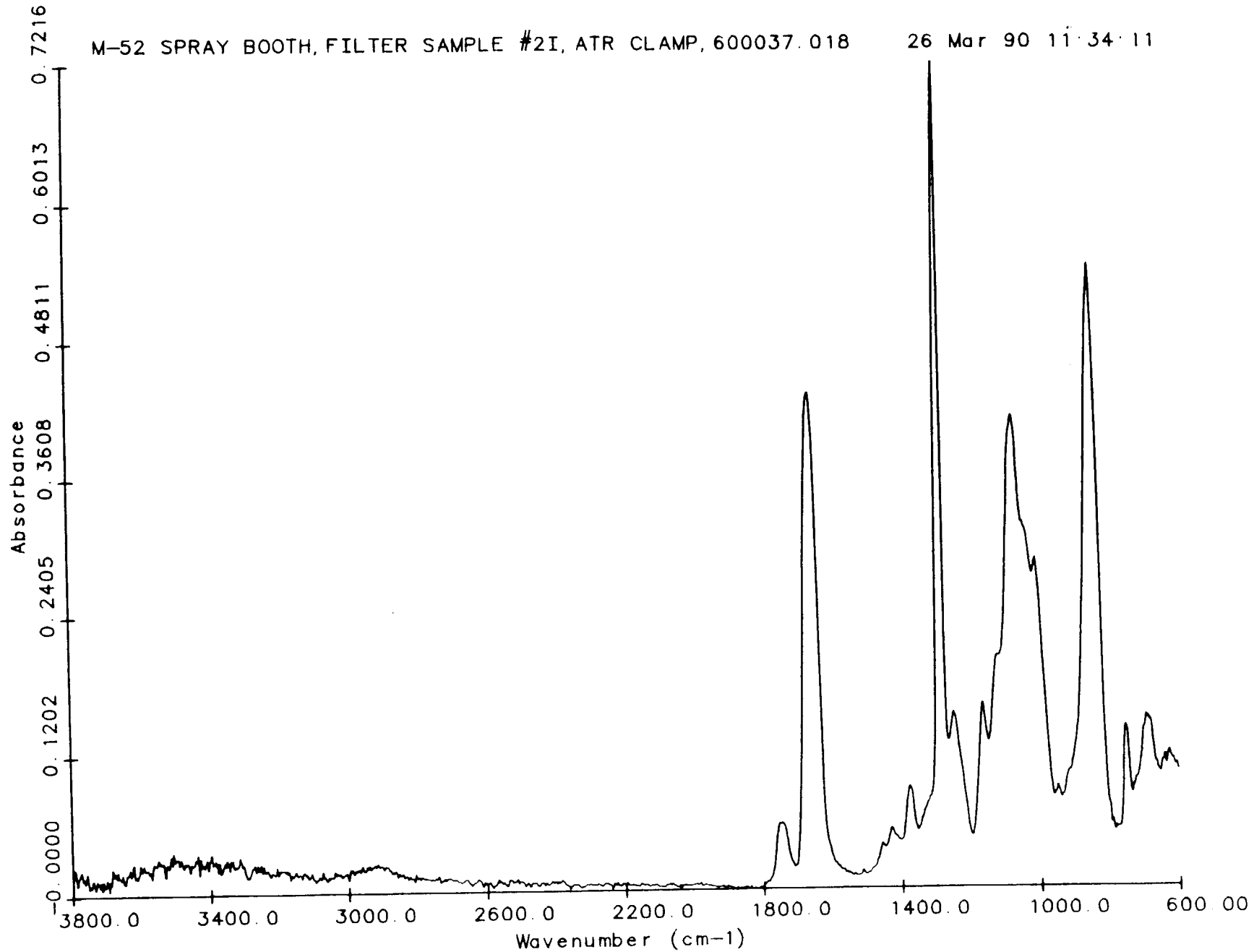

M-52 TEFLON BOOTH MIDDLE WEST SIDE, SAMPLE #5F, ATR, 600037.013
26 Mar 90 10:13:17
Absorbance
0.2853
0.2389
0.1925
0.1461
0.0996
0.0532
0.0068
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

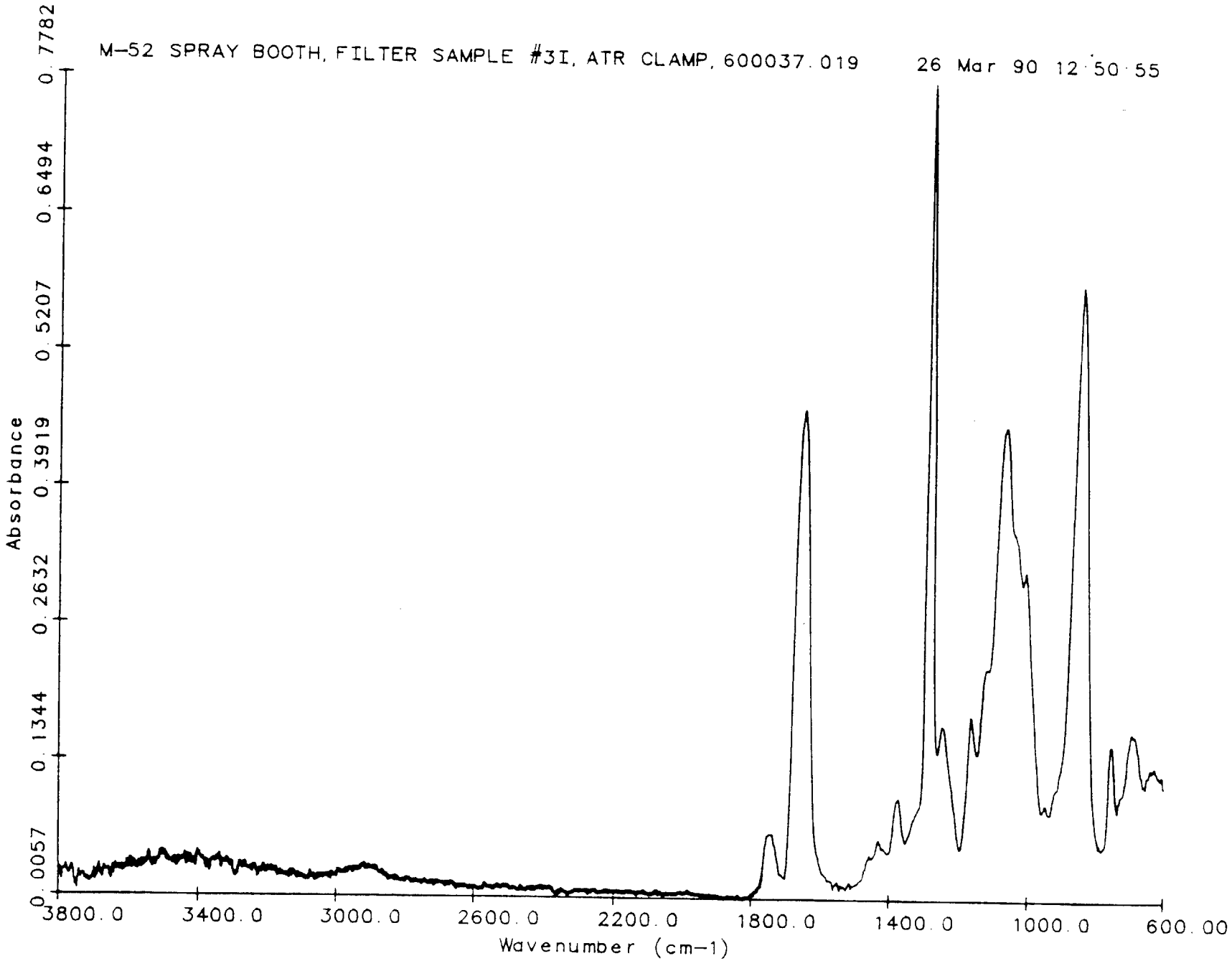

M-52 TEFLON BOOTH SOUTH EAST CORNER, SAMPLE #6F, ATR, 600037.014
26 Mar 90 10:41:35
Absorbance
0.3956
0.3267
0.2577
0.1888
0.1199
0.0510
0.0179
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

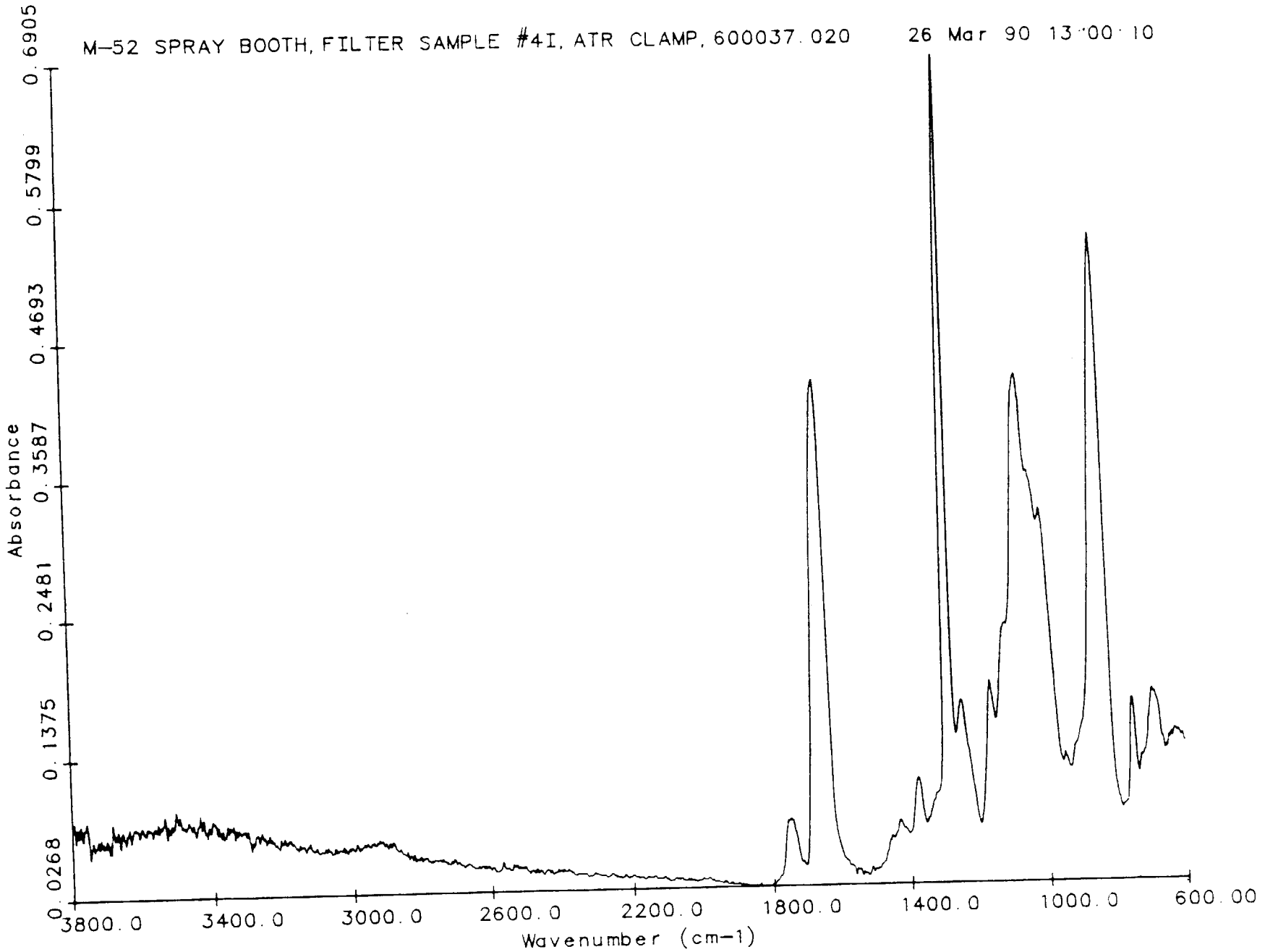

M-52 TEFLON BOOTH NORTH EAST CORNER, SAMPLE #7F, ATR, 600037.015
26 Mar 90 10:51:35
Absorbance
0.8093
0.6698
0.5304
0.3910
0.2516
0.1121
-0.0273
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

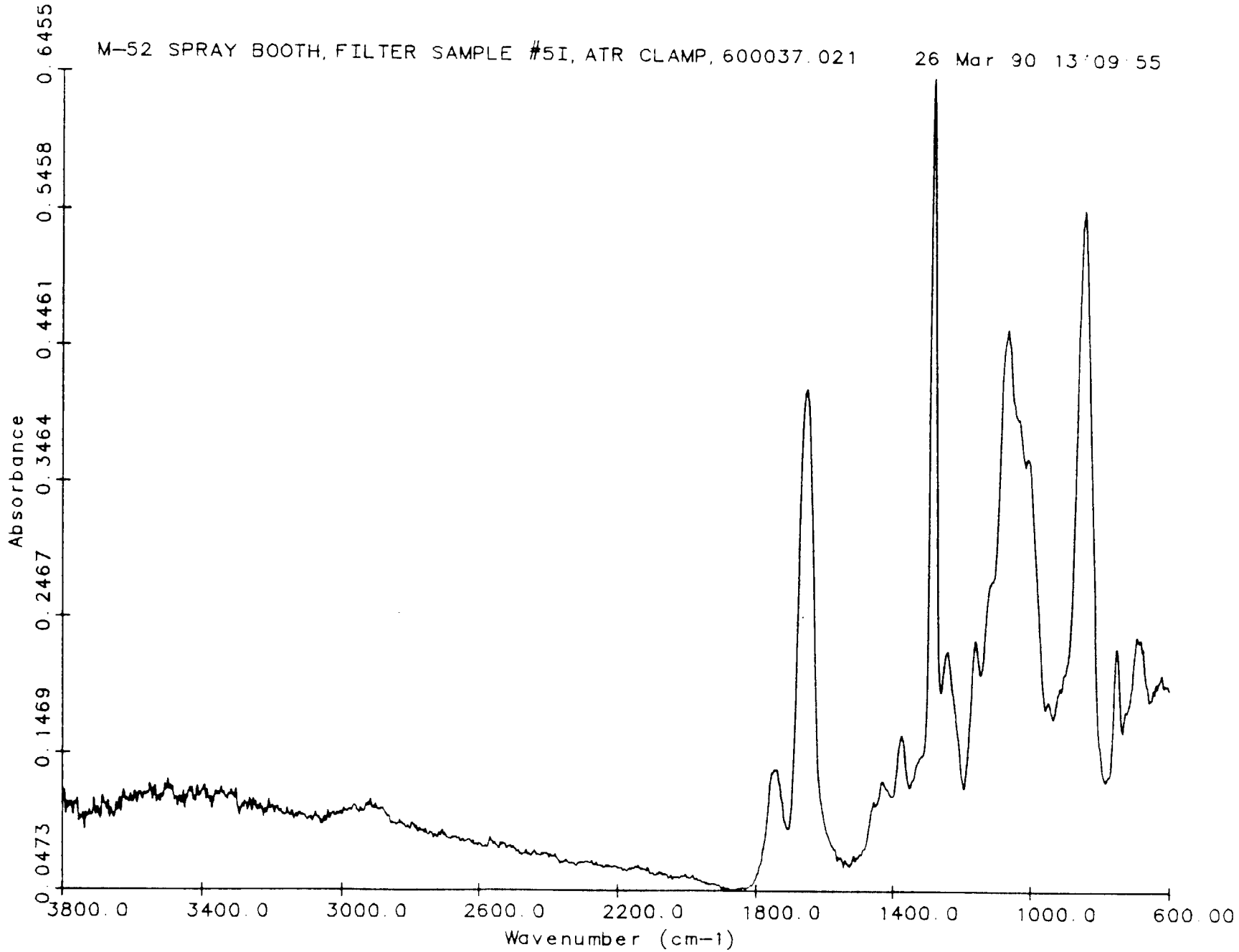

M-52 FREON TF CONTROL #2, SAMPLE #8F, ATR CAST, 600037.016 26 Mar 90 11:02:32
Absorbance
0.1376
0.1122
0.0868
0.0614
0.0360
0.0105
-0.0149
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

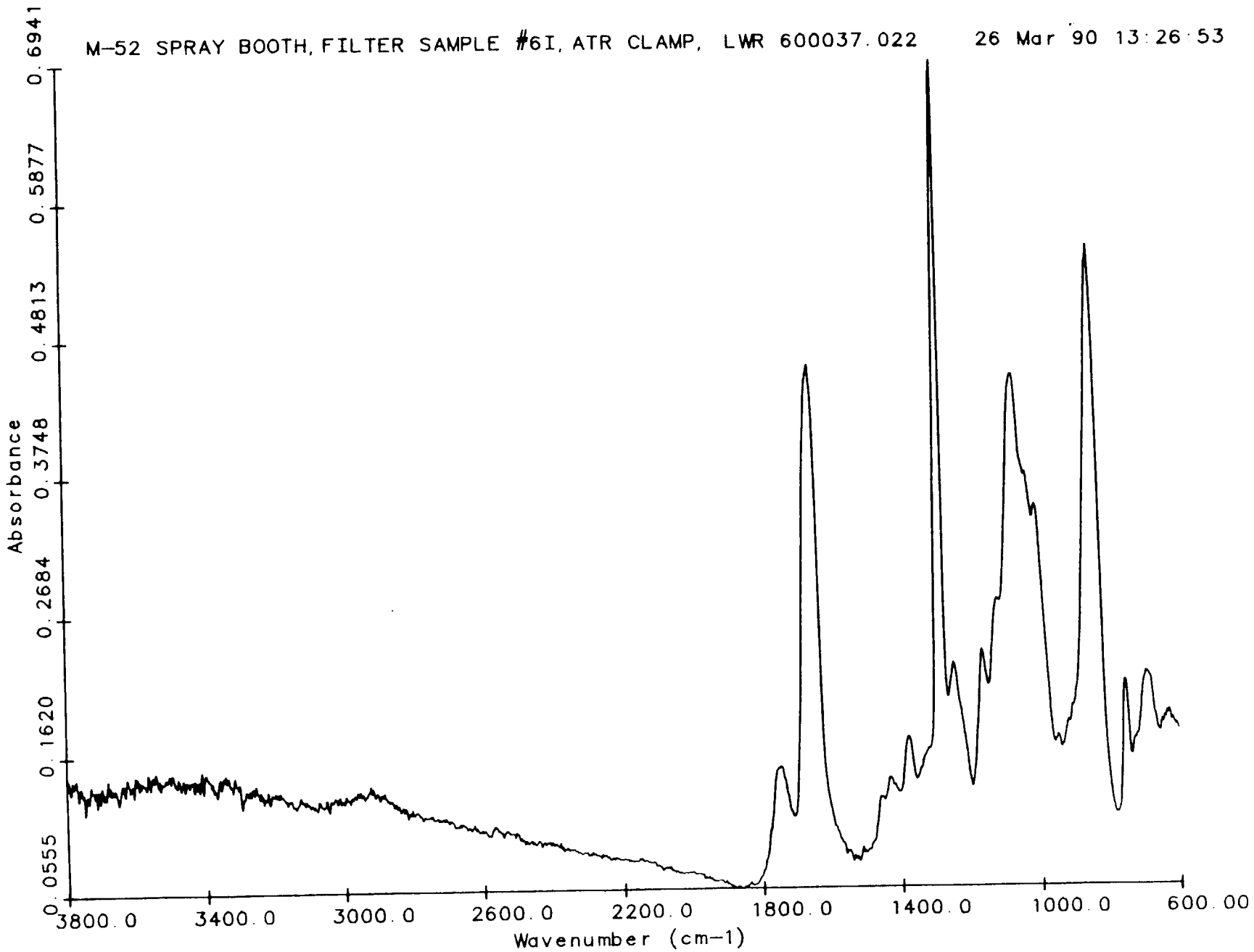

M-52 SPRAY BOOTH, FILTER SAMPLE #1I, ATR CLAMP, 600037.017
26 Mar 90 11:23:58
Absorbance
0.8882
0.7628
0.6374
0.5119
0.3865
0.2610
0.1356
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

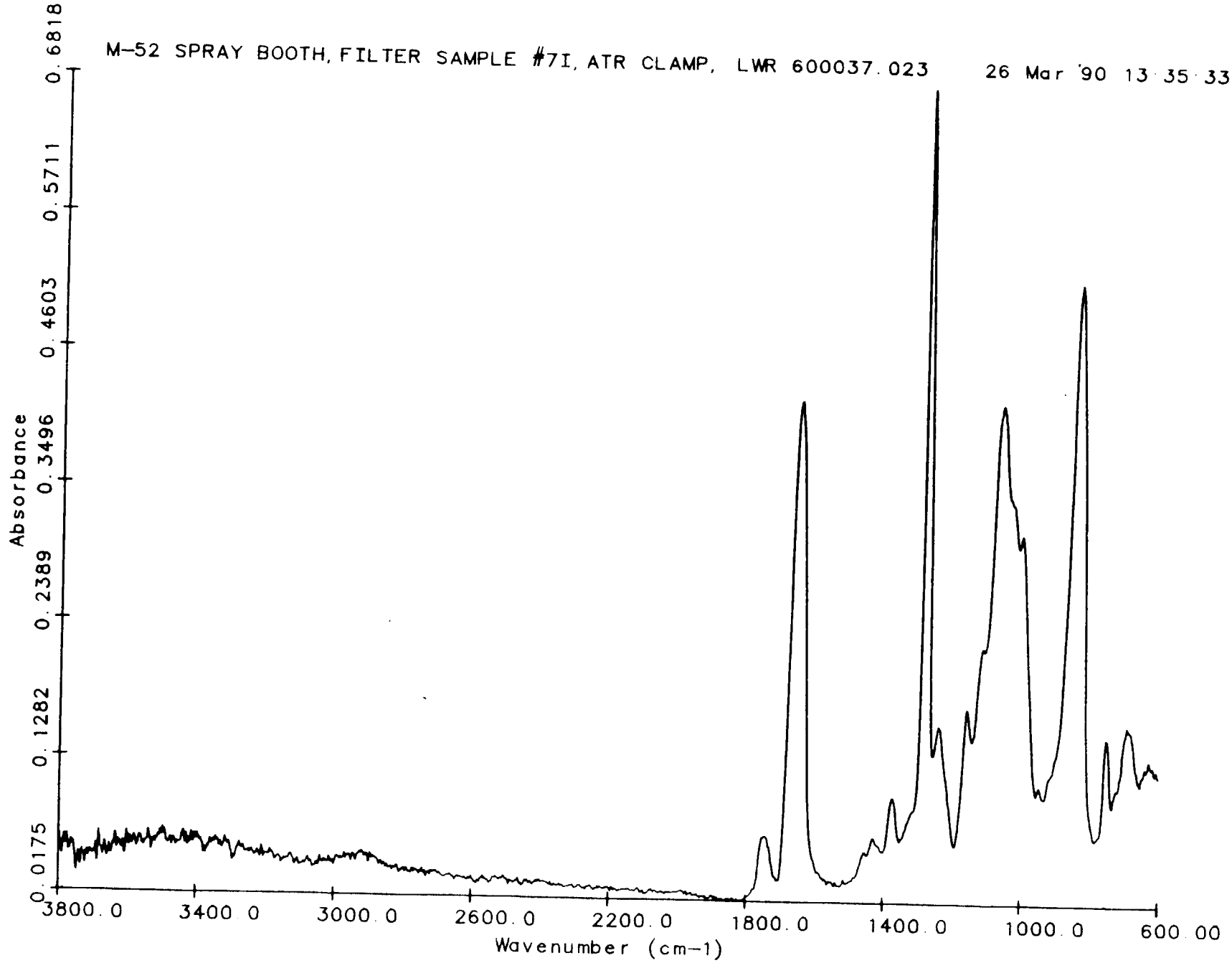

M-52 SPRAY BOOTH, FILTER SAMPLE #2I, ATR CLAMP, 600037.018
26 Mar 90 11:34:11
Absorbance
0.7216
0.6013
0.4811
0.3608
0.2405
0.1202
-0.0000
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

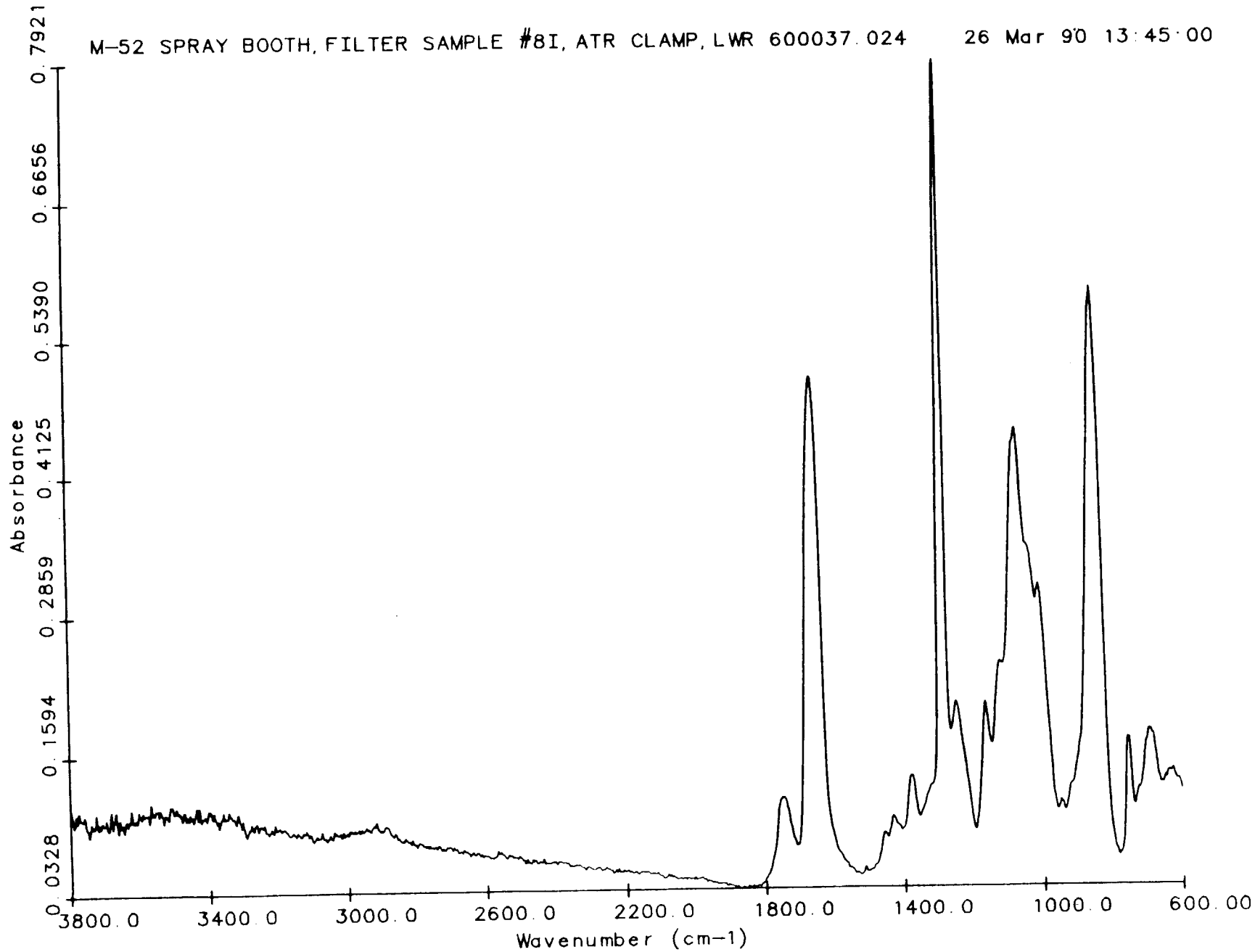

M-52 SPRAY BOOTH, FILTER SAMPLE #3I, ATR CLAMP, 600037.019
26 Mar 90 12:50:55
Absorbance
0.7782
0.6494
0.5207
0.3919
0.2632
0.1344
0.0057
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

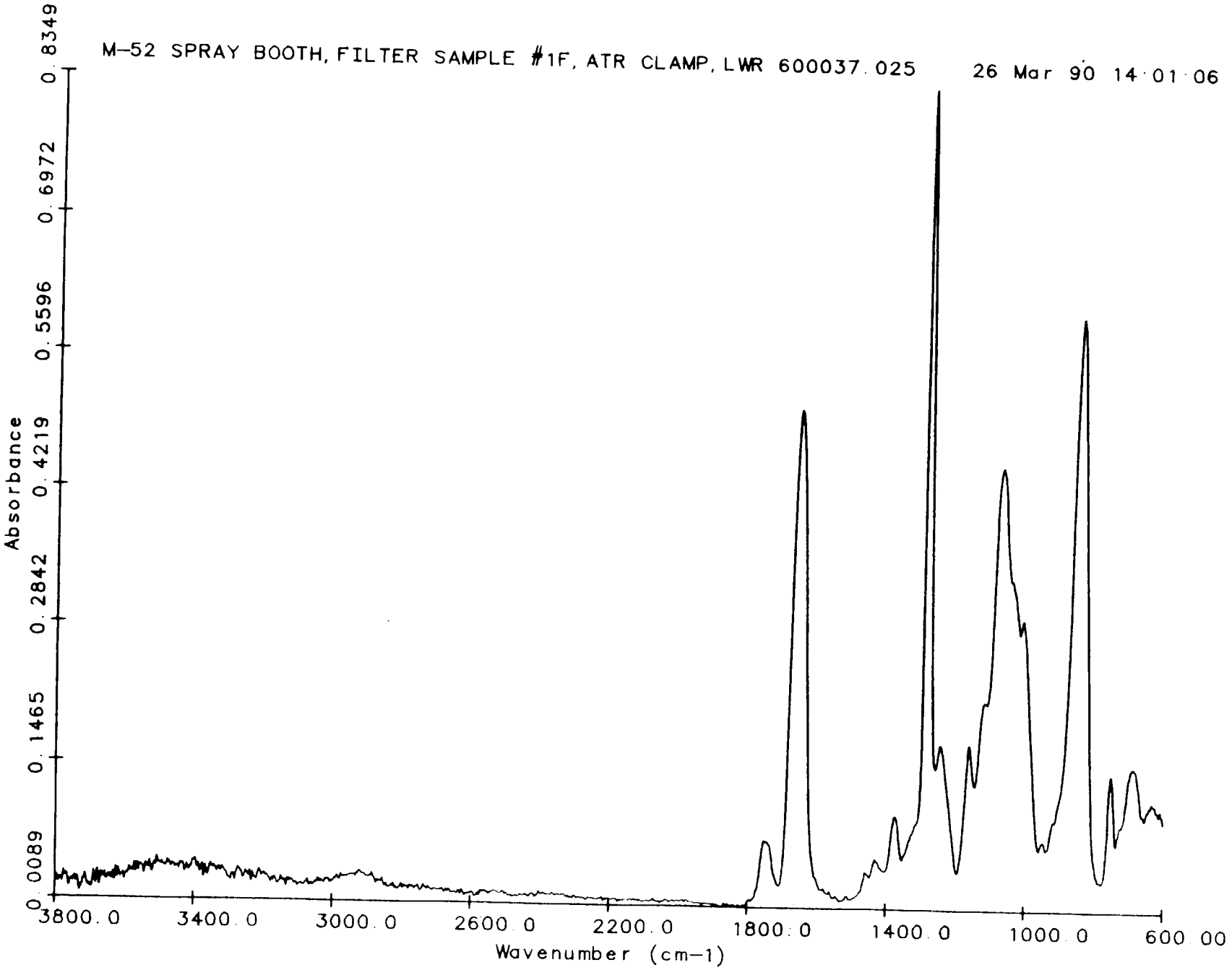

M-52 SPRAY BOOTH, FILTER SAMPLE #4I, ATR CLAMP, 600037.020
26 Mar 90 13:00:10
Absorbance
0.6905
0.5799
0.4693
0.3587
0.2481
0.1375
0.0268
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

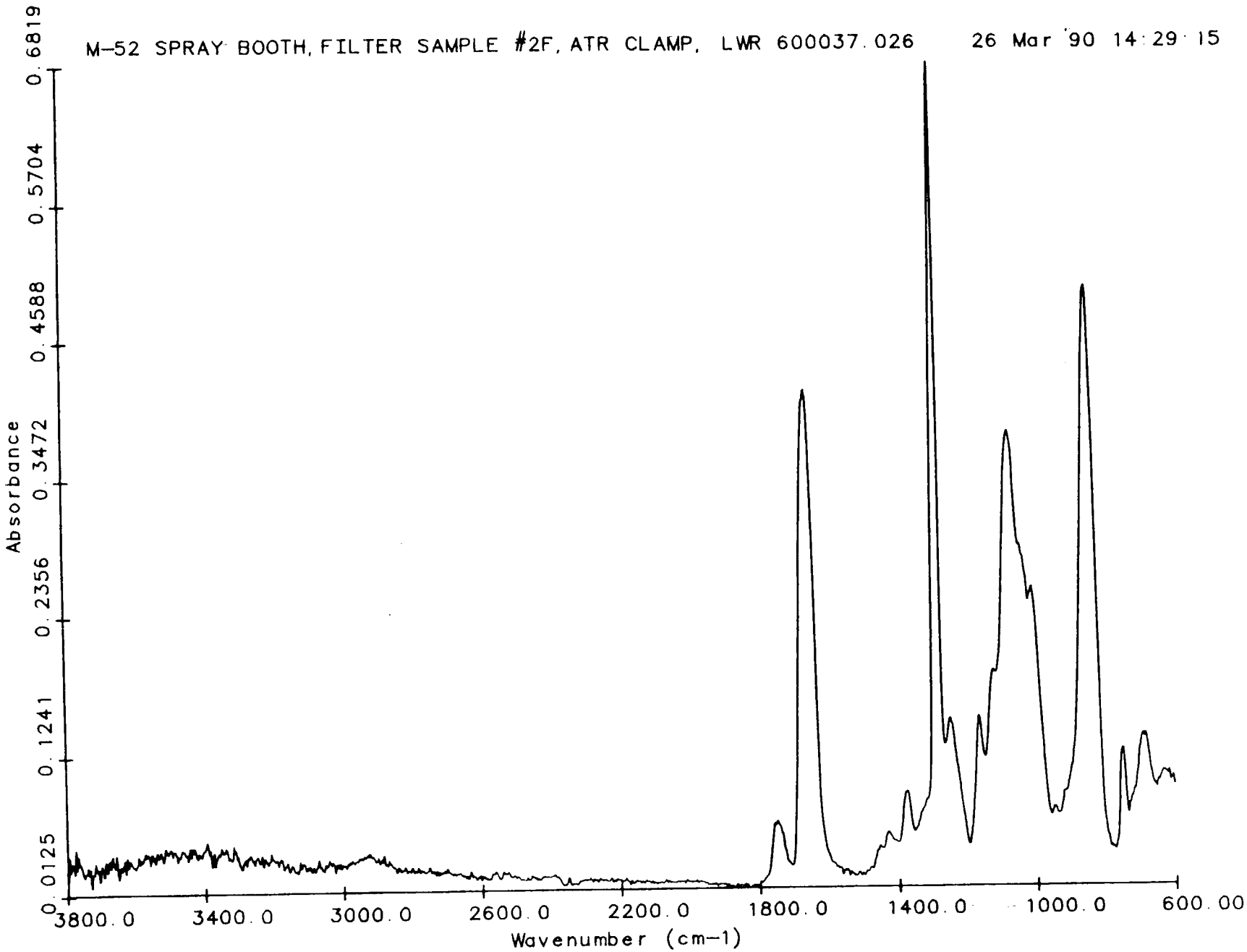

M–52 SPRAY BOOTH, FILTER SAMPLE #5I, ATR CLAMP, 600037.021
26 Mar 90 13:09:55
Absorbance
0.6455
0.5458
0.4461
0.3464
0.2467
0.1469
0.0473
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm–1)

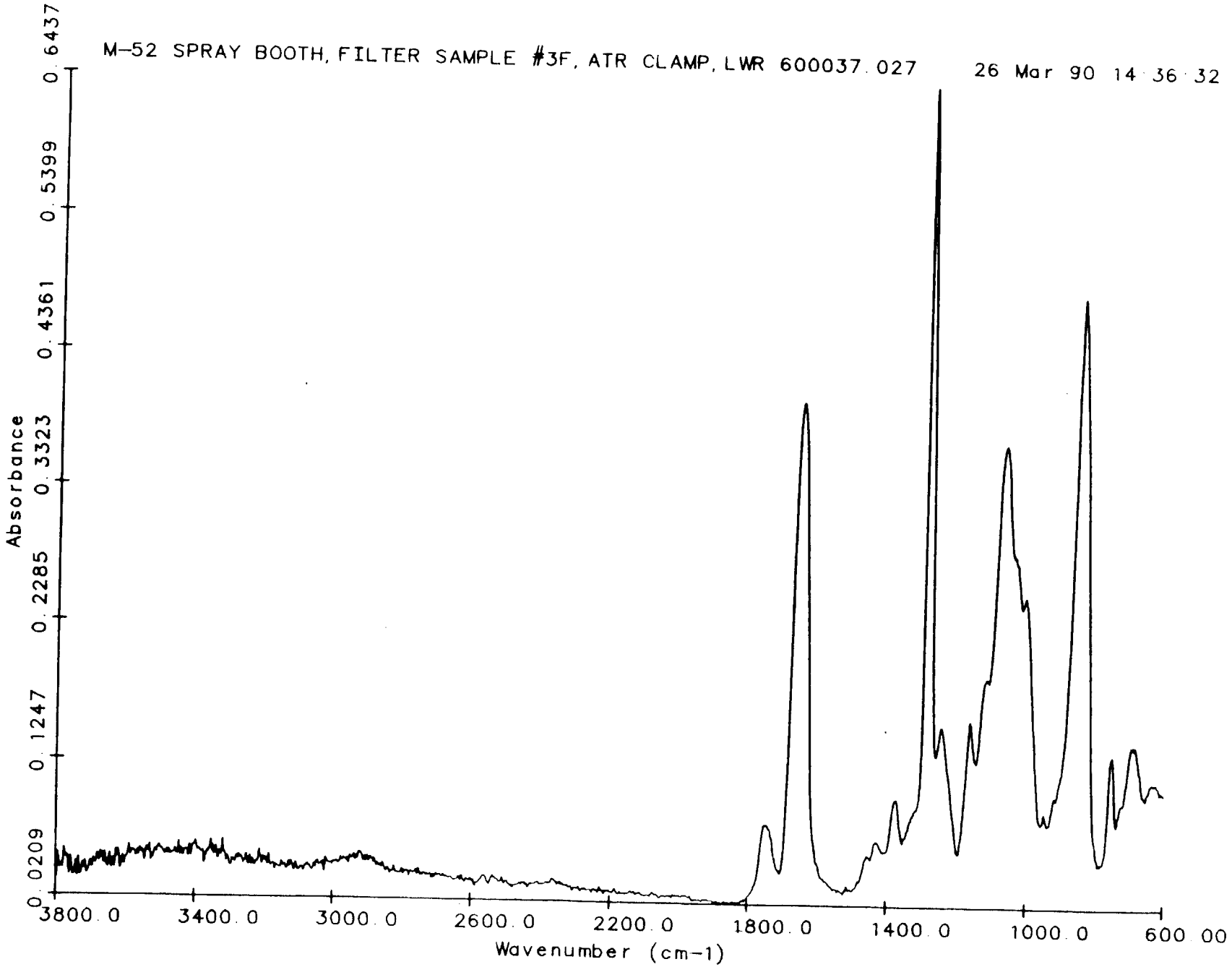

M-52 SPRAY BOOTH, FILTER SAMPLE #6I, ATR CLAMP, LWR 600037.022
26 Mar 90 13:26:53
Absorbance
0.6941
0.5877
0.4813
0.3748
0.2684
0.1620
0.0555
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

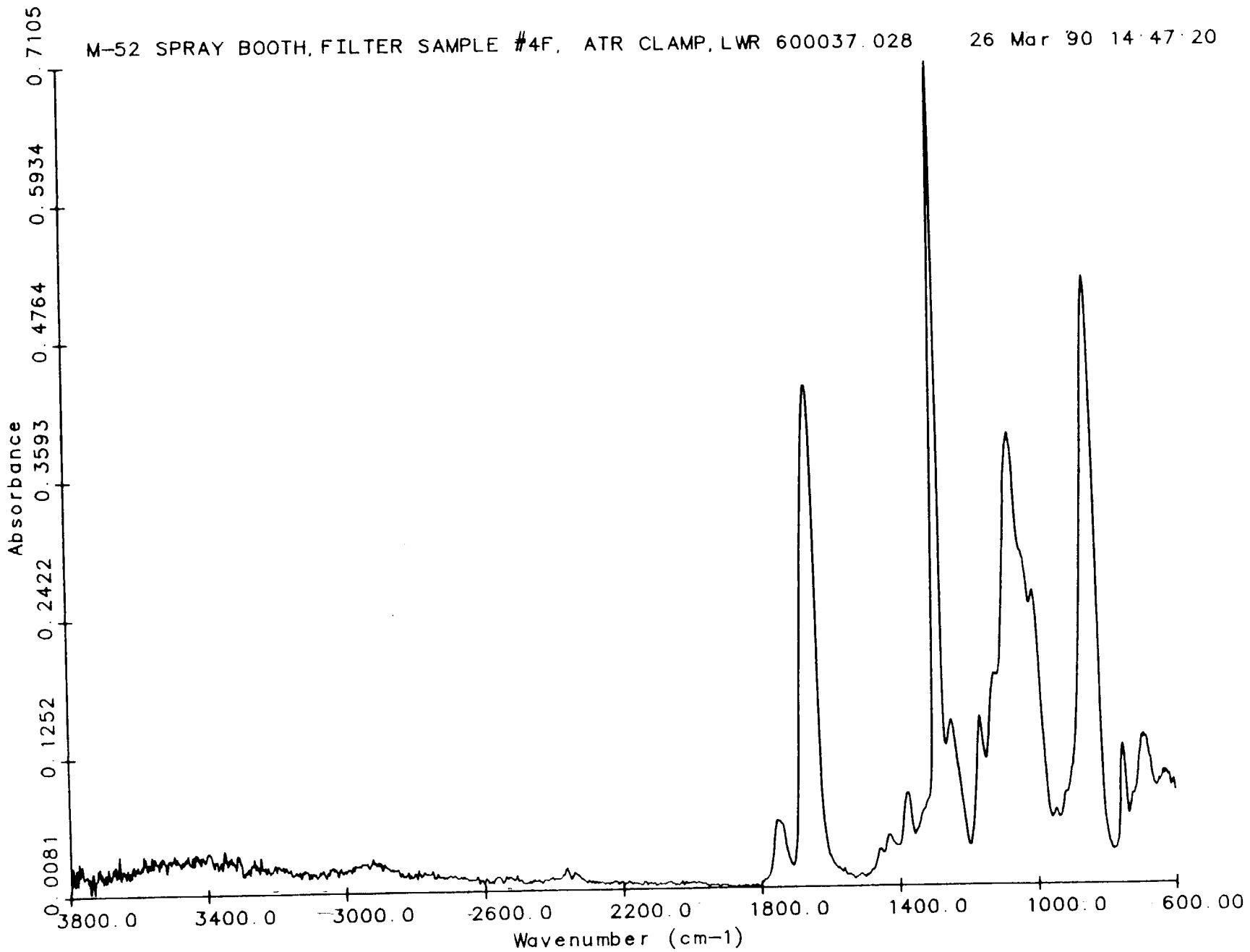

M-52 SPRAY BOOTH, FILTER SAMPLE #7I, ATR CLAMP, LWR 600037.023
26 Mar '90 13:35:33
Absorbance
0.6818
0.5711
0.4603
0.3496
0.2389
0.1282
0.0175
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

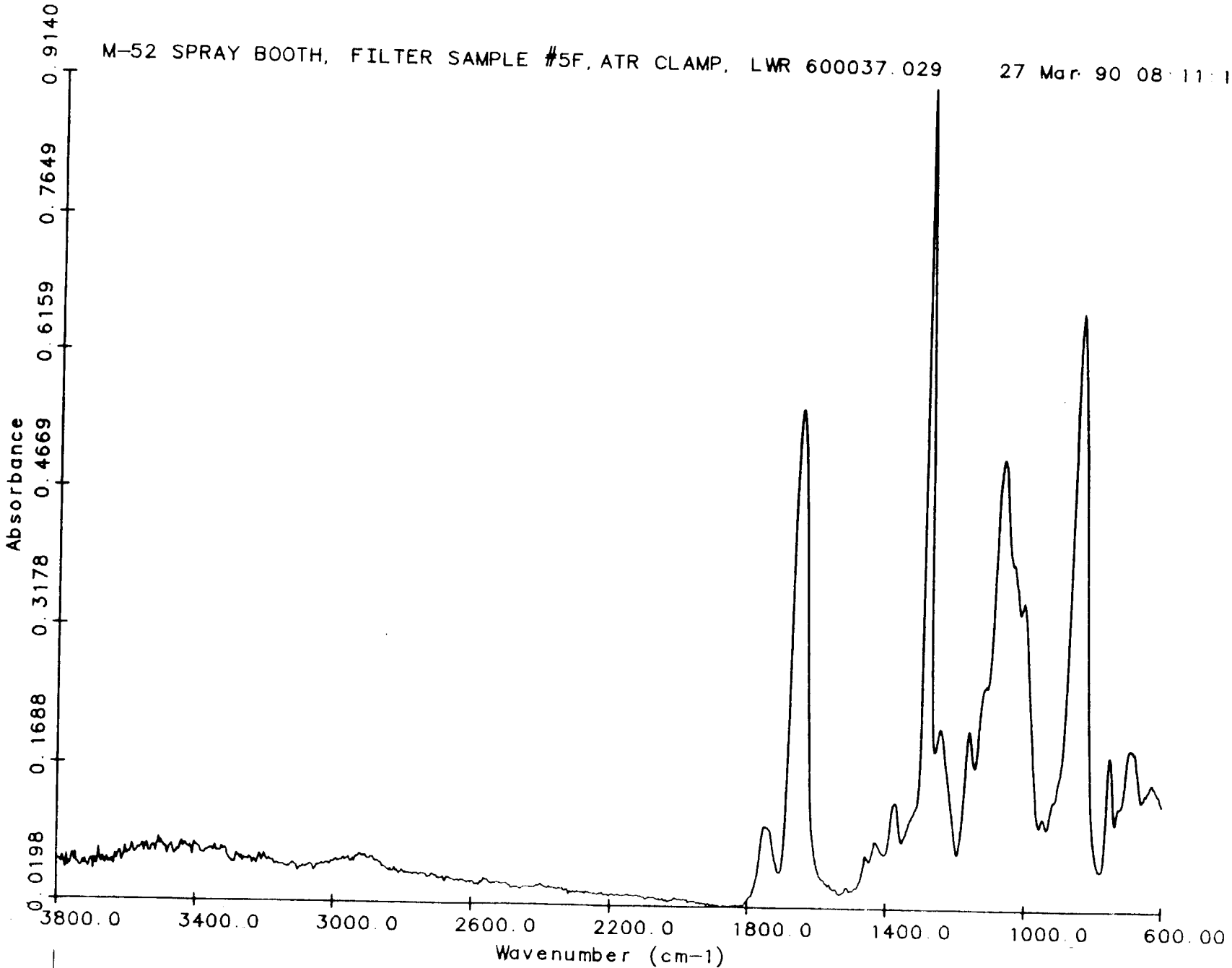

M-52 SPRAY BOOTH, FILTER SAMPLE #8I, ATR CLAMP, LWR 600037.024
26 Mar 90 13:45:00
Absorbance
0.7921
0.6656
0.5390
0.4125
0.2859
0.1594
0.0328
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

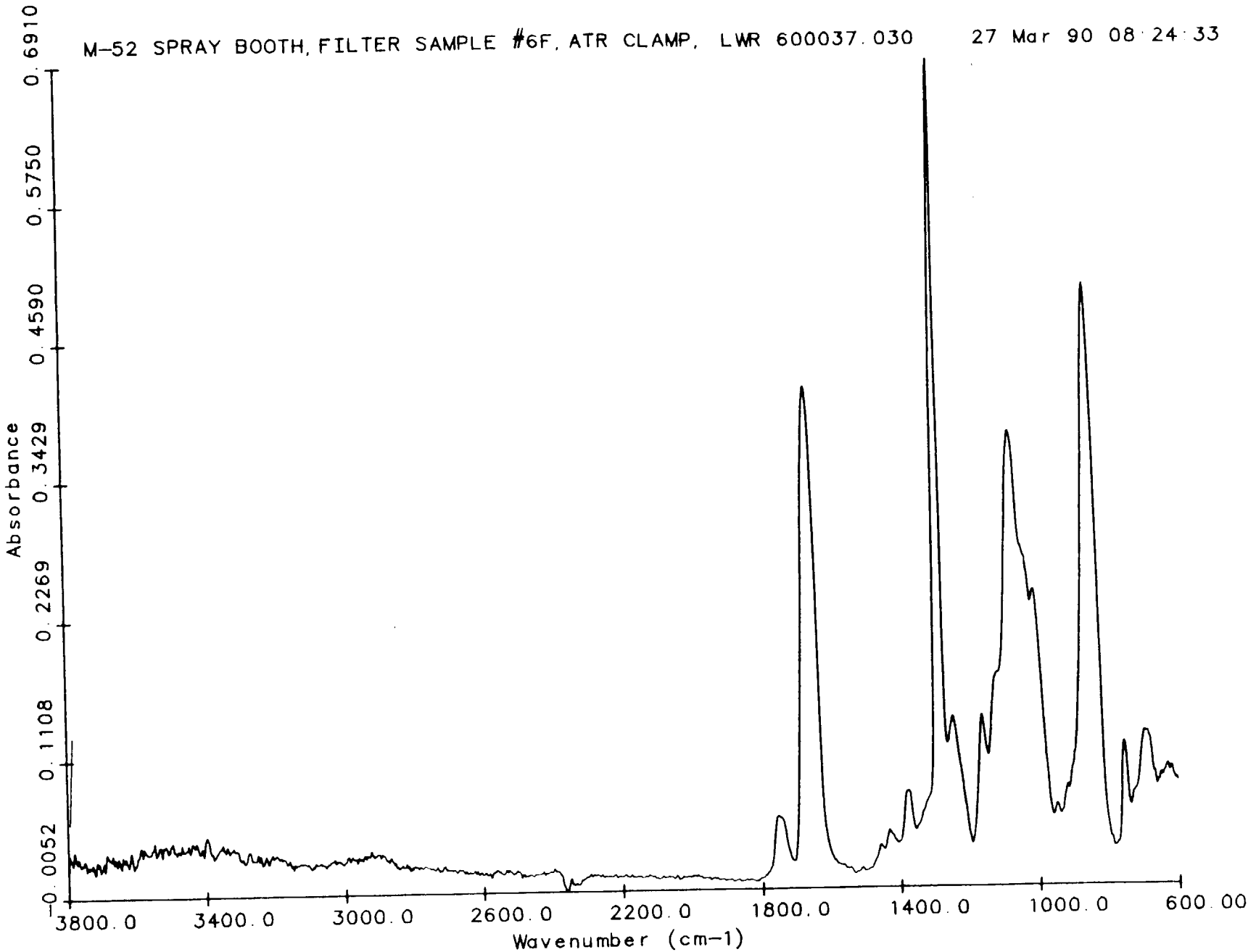

M-52 SPRAY BOOTH, FILTER SAMPLE #1F, ATR CLAMP, LWR 600037.025
26 Mar 90 14:01:06
Absorbance
0.8349
0.6972
0.5596
0.4219
0.2842
0.1465
0.0089
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

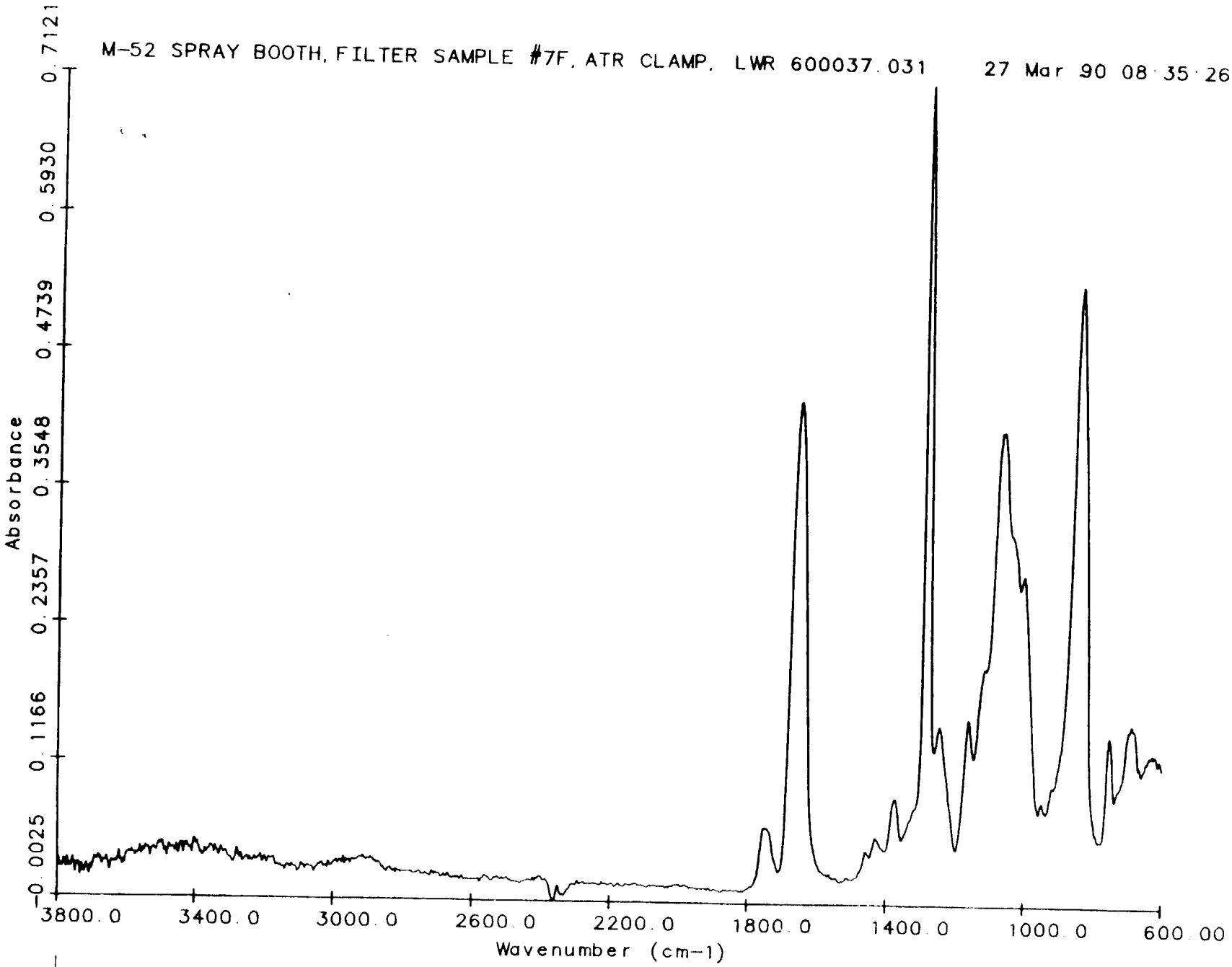

M-52 SPRAY BOOTH, FILTER SAMPLE #2F, ATR CLAMP, LWR 600037.026
26 Mar 90 14:29:15
Absorbance
0.6819
0.5704
0.4588
0.3472
0.2356
0.1241
0.0125
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

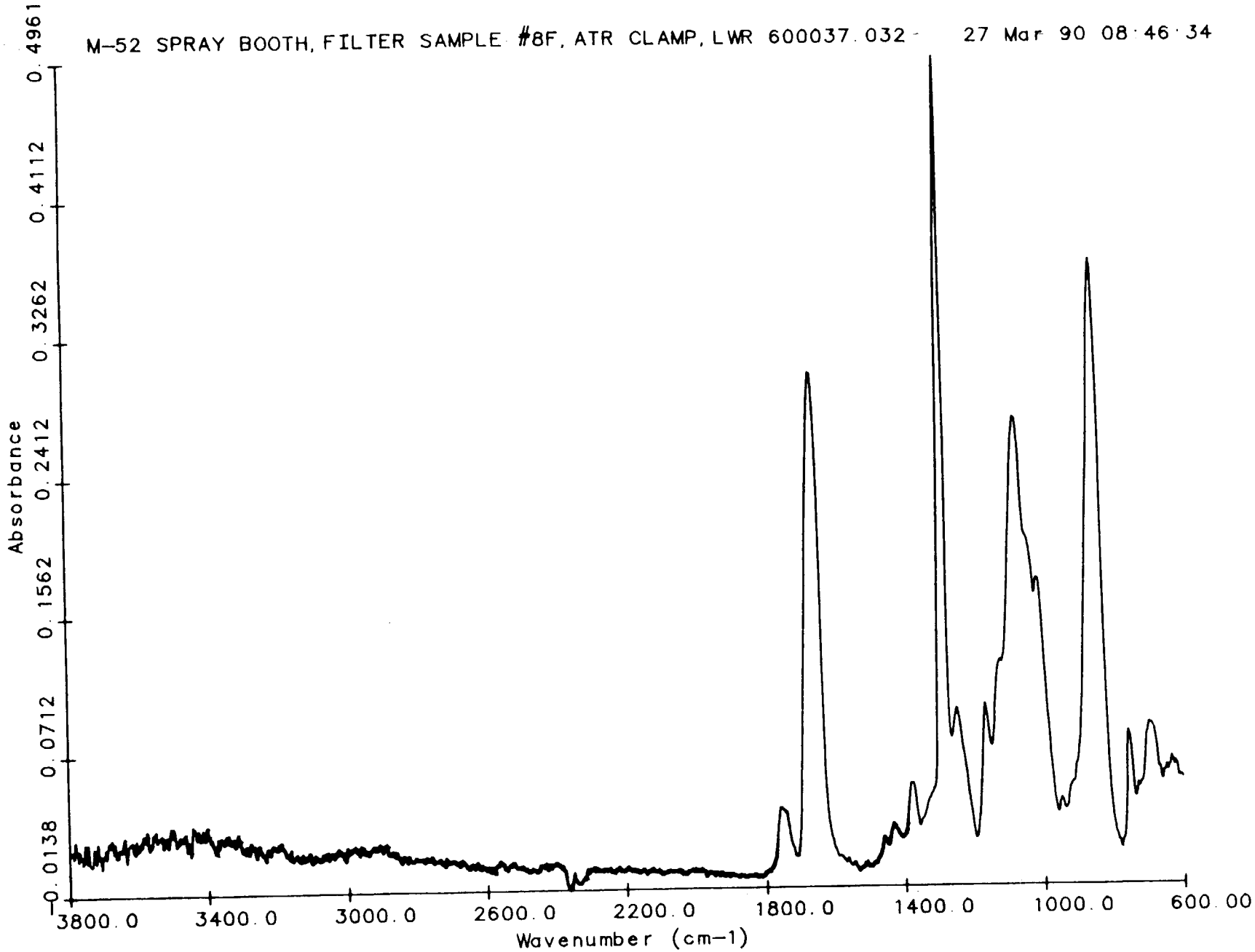

M-52 SPRAY BOOTH, FILTER SAMPLE #3F, ATR CLAMP, LWR 600037.027
26 Mar 90 14:36:32
Absorbance
0.6437
0.5399
0.4361
0.3323
0.2285
0.1247
0.0209
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, FILTER SAMPLE #4F, ATR CLAMP, LWR 600037.028
26 Mar 90 14:47:20
Absorbance
0.7105
0.5934
0.4764
0.3593
0.2422
0.1252
0.0081
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, FILTER SAMPLE #5F, ATR CLAMP, LWR 600037.029
27 Mar 90 08:11:19
Absorbance
0.9140
0.7649
0.6159
0.4669
0.3178
0.1688
0.0198
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, FILTER SAMPLE #6F, ATR CLAMP, LWR 600037.030
27 Mar 90 08:24:33
Absorbance
0.6910
0.5750
0.4590
0.3429
0.2269
0.1108
0.0052
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, FILTER SAMPLE #7F, ATR CLAMP, LWR 600037.031
27 Mar 90 08:35:26
Absorbance
0.7121
0.5930
0.4739
0.3548
0.2357
0.1166
0.0025
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


M-52 SPRAY BOOTH, FILTER SAMPLE #8F, ATR CLAMP, LWR 600037.032
27 Mar 90 08:46:34
Absorbance
0.4961
0.4112
0.3262
0.2412
0.1562
0.0712
-0.0138
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

Appendix J

NVR/Particle Counter Results

Final

NVR
After Teflon booth clean

Environmental Fallout Panel Data Sheet

Analysis and Results

EFP S/N	Date/ Time Placed	Location	Date/ Time Retrieved	Anal. Date	Particle Count	Particle Matter (mg/ft²)	NVR (mg/ft²)	FTIR (y/n) y: attach spectrum	Comments
(6) 003	21 MAR 90 00:00	M52 Teflon Booth N.E. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	0.0		Detectable NVR limit is 2.0 mg/ft² or [illegible]
(2) [illegible]	21 MAR 90 [illegible]	M52 Teflon Booth N.W. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	2.2		Detectable NVR limit is 2.0 mg/ft² or great
(1) [illegible]	21 MAR 90 00:00	M52 Teflon Booth Mid E. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	1.4		Detectable NVR limit is 2.0 mg/ft² or great
(4) [illegible]	21 MAR 90 00:00	M52 Teflon Booth Mid W. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	0.0		Detectable NVR limit is 2.0 mg/ft² or great
(5) 666	21 MAR 90 00:00	M52 Teflon Booth South E. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	0.0		Detectable NVR limit is 2.0 mg/ft² or great
(3) [illegible]	21 MAR 90 00:00	M52 Teflon Booth South W. Site	21 MAR 90 05:00	21Mar90	n/a	n/a	1.0		Detectable NVR limit is 2.0 mg/ft² or great

NVR Results

Initial Before teflon booth cleaning

Environmental Fallout Panel Data Sheet

Analysis and Results

EFP S/N	Date/ Time Placed	Location	Date/ Time Retrieved	Anal. Date	Particle Count	Particle Matter (mg/ft^2)	NVR (mg/ft^2)	FTIR (y/n) y: attach spectrum	Comments
047	13Feb90 1000	MSZ Teflon Southeast	13Feb90 1400	14Feb90	n/a	n/a	0.4		Detectable NVR limit is 20 mg/ft² or greater
056	13Feb90 1000	Teflon southwest	13Feb90 1400	"	"	"	0.4		"
053	13Feb90 1000	Teflon East middle	13Feb90 1400	"	"	"	0.4		"
055	13Feb90 1000	Teflon west middle	13Feb90 1400	"	"	"	0.4		"
026	13Feb90 1000	Teflon northeast	13Feb90 1400	"	"	"	0.8		"
013	13Feb90 1000	Teflon Northwest	13Feb90 1400	"	"	"	0.0		"

LOC	0.5u	0.7u	1.0u	5.0u
	------- (CUMULATIVE) -------			
25	142366	3269	313	9
24	43601	782	62	2
23	246004	4198	332	9
22	36561	685	72	4
21	146356	3470	306	11
20	68253	1601	112	7
19	228489	4467	293	7
18	51171	1168	69	3
17	114718	2680	261	9
16	47799	875	91	3
15	155444	3303	344	12
14	68845	1003	79	5
13	222737	2897	269	9
12	70568	1568	167	6
11	73151	1217	143	6
10	222361	4168	338	9
9	70216	1179	88	7
8	192414	4175	335	11
7	37932	984	72	2
6	96886	2977	281	8
5	145916	5587	298	7
4	138904	7336	363	6
3	239488	27380	1018	24
2	254839	48105	4519	52
1	322331	106400	40208	127
MEAN	137494	9659	2017	14
STDEV	81390	22164	7843	25

Just After Taffon Cleaning

Final results, [illegible]

Environmental Fallout Panel Data Sheet

Analysis and Results

EFP S/N	Date/ Time Placed	Location	Date/ Time Retrieved	Anal. Date	Particle Count	Particle Matter (mg/ft²)	NVR (mg/ft²)	FTIR (y/n) y attach spectrum
010	16 Apr 90 0840	Teflon booth S. E.	16 Apr. 1 90 1240	17 APR 1990	n/a	n/a	0.0	
022	16 Apr 90 0840	Teflon booth S W	16 Ap. 1 90 1240	17 APR 1990	n/a	n/a	0.8	
019	16 Apr 190 0840	Teflon booth M. E.	16 Apr 1 90 1240	17 APR 1990	n/a	n/a	0.8	
022	16 Apr 190 0840	Teflon booth M. W.	16 Ap 1 90 1240	17 APR 1990	n/a	n/a	0.4	
034	16 Apr 190 0840	Teflon booth N. E.	16 Apr 1 90 1240	17 APR 1990	n/a	n/a	0.4	
041	16 Apr 190 0840	Teflon booth N. W.	16 Ap. 1 90 1240	17 APR 1990	n/a	n/a	0.0	

AIRBORNE PARTICLE COUNTER - NET2000

16 Apr. 1 1990 MS2 Teflon booth

SENSOR ID - 1

LOC	COUNT (CUMULATIVE) 0.5u	0.7u	1.0u	5.0u
21	181101	5268	409	26
20	166118	4637	245	10
19	192960	[illegible]	338	16
18	54951	[illegible]	115	4
17	190118	5385	418	13
16	167161	4218	286	12
15	146801	3019	203	11
14	197823	4319	308	9
13	52933	1104	69	4
12	208618	4892	444	17
11	55400	1622	160	6
10	155645	3833	424	22
9	77402	1118	131	5
8	258036	2484	265	11
7	74594	543	91	6
6	24187	217	22	2
5	165524	2518	242	3
4	99702	3902	394	23
3	45756	3880	202	4
2	400686	55158	3766	27
1	331270	119341	44166	273
MEAN	157466	11161	2509	24
STDEV	100030	26645	9745	56

ORIGINAL PAGE IS OF POOR QUALITY

Appendix K

NASA Test Box Results/FTIR Scans

LABORATORY WORK REQUEST

584093

FROM	EXTENSION	COST CENTER	PROJECT NO.	TASK	SUBTASK
ORGANIZATION	MAIL STOP	WORK ORDER NO.		USER	PCN

SAMPLE INFORMATION

SAMPLE DESCRIPTION	☐ RAW MATERIAL ☐ INPROCESS ☐ POST PROCESS	DATE

PART NO. STOCK NO.	SERIAL NO./LOT NO.	ASSEMBLY PART NO.	ASSEMBLY SERIAL NO.
MIX	GRIND	SAMPLED BY	

TEST REQUIRED OR DESCRIPTION OF WORK REQUIRED. INCLUDE REASON FOR REQUEST

1. Please check this blendedfrclothjfilter for teflon and tecron products as per teflon procedure (suggestion of J. Dietz and R.D. Law). Please list results.
2. (NASA Test Box
3. Before Cleaning, results
4. 1st CTP
5.
6.
7.
8.

REPORT RESULTS TO	SEND COPY TO	RESULTS DESIRED BY (SPECIFIC DATE)
Monte Scothern		2 Marchh90
		AUTHORIZED SIGNATURE OR INSPECTION STAMP: Monte Scothern

FOR LABORATORY USE ONLY

SPECIAL INSTRUCTIONS

RESULTS OF LABORATORY ANALYSIS

No Teflon detected by FTIR analysis
FTIR spectra are attached. J.C.K.

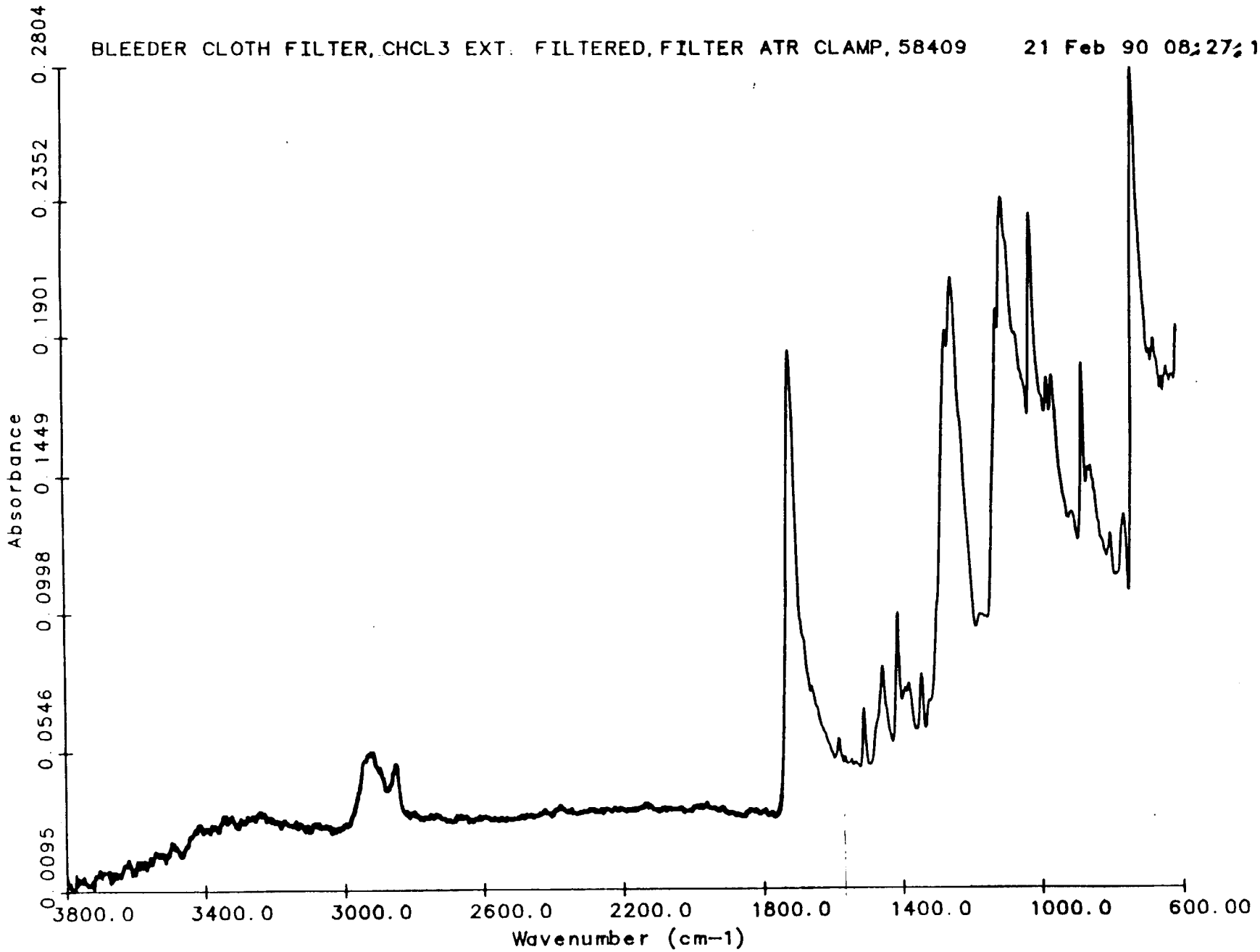
DISPOSITION

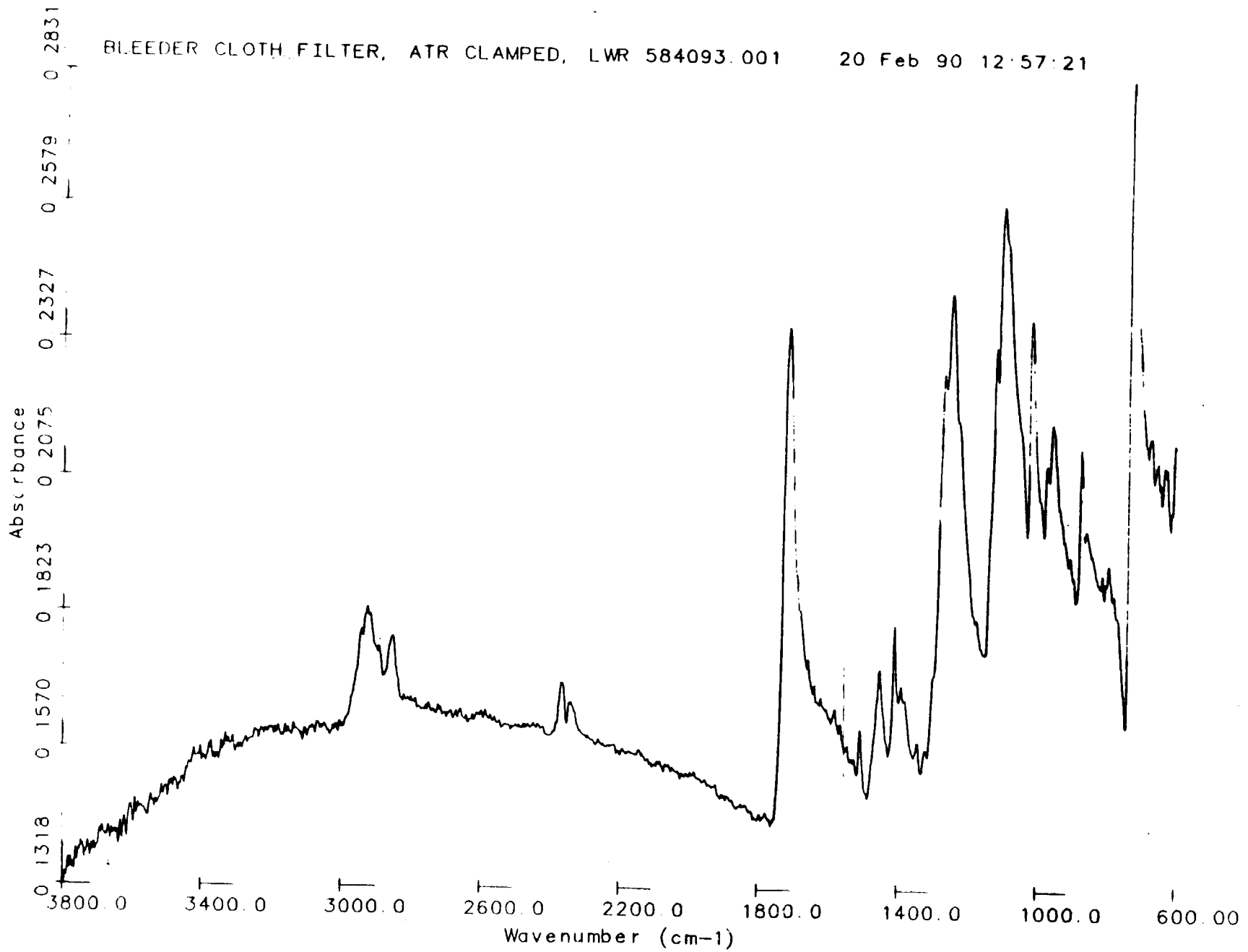
☐ ACCEPT ☐ REJECT ☐ RESAMPLE

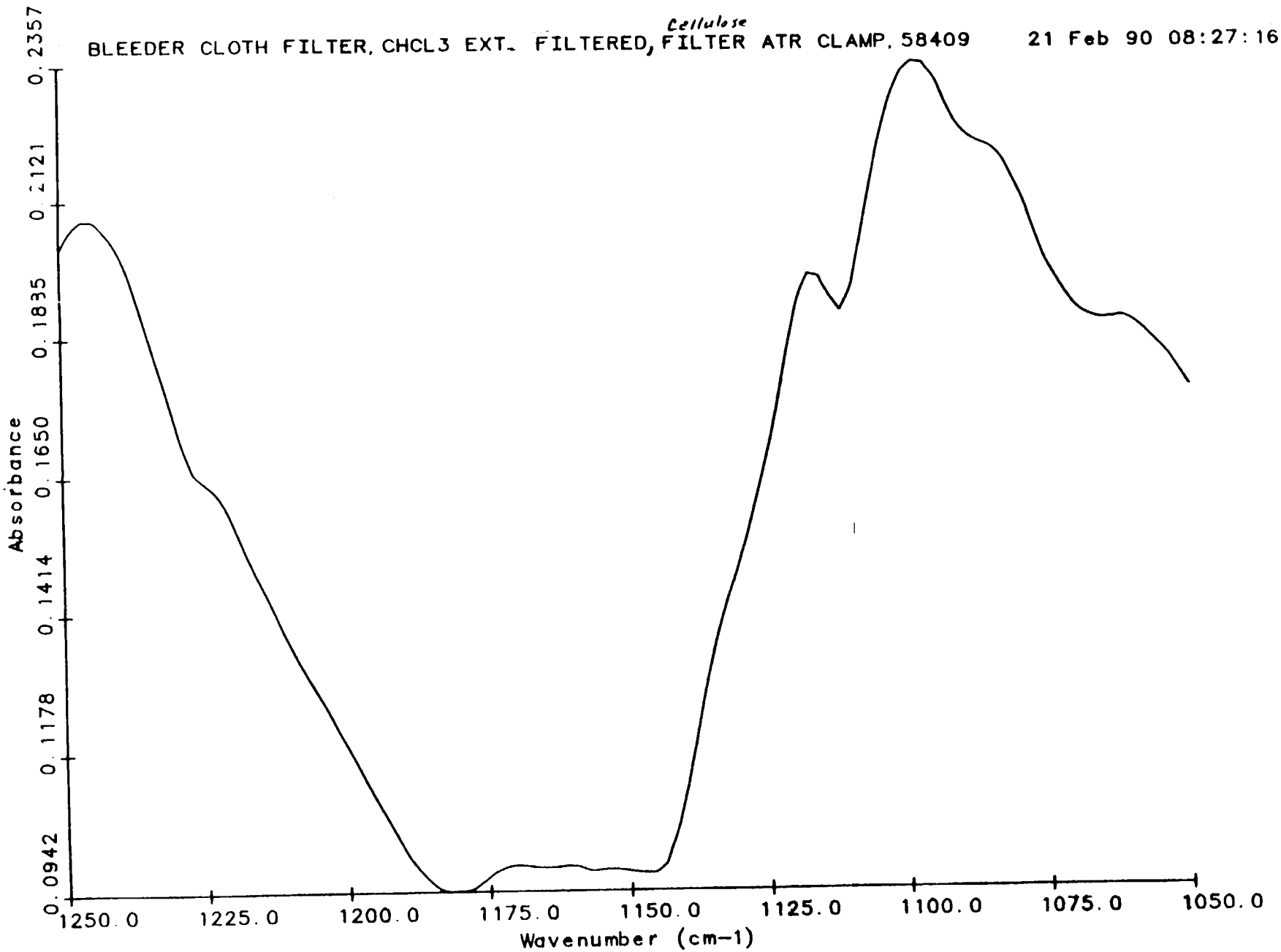
DATE AND TIME COMPLETED	TIME REQUIRED	DATE REPORTED	SIGNATURE

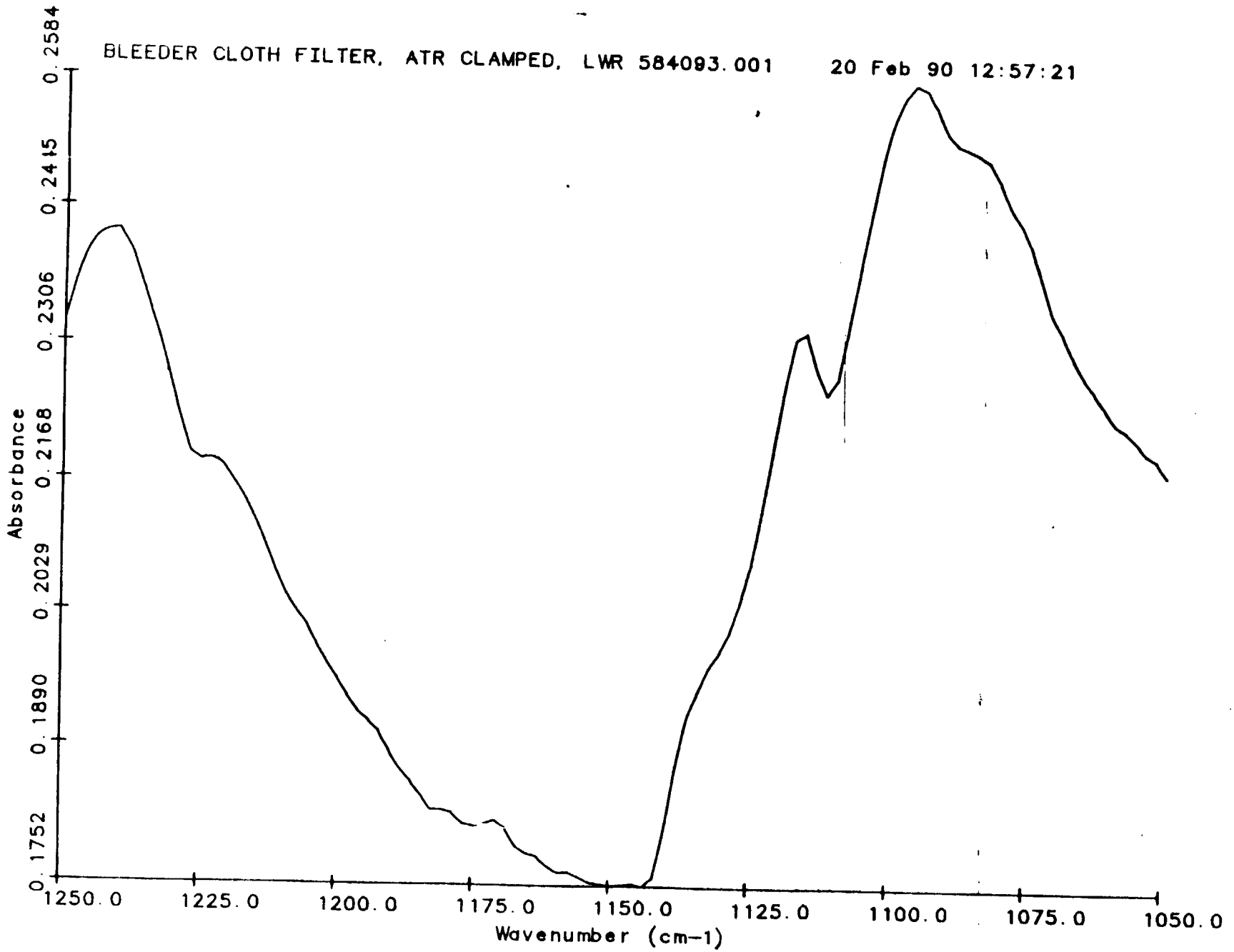
TWR-50012
K-2

FORM [illegible] REV 2 88


BLEEDER CLOTH FILTER, CHCL3 EXT. FILTERED, FILTER ATR CLAMP, 58409
21 Feb 90 08:27:16
Absorbance
0.2804
0.2352
0.1901
0.1449
0.0998
0.0546
0.0095
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)




BLEEDER CLOTH FILTER, CHCL3 EXT. FILTERED, Cellulose FILTER ATR CLAMP, 58409
21 Feb 90 08:27:16
Absorbance
0.2357
0.2121
0.1835
0.1650
0.1414
0.1178
0.0942
1250.0
1225.0
1200.0
1175.0
1150.0
1125.0
1100.0
1075.0
1050.0
Wavenumber (cm-1)


BLEEDER CLOTH FILTER, ATR CLAMPED, LWR 584093.001
20 Feb 90 12:57:21
Absorbance
0.2584
0.2415
0.2306
0.2168
0.2029
0.1890
0.1752
1250.0
1225.0
1200.0
1175.0
1150.0
1125.0
1100.0
1075.0
1050.0
Wavenumber (cm-1)

ADVANCED TECHNOLOGY
LABORATORY SERVICES

LABORATORY REPORT

06 Apr. 1990

Originator: R. W. Jessop
Ext. 6238, M/S 695

Request: LWR 594129
Laboratory Log # 03-01-90-31743

Subject: FTIR Analysis of Bleeder Cloth Filter for Teflon

The FTIR spectrum of the bleeder cloth was obtained by clamping the material against an ATR crystal. No Teflon was detected on the sample.

A copy of the FTIR spectrum is attached.

Nasa Test box
After cleaning, results
final

R. C. Raisor, Spectrochemical Analysis
LAB90093
B1143

LABORATORY WORK REQUEST

59139

TO:

FROM	EXTENSION	COST CENTER	PROJECT NO.	TASK	SUBTASK
R. W. Jessop	6933	6950			
ORGANIZATION	**MAIL STOP**	**WORK ORDER NO.**		**USER**	**PCN**

SAMPLE INFORMATION

SAMPLE DESCRIPTION		DATE
Bleeder cloth filter	☐ RAW MATERIAL ☒ INPROCESS ☐ POST PROCESS	March 21, 1990

PART NO./STOCK NO.	SERIAL NO./LOT NO.	ASSEMBLY PART NO.	ASSEMBLY SERIAL NO.

MIX	GRIND	SAMPLED BY

TEST REQUIRED OR DESCRIPTION OF WORK REQUIRED, INCLUDE REASON FOR REQUEST

1. Analysis this bleeder cloth filter for teflon residue per J. Dietz please list results.
2.
3.
4.
5.
6.
7.
8.

REPORT RESULTS TO	SEND COPY TO	RESULTS DESIRED BY (SPECIFIC DATE)
R. W. Jessop m/s 695	S. Goleniewski m/s L72	ASAP @@ 22 march 1990
		AUTHORIZED SIGNATURE OR INSPECTION STAMP

FOR LABORATORY USE ONLY

SPECIAL INSTRUCTIONS

RESULTS OF LABORATORY ANALYSIS

DISPOSITION

☐ ACCEPT ☐ REJECT ☐ RESAMPLE

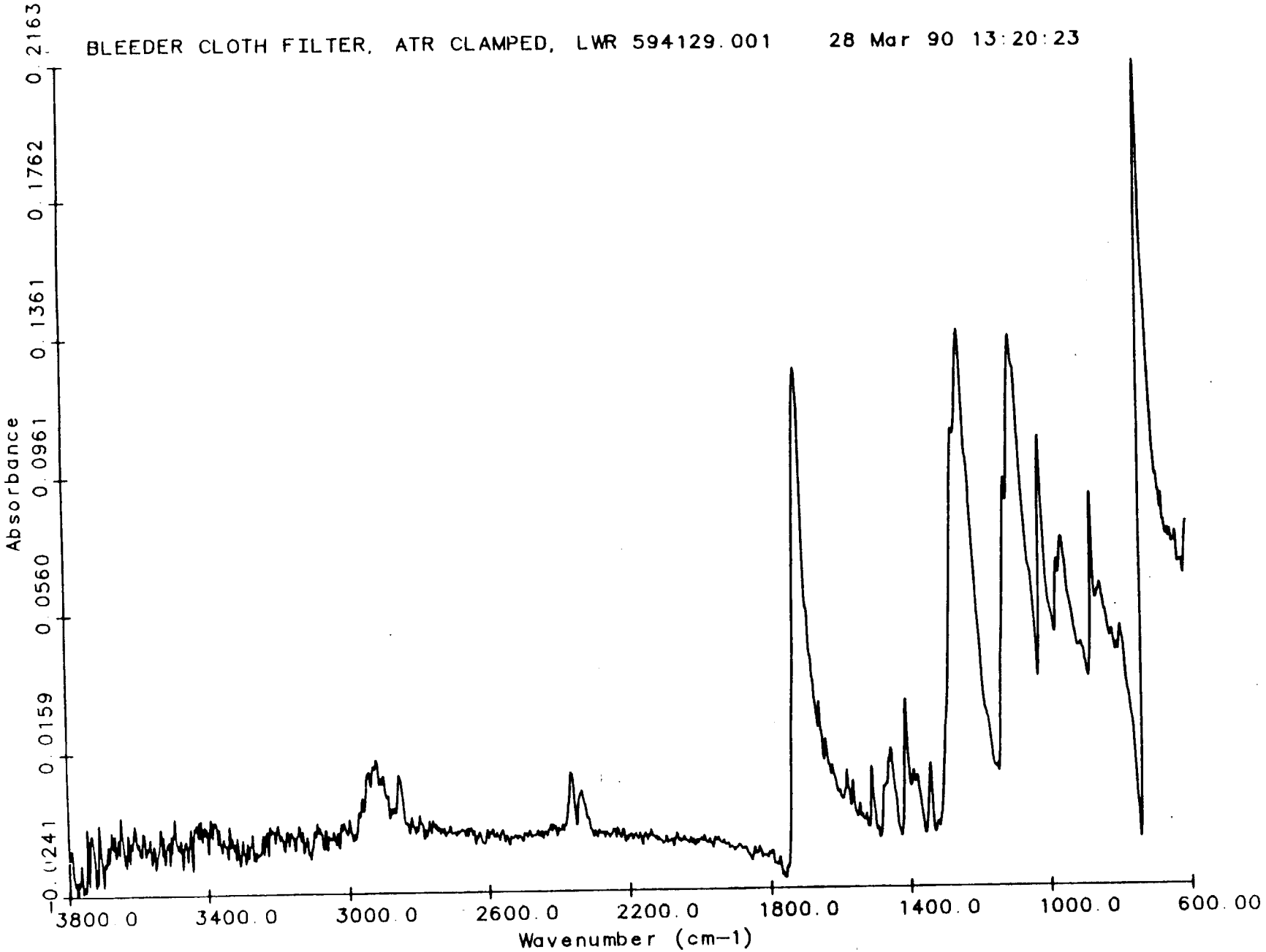
DATE AND TIME COMPLETED	TIME REQUIRED	DATE REPORTED	SIGNATURE

TWR-50012

K-8

FORM TC 716 (REV 7 86)

ORIGINAL PAGE IS
OF POOR QUALITY



No Teflon Detected

LABORATORY WORK REQUEST

OU-16-90-32312
TR 594134

TO:
Jim Dietz

FROM:	EXTENSION	COST CENTER	PROJECT NO.	TASK	SUBTASK
R. W. Jessop	6238	6953			
ORGANIZATION	**MAIL STOP**	**WORK ORDER NO.**		**USER**	**PCN**
Cont. control Mfg. Engineering	695	B1143			

SAMPLE INFORMATION

SAMPLE DESCRIPTION		DATE
Air Weave Bleeder Cloth	☐ RAW MATERIAL ☒ INPROCESS ☐ POST PROCESS	16 April 1990

PART NO./STOCK NO.	SERIAL NO./LOT NO.	ASSEMBLY PART NO.	ASSEMBLY SERIAL NO.

MIX	GRIND	SAMPLED BY

TEST REQUIRED OR DESCRIPTION OF WORK REQUIRED. INCLUDE REASON FOR REQUEST

1. Analysis ~~the~~this bleeder cloth filter for teflon residue per J. Dietz please list results.
2. Test Box Filter
3. After dome process, Final
4.
5.
6.
7.
8.

REPORT RESULTS TO	SEND COPY TO	RESULTS DESIRED BY (SPECIFIC DATE)
R. W. Jessop m/s 695		ASAP 18 April 1990
		AUTHORIZED SIGNATURE OR INSPECTION STAMP

FOR LABORATORY USE ONLY

SPECIAL INSTRUCTIONS

RESULTS OF LABORATORY ANALYSIS

NO teflon detected by FTIR analysis
J.C.K.

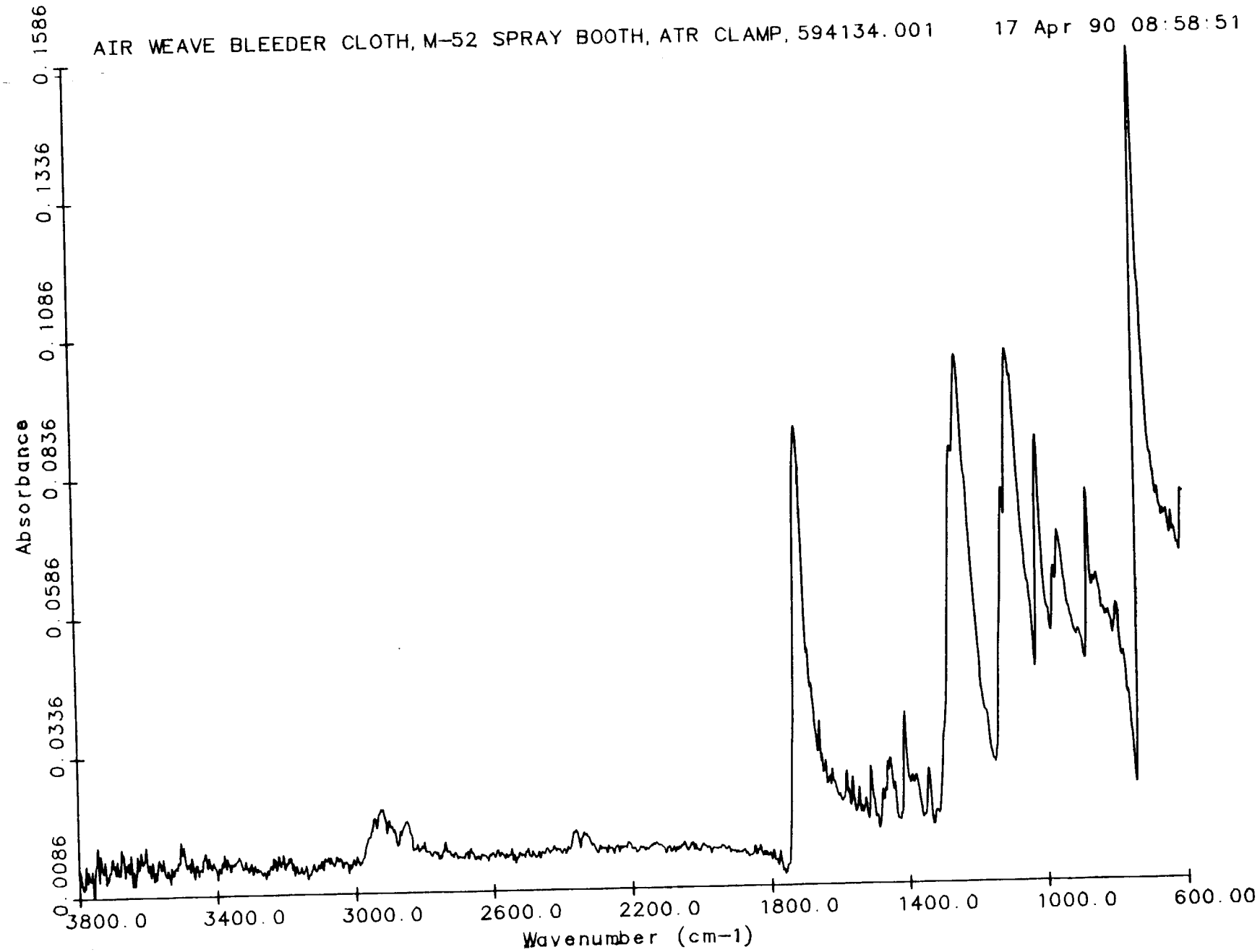
DISPOSITION

☐ ACCEPT ☐ REJECT ☐ RESAMPLE

DATE AND TIME COMPLETED	TIME REQUIRED	DATE REPORTED	SIGNATURE

FORM TC 716 (REV 2-86)

TWR-50012
K-10


AIR WEAVE BLEEDER CLOTH, M-52 SPRAY BOOTH, ATR CLAMP, 594134.001
17 Apr 90 08:58:51
Absorbance
0.1586
0.1336
0.1086
0.0836
0.0586
0.0336
0.0086
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

Appendix L

Witness Panel Pull Test Data

LABORATORY WORK REQUEST

32427

TO: MECH. TEST LAB

FROM	EXTENSION	COST CENTER	PROJECT NO	TASK	SUBTASK
[illegible]	[illegible]	[illegible]	4L301		
ORGANIZATION	**MAIL STOP**	**WORK ORDER NO**		**USER**	**PCN**
[illegible]	[illegible]	[illegible]			

SAMPLE INFORMATION

SAMPLE DESCRIPTION		DATE
[illegible]	☐ RAW MATERIAL ☒ INPROCESS ☐ POST PROCESS	18 APRIL 90

PART NO STOCK NO	SERIAL NO LOT NO	ASSEMBLY PART NO	ASSEMBLY SERIAL NO
TENSILE BUTTONS PEEL	[illegible]		
MIX # 0001644 # 0001615	GRIND 0001723 0001696 0001677	SAMPLED BY [illegible]	

TEST REQUIRED OR DESCRIPTION OF WORK REQUIRED. INCLUDE REASON FOR REQUEST

1 CONDUCT TESTS @ [illegible]

2 CONDUCT TENSILE BUTTON TESTS @ 0.2 IN/MIN PULL RATE [illegible]

3 CONDUCT 45° PEEL TEST @ 2.0 IN/MIN PULL RATE [illegible]

4 CONDUCT TENSILE BUTTON TESTS @ [illegible] IN/MIN PULL RATE [illegible]

5 REPORT: RAW DATA / DATA SUMMARY / STATISTICS [illegible]

6 MODE OF FAILURE [illegible]

7 — THANKS!

8

REPORT RESULTS TO	SEND COPY TO	RESULTS DESIRED BY SPECIFIC DATE
[illegible] HEISSEL		[illegible]
		AUTHORIZED SIGNATURE OR INSPECTION STAMP [illegible]

FOR LABORATORY USE ONLY

SPECIAL INSTRUCTIONS

silane [illegible] was [illegible]

RESULTS OF LABORATORY ANALYSIS

NOTE: BUTTON STRESS (PSI) ON PAGE 3, 4, 5 OF Report HAS BEEN CORRECTED TO REFLECT DIAMETER OF 1.250" INSTEAD OF 1.234" AS ORIGINALLY CALCULATED.

DISPOSITION

☐ ACCEPT ☐ REJECT ☐ RESAMPLE

DATE AND TIME COMPLETED	TIME REQUIRED	DATE REPORTED	SIGNATURE

FORM TC 716 (REV 2 86)

ORIGINAL PAGE IS OF POOR QUALITY

Failure Mode Key

Job #: [illegible]	1 = Adhesive/Metal	5 = Cohesive/Rubber	9 = [illegible]
Work Order: 81103	2 = Cohesive/Adhesive	6 = Adhesive/Rubber	10 = Failure Comment:
Originator: V.HEUSSER	3 = Adhesive Phenolic	7 = Cohesive/Liner	TS = Tab Stroke
	4 = Cohesive/Phenolic	8 = Adhesive/Liner	B = Button Side
			P = Panel Side

Date: 4-1?-9? Test Machine: BALDWIN Temperature: 75 Deg. F
Technician: CD Test Type: Tensile Adhesion Crosshead Speed: .05 in/min

Test No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	1	2	3	4	5	6	7	8	9	10
[illegible]		0001644	1.12838	1.000	3225	3225	95	5								B
[illegible]		0001644	1.12838	1.000	3014	3013	100									P
3		0001644	1.12833	1.000	2421	2421	100									P
4		0001644	1.12838	1.000	3113	3113	100									P
5		0001644	1.12833	1.000	3436	3436	95	5								P
6		0001644	1.12838	1.000	3617	3617	100									B
7		0001644	1.12838	1.000	3318	3318	100									P
8		0001644	1.12838	1.000	3606	3606	95	5								P
9		0001644	1.12833	1.000	2005	2005	100									B
10		0001644	1.12838	1.000	3565	3564	97	3								B
11		0001644	1.12839	1.000	2451	2451	100									B
12		0001644	1.12838	1.000	2468	2469	96								4	B
13		0001644	1.12838	1.000	2615	2615	95	5								B
14		0001644	1.12838	1.000	3535	3535	95	5								B
15		0001644	1.12838	1.000	2685	2685	95								5	B
16		0001644	1.12838	1.000	2281	2281	97								3	B
17		0001644	1.12839	1.000	2967	2967	100									P
18		0001644	1.12839	1.000	2773	2773	100									P
19		0001644	1.12839	1.000	3289	3289	94	3							3	B
20		0001644	1.12838	1.000	2404	2404	100									B
21		0001644	1.12838	1.000	3078	3078	100									B
22		0001644	1.12838	1.000	3242	3242	100									B
23		0001644	1.12838	1.000	2984	2984	96	2							2	B
24		0001644	1.12839	1.000	1853	1853	100									B
Average (PSI):						2914	99	1							1	
Standard Deviation:						514.0										
Coeff. of Var:						17.6										

Prepared by the Mechanical Properties Characterization Section of the R&D Laboratories

PAGE 1

ORIGINAL PAGE IS
OF POOR QUALITY

Failure Mode Key:

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Oil
10 = Failure Consent
TB = Tab Broke
B = Button Side
P = Panel Side

R&R # : A19621
Work Order: 81139
Originator: J.HEUSSER

Date: 4-15-91
Technician: CD

Test Machine: BALDWIN
Test Type: Tensile Adhesion

Temperature: 75 Deg. F
Crosshead Speed: .05 in/min

Test No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
25		0001615	1.12836	1.000	3113	3113	80	20								
* 26		0001615	1.12838	1.000	3934	3934	65	25							10	P
29		0001615	1.12838	1.000	3037	3037	86	10							4	P
30		0001615	1.12838	1.000	3623	3623	60	40								B
* 31		0001615	1.12838	1.000	2087	2087	25	25							50	P
* 32		0001615	1.12838	1.000	3805	3805	70	20							10	P
33		0001615	1.12835	1.000	3441	3441	70	30								P
34		0001615	1.12838	1.000	4297	4297	72	20							8	P
35		0001615	1.12836	1.000	4069	4069	50	42							8	P
* 36		0001615	1.12838	1.000	3248	3248	25	55							20	B
37		0001615	1.12838	1.000	3822	3822	60	40								B
38		0001615	1.12838	1.000	4063	4063	60	35							5	B&P
* 39		0001615	1.12838	1.000	2193	2193	40	5							55	B&P
* 40		0001615	1.12838	1.000	1467	1467	10	30							60	P
* 41		0001615	1.12839	1.000	3226	3226	40	25							35	P
42		0001615	1.12838	1.000	3957	3957	45	55								B
43		0001615	1.12838	1.000	4139	4139	70	27							3	P
44		0001615	1.12838	1.000	4209	4209	55	45								P
45		0001615	1.12838	1.000	4373	4373	90	10								B
46		0001615	1.12838	1.000	3812	3812	97	10							3	B
47		0001615	1.12838	1.000	4069	4069	40	60								B
48		0001615	1.12838	1.000	4502	4502	80	15							5	B&P
Average (PSI):						3975	67	31							2	
Standard Deviation:						452.8										
Coeff. of Var:						11.7										

* Excluded from Average

Prepared by the Mechanical Properties Characterization Section of the R&D Laboratories

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment:
TB = Tab Broke
B = Button Side
P = Panel Side

LWK # : 500021
Work Order: 81139
Originator: W.HEUSSER

Date: 04-20-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: Tensile Cohesion Crosshead Speed: .5 in/min

Test No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1		0001677	1.25000	1.227	1044	851					100					
2		0001677	1.25000	1.227	1064	867					100					
3		0001677	1.25000	1.227	1054	859					100					
4		0001677	1.25000	1.227	956	779					100					
5		0001677	1.25000	1.227	890	726		8			92					P
6		0001677	1.25000	1.227	937	763		5			95					P
7		0001677	1.25000	1.227	1096	893					100					
8		0001677	1.25000	1.227	1037	845					100					
Average (PSI):						823		2			98					
Standard Deviation:						58.9										
Coeff. of Var:						7.2										

Date: 04-19-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: 45 Degree Peel Crosshead Speed: 2.0 in/min

Test No.	Segment ID.	Panel ID. Serial	Width (in)	Min Stress (pli)	Max Stress (pli)	Avg Stress (pli)	Inches Peeled	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	45 DEG. PEEL	0001677	1.0000	171.3	182.7	178.1	3.4					100					
2	45 DEG. PEEL	0001677	1.0000	174.5	190.4	183.4	3.2					100					
3	45 DEG. PEEL	0001677	1.0000	171.2	184.5	177.7	3.0					100					
4	45 DEG. PEEL	0001677	0.9500	174.7	187.8	180.8	3.2					100					
5	45 DEG. PEEL	0001677	1.0000	169.3	186.5	180.7	3.6					100					
6	45 DEG. PEEL	0001677	0.9800	164.7	183.9	178.1	3.2					100					
7	45 DEG. PEEL	0001677	1.0000	157.7	184.8	174.1	3.2					100					
Average:				169.1	185.6	179.8						100					
Standard Deviation:				6.0	2.6	3.8											
Coeff. of Var:				3.58	1.41	1.65											

LWR # : 500021
Work Order: B1138
Originator: V.MEUSSER

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side

Date: 04-20-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: Tensile Adhesion Crosshead Speed: .5 in/min

Test No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
9		0001636	1.25000	1.227	1017	829		4			96					
10		0001636	1.25000	1.227	1027	837					100					
11		0001636	1.25000	1.227	917	747					100					
12		0001636	1.25000	1.227	995	811		2			98					P
13		0001636	1.25000	1.227	1049	855					100					
14		0001636	1.25000	1.227	983	801		2			98					P
15		0001636	1.25000	1.227	1030	839					100					
16		0001636	1.25000	1.227	1050	856					100					
Average (PSI):						822		1			99					
Standard Deviation:						35.6										
Coeff. of Var:						4.3										

Date: 04-19-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: 45 Degree Peel Crosshead Speed: 2.0 in/min

Test No.	Segment ID.	Panel ID. Serial	Width (in)	Min Stress (pli)	Max Stress (pli)	Avg Stress (pli)	Inches Peeled	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
8	45 DEG. PEEL	0001636	1.0200	145.6	165.7	158.3	3.6					100					
9	45 DEG. PEEL	0001636	0.9900	156.5	168.3	163.1	3.4					100					
10	45 DEG. PEEL	0001636	1.0000	152.8	165.1	158.8	3.5					100					
11	45 DEG. PEEL	0001636	1.0400	148.3	165.8	160.1	3.4					100					
12	45 DEG. PEEL	0001636	0.9600	162.1	172.4	167.8	3.2					100					
13	45 DEG. PEEL	0001636	1.0300	151.9	171.2	163.5	4.2					100					
14	45 DEG. PEEL	0001636	1.0300	150.5	167.2	159.9	3.3					100					
Average:				152.5	168.0	161.6						100					
Standard Deviation:				5.4	2.9	3.4											
Coeff. of Var:				3.57	1.70	2.09											

Prepared by the Mechanical Properties Characterization Section of the R&D Laboratories

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side

WR # : 600021
Work Order: B1138
Originator: V.HEUSSER

Date: 04-20-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: Tensile Adhesion Crosshead Speed: .5 in/min

Test No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
17		0001723	1.25000	1.227	1081	881			3		97					P
18		0001723	1.25000	1.227	1064	867					100					
19		0001723	1.25000	1.227	1059	863			3		97					P
20		0001723	1.25000	1.227	1076	877					100					
21		0001723	1.25000	1.227	1012	825			5		95					P
22		0001723	1.25000	1.227	1012	825					100					
23		0001723	1.25000	1.227	1074	875					100					
24		0001723	1.25000	1.227	1042	849					100					
Average (PSI):						858			1		99					
Standard Deviation:						22.4										
Coeff. of Var:						2.6										

Date: 04-19-90 Test Machine: RIEHLE Temperature: 75 Deg. F
Technician: LD.WALTERS Test Type: 45 Degree Peel Crosshead Speed: 2.0 in/min

Test No.	Segment ID.	Panel ID. Serial	Width (in)	Min Stress (pli)	Max Stress (pli)	Avg Stress (pli)	Inches Peeled	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
15	45 DEG. PEEL	0001723	1.0000	157.2	169.4	164.0	4.0		3			97					
16	45 DEG. PEEL	0001723	0.9800	154.8	170.3	165.0	3.3					100					
17	45 DEG. PEEL	0001723	1.0000	157.0	171.0	165.5	3.9		3			97					
18	45 DEG. PEEL	0001723	0.9800	157.9	171.7	165.7	4.1					100					
19	45 DEG. PEEL	0001723	1.0000	155.2	172.0	166.3	3.2		2			98					
20	45 DEG. PEEL	0001723	1.0000	158.3	175.7	168.7	3.5					100					
21	45 DEG. PEEL	0001723	1.0000	153.9	173.8	164.4	3.9					100					
Average:				156.3	171.3	165.7			1			99					
Standard Deviation:				1.7	2.2	1.5											
Coeff. of Var:				1.08	1.28	0.93											

Appendix M

Engineering Evaluation Results

Thiokol CORPORATION
SPACE OPERATIONS

10 May 1990
L623-FY90-M142

TO: Distribution

FROM: V. Fitch
Thermal Insulation Design

SUBJECT: CTP-0142A, Revision B Justification

REFERENCE: L623-FY90-M134, 'CTP-0142, Bond Strength Test Results, V. Fitch, 24 April 1990

1.0 INTRODUCTION

The M-52 spray booth qualification test for paint and Chemlok application processes of domes was conducted per CTP-0142A. The spray booth passed all tests, except, it did not pass the paragraph 8.2.2A test of the CTP. In accordance with paragraph 8.2.2A, two each NBR insulation to steel and steel epoxy steel (systems tunnel type III) witness panels were processed simultaneously with the test dome. The insulation witness panels represented the dome process configuration and the epoxy witness panels provided a sensitive bond system for discrimination of contaminants in the spray booth.

The insulation witness panels had acceptable bond strengths when compared against the established RSRM witness panel data base. The epoxy witness panels did not have acceptable bond strength when compared against the established RSRM witness panel data base. A subsequent investigation identified circumstances that could account for the unacceptable bond strengths of the epoxy witness panels. An engineering evaluation test was conducted that verified the cause and affect relationship between the circumstances and the bond strengths of the epoxy witness panels.

2.0 OBJECTIVE

The objective of this memo is to disseminate the events and rationale that drove revision B of CTP-0142A.

3.0 SUMMARY

The introduction of adverse bonding variables to the CTP epoxy witness panel test mitigates this test failure. The wrongly introduced variables had a detrimental effect on the bond strength of the epoxy witness panels as evidenced by the engineering evaluation test. Had the variables not been wrongly introduced, the test of epoxy witness panels would not have failed.

A023243a

4.0 CONCLUSIONS

The epoxy witness panels were adversely affected by process variables wrongly introduced to the test that were not associated with the test objectives and, hence, a "no test" declaration for the epoxy witness panel portion of the CTP is justified.

Comparison of the CTP epoxy witness panels with the established RSRM systems tunnel witness panel data base is erroneous.

5.0 RECOMMENDATIONS

Perform a re-test of the epoxy witness panels.

Revise the epoxy witness panel test method and the CTP accordingly.

Compare test results against a control set instead of the systems tunnel witness panel data base.

6.0 DISCUSSION

Reference 1 details the CTP epoxy witness panel test results, the wrongly introduced test variables, and the engineering evaluation test procedure. These items are recapped below.

The insulation witness panels predominantly had cohesive failure and elastomer strength consistent with the established RSRM witness panel data base. The average tensile adhesion strengths were 823 and 822 psi and the average peel strengths were 179 and 162 pli (LWR-600021). The data base mean are 756 psi and 172 pli. The epoxy witness panels predominantly had adhesive failure and averaged bond strength that was not within 5 standard deviations of the established RSRM data base mean. The average tensile adhesion strengths were 2914 and 3875 psi (LWR-600021). The data base mean is 5588 psi and the mean less five standard deviations is 3734 psi.

The high occurrence of epoxy witness panel adhesive failure prompted concern about witness panel preparation. Three variables were identified as being wrongly introduced to the test. 1) The bond surfaces of the panels were not prepared with silane primer (adhesion promoter applied to the systems tunnel case bond surface and witness panels). Silane primer precludes adhesive failure by masking minor surface contamination effects. 2) The panels remained in the spray booth for upwards of a week prior to assembly. The steel bond surface had ample time to oxidize. Oxidation will lower the applicable epoxy to steel bond strength. Additionally, the test environment of the panels was not controlled and the distinct possibility exists that adverse unknown variables were introduced. 3) The prepared witness panel bond surfaces were covered with "black poly" while on the panel holder (the Chemloked panels were left on the floor and uncovered). Manufacturing procedures do not allow prepared bond surfaces to be in contact with black poly. This procedure was established after a similar incident when the bond strength of Chemloked witness panels was suspected as being adversely effected by transference of contamination from black poly.

A023243a

The engineering evaluation test objective was to account for the effects of the test variables introduced during the CTP testing. Preparation of the bond specimens is discussed below.

1) 2 freshly grit blasted and methyl chloroform vapor degreased witness panels (designated A and B) were placed in the spray booth and exposed to a spray booth operational cycle. The operational cycle simulates the external paint cure cycle and consists of having the make-up air fans on with booth temperature at 135°F for 5 hours.

2) 2 freshly grit blasted and methyl chloroform vapor degreased witness panels (designated C and D) were placed outside of the spray booth in the M-52 surge area and exposed to ambient conditions (facility control).

3) 2 freshly grit blasted and methyl chloroform vapor degreased witness panels (designated E and F) were assembled in the laboratory along with the aforementioned panels (lab control).

4) The bond surfaces of panels A - D & F were not silane primed but the bond surface of panel E was silane primed. All tensile buttons were silane primed to force the failure to the panel side. Following a 24 hour ambient cure the tensile buttons were pull tested at a 0.05 inch per minute pull rate.

The engineering evaluation test results are listed below.

PANEL	EXPOSURE	TENSILE (psi)	% ADHESIVE FAILURE
A	BOOTH CYCLE	4225	21
B	BOOTH CYCLE	4185	25
C	M-52 AMBIENT	3893	40
D	M-52 AMBIENT	3850	49
E	LAB CONTROL, No. 1	5386	0
F	LAB CONTROL, No. 2	3652	34

The conclusions derived through this test are listed below.

1) The spray booth environment exposed panels had significantly greater bond strength than the surge area environment exposed panels. This indicates that the spray booth will provide a better bonding environment for domes than is currently available for case hardware.

2) The silane primer increased the bond strength 50% for the control panels. This indicates that silane primer would have significantly increased the bond strength of the CTP witness panels.

A023243a

3) The spray booth panels had greater strength during the engineering evaluation test than they did during the CTP test. This indicates that the controlled test minimized the effect on bond strength from oxidation, "black poly", and/or unknown variables.

The engineering evaluation test provides sufficient justification to repeat the epoxy witness panel test. Scrutiny of the CTP test procedure following the engineering evaluation test lead to the conclusion that the CTP test method was flawed. Nor should its results be compared with the systems tunnel data base for acceptance. The reasons for this are 1) silane primer precludes surface contamination effects and discrimination of surface contamination effects is the objective of the test, 2) time lines of systems tunnel surface preparation to primer application and dome surface preparation to panel primer application are not consistent which introduces the oxidation variable, and 3) systems tunnel panels are prepared in final assembly and the CTP test panels are prepared in the lab which introduces a human and facility variable.

Revision of the test procedure was prudent. The re-test is designed to isolate the spray booth environment exposure variable. Panels (5 total) exposed to the spray booth environment will be statistically compared against control panels not exposed to the spray booth environment (5 total). Should the spray booth exposed panels have significantly lower bond strength than the control panels, the test has failed (Significantly lower bond strength was defined at the 95% confidence level during the CTP-0142B TRR). All other process variables will be a constant for both panel sets. The panel bond surface will not be silane primed for the primer masks contaminants. All tensile buttons will be silane primed to ensure that any adhesive failure occurs on the panel side.

The dome is not required per CTP-0142B to be re-processed during this re-test. A spray booth operational cycle of make-up air fans on and booth temperature at 135°F for 4 to 5 hours is specified and will suffice. The ability to process the dome in the spray booth has been identified. The issue to be addressed by this test is whether or not there are contaminants indigenous to the spray booth that could become airborne and be deposited on dome bond surfaces during processing and that would adversely affect the NBR to steel bond strength.

The proposed test as discussed and the revision to the CTP were approved via TRR Wednesday, 9 May.

V. Fitch

Approved by:

F. B. Baugh, Supervisor
Thermal Insulation Design

VWF/pn

A023243a

Distribution	M/S
L. Allred	L72A
B. Andersen	650
F. Baugh	L62B
D. Call	692
J. Daines	L61
D. Earl	692
N. Eddy	L62B
V. Fitch	L62B
S. Foth	811
R. Furrows	L72
L. Manuel	L71
R. Marsh	E63
S. Mildenhall	L90
P. Petty	L82
R. Raisor	245
C. Whitworth	L90
K. Wilks	E63
R. Wilks	L62

Appendix N

CTP-0142, Revision A, Conscan Data

PART NO.: 7083C29-01(910) L SERIAL/LOT: 0000002 0000002

CPI	RV	OPERATION	WORK ORDER	USER	PROD CTL	C/C	CYL HRS	MFG STP DATE	Q-A STP DATE
HR61A	00	100 CONSCAN	HR61A	00	0001	6541			

0510 APR 1990 13

STEP I N S T R U C T I O N S

350 PROCESS PER ENGINEERING DIRECTION. ENGINEERING INFORMATION ONLY.

370 CONSCAN PANELS PER DI-1014. RECORD DATA FROM POINTS 1-5 AS REFERENCED IN SKETCH PANELSMS-02. RECORD S/N AND READINGS FROM EACH POINT AND AVG READINGS BELOW.

NOTE: DO NOT CLEAN PANELS BEFORE CONSCANNING.

T 30319 W 4 APR 90

PANEL ID	S/N	1	2	3	4	5	AVG.
A)	0001696	922	832	658	817	832	813
B)	0001723	785	847	749	729	838	790
C)	0001677	695	725	822	851	868	792

SEND A COPY IF CONSCAN READINGS TO DON FISHER M/S L90.

380 ---- ----

REQUIRED _____ NOT REQUIRED __✓_____

30440 4 APR 90 T 30319 W 4 APR 90

CLEAN WITNESS PANELS USING THE FOLLOWING METHODS UNTIL READING IS ABOVE 372: ---- ----

1. WIPE THE PANELS WITH ULTRA FINE SCOTCHBRITE.
2. DOUBLE WIPE THE AREA USING TCA AND RYMPLECLOTH.

390

REQUIRED _____ NOT REQUIRED __✓_____

T 30319 W 4 APR 90

CONSCAN THE PANELS PER DIP 1014 IF THE WITNESS PANELS ARE RECLEANED. ---- ----
RECORD THE DATA FROM POINT 1-5 AS REFERENCED IN SKETCH PANELSMS-02.
RECORD THE S/N AND READINGS FROM EACH POINT AND AVG READING BELOW.

OPERATION: 100

PART NO.: 7082029-C1(910) L SERIAL/LOT: 0000002 0000002

CPI	RV	OPERATION	WORK ORDER	USER	PROD CTL	C/C	CYL HRS	MFG STP DATE	Q-A STP DATE
HR61A	00	100 CONSCAN	HR61A	00	0001	6541			

STEP

345

I N S T R U C T I O N S

2. DOUBLE WIPE USING RYMPLECLOTH DAMPENED WITH TCA.

350

QC, HAVE MFG RE-CLEAN AREAS WHERE CONSCAN READING IS BELOW 378. UNTIL ACCEPTABLE READING (ABOVE 378) IS OBTAINED, CONSCAN AGAIN AND RECORD ACCEPTABLE READINGS.

IN AN EFFORT TO OBTAIN CONCLUSIVE DATA FOR COMPARISON FROM END OF DEGREASE READINGS IT IS NECESSARY TO TRY TO ESTABLISH THE SAME GENERAL LOCATION TO OBTAIN BOTH SETS OF MEASUREMENTS. THE FOLLOWING PROCEDURE SHOULD BE USED TO OBTAIN THE PEAK AND HOLD MEASUREMENTS USING THE ONE INCH SENSOR AND THE .25 INCH STANDOFF.

QC, PRIOR TO CHEMLOK APPLICATION THE FOLLOWING MEASUREMENT WILL BE TAKEN. TEMPERATURE OF CASE MUST BE 50-104 DEG F.

RECORD CASE TEMPERATURE. 78°.

BEFORE 486 AFTER 429

OBTAIN ONE READING AS CLOSE TO THE DOME END AS POSSSIBLE AND ENSURE THAT IT IS ON A FLAT INSULATION BONDING SURFACE. THESE READINGS ARE REQUIRED AT THE FOLLOWING ANGULAR LOCATIONS AND THE SPECIFIED LONGITUDINAL LOCATIONS.

DEGREE	AS CLOSE AS PRACTICAL TO FWD END	TWO FEET FRONT FWD END	FOUR FEET FRONT FWD END	AS CLOSE AS PRACTICAL TO NOZZLE BOSS
0	497	559	476	473
45	466	492	550	464
90	443	514	575	553
135	482	530	533	768
180	424	519	551	981
225	451	567	552	598
270	415	460	469	509
315	491	505	472	517

QC NOTE: ALL STEPS MAY OR WILL BE DEVIATED FROM DURING THIS

T 30319 W 9 APR 90

T 30319 W 9 APR 90

T 30319 W 9 APR 90

T 30319 W 9 APR 90

T 30319 W 9 APR 90

Appendix O

Postperformance Fallout Panel FTIR Data

Final Results, Fall-out panels (FTIR of NVR)
after booth opp. cycle

LABORATORY REPORT

20 Apr. 1990

Originator: M-35A
Report to: Joel Ward (Ext 5294, M/S 887A)

Request: LWR 582896
Laboratory log # 04-19-90-32462

Subject: FTIR Analysis of NVR and Filtered Particulate samples from M-52 Spray Booth for the presence of Teflon
Sampled 16 Apr. 1990

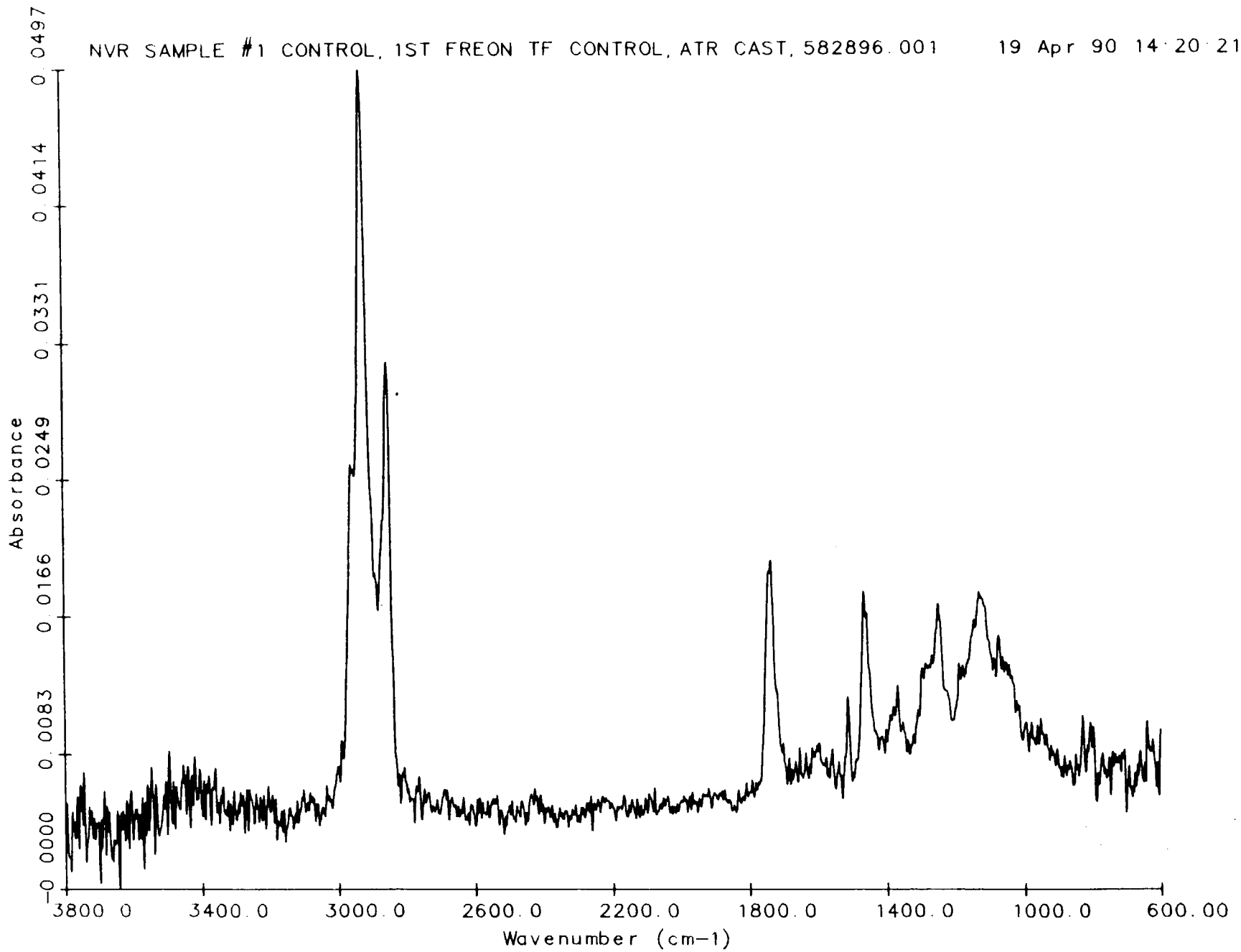
FTIR analysis has been carried out on NVR fallout samples and particulate samples from the M-52 spray booth. In particular, each sample was checked for the presence of Teflon residue. The presence of Teflon was determined by the appearance of the C-F absorbance peaks at about 1160 and about 1230 wavenumbers.

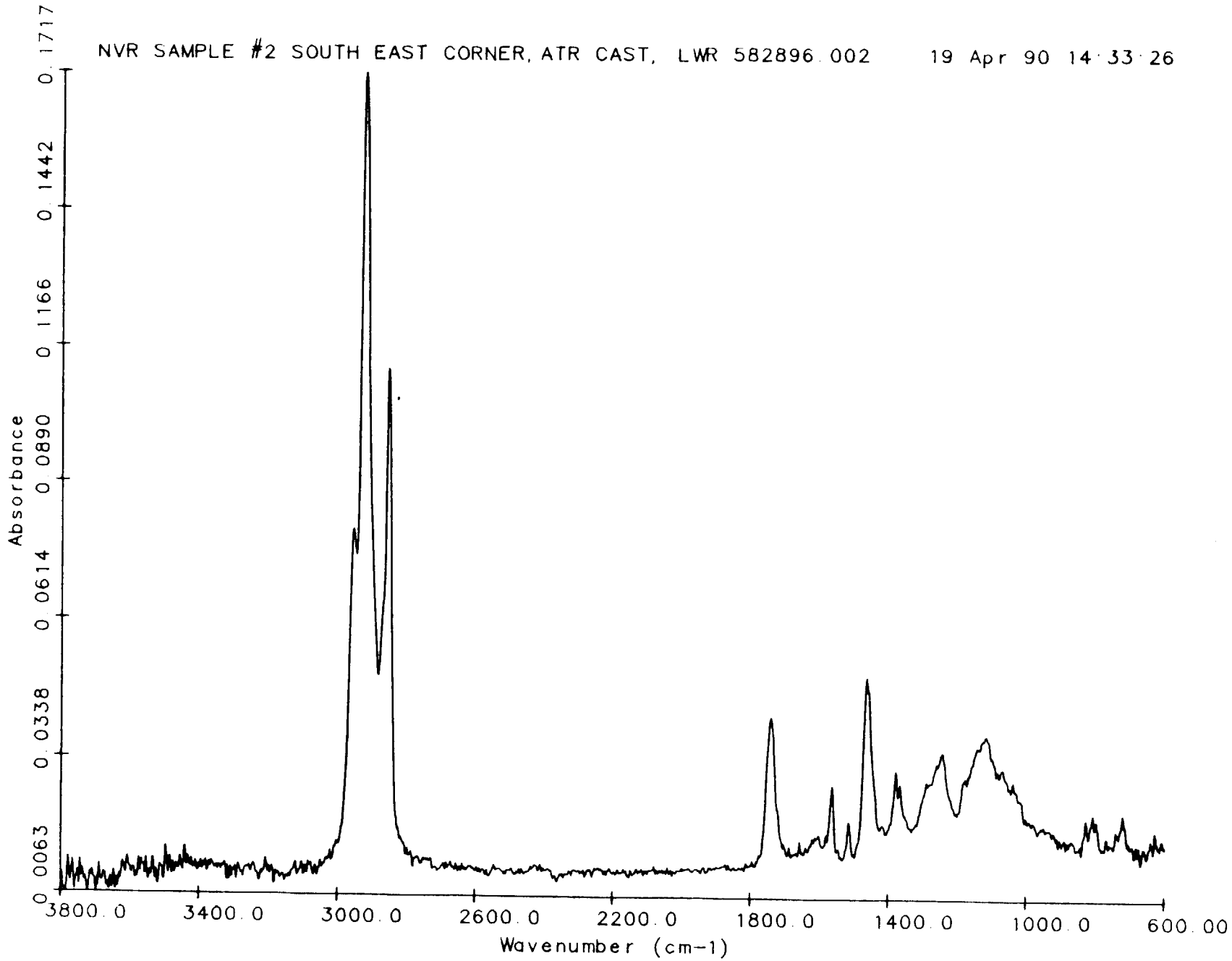
Eight fallout NVR samples and eight filter samples (including ref. samples) were received for testing.

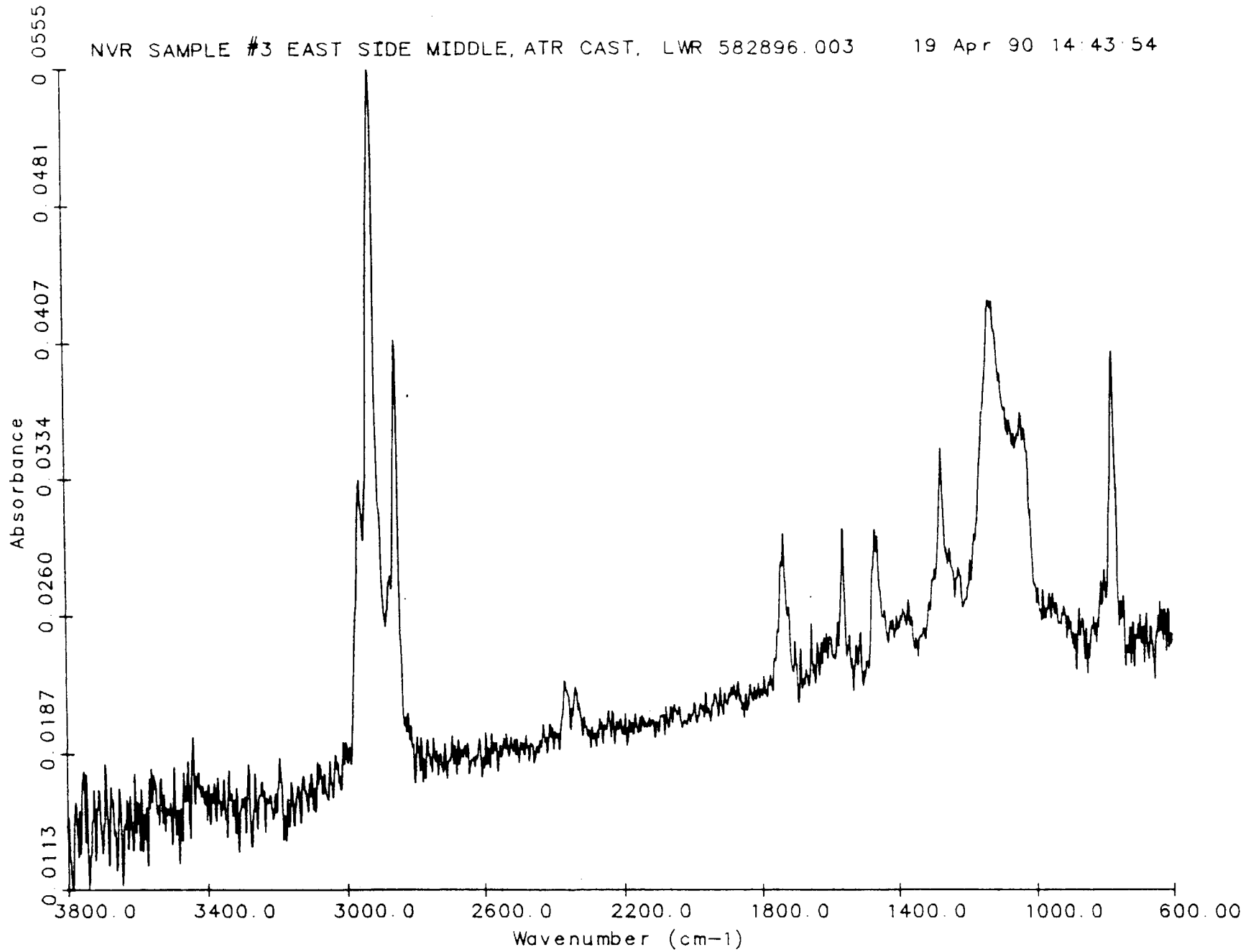
No Teflon was detected with any of the samples.

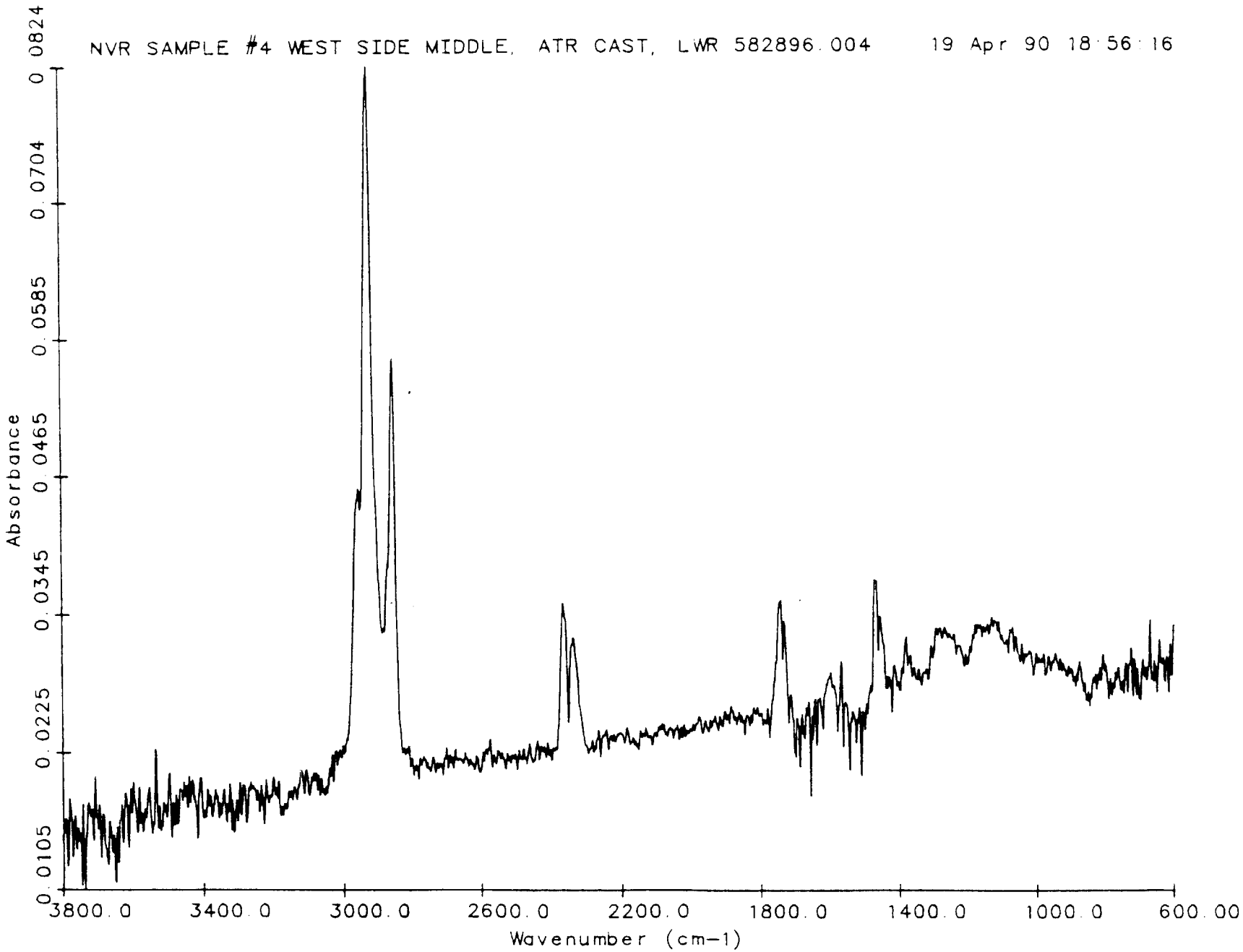
Copies of the FTIR spectra are attached.

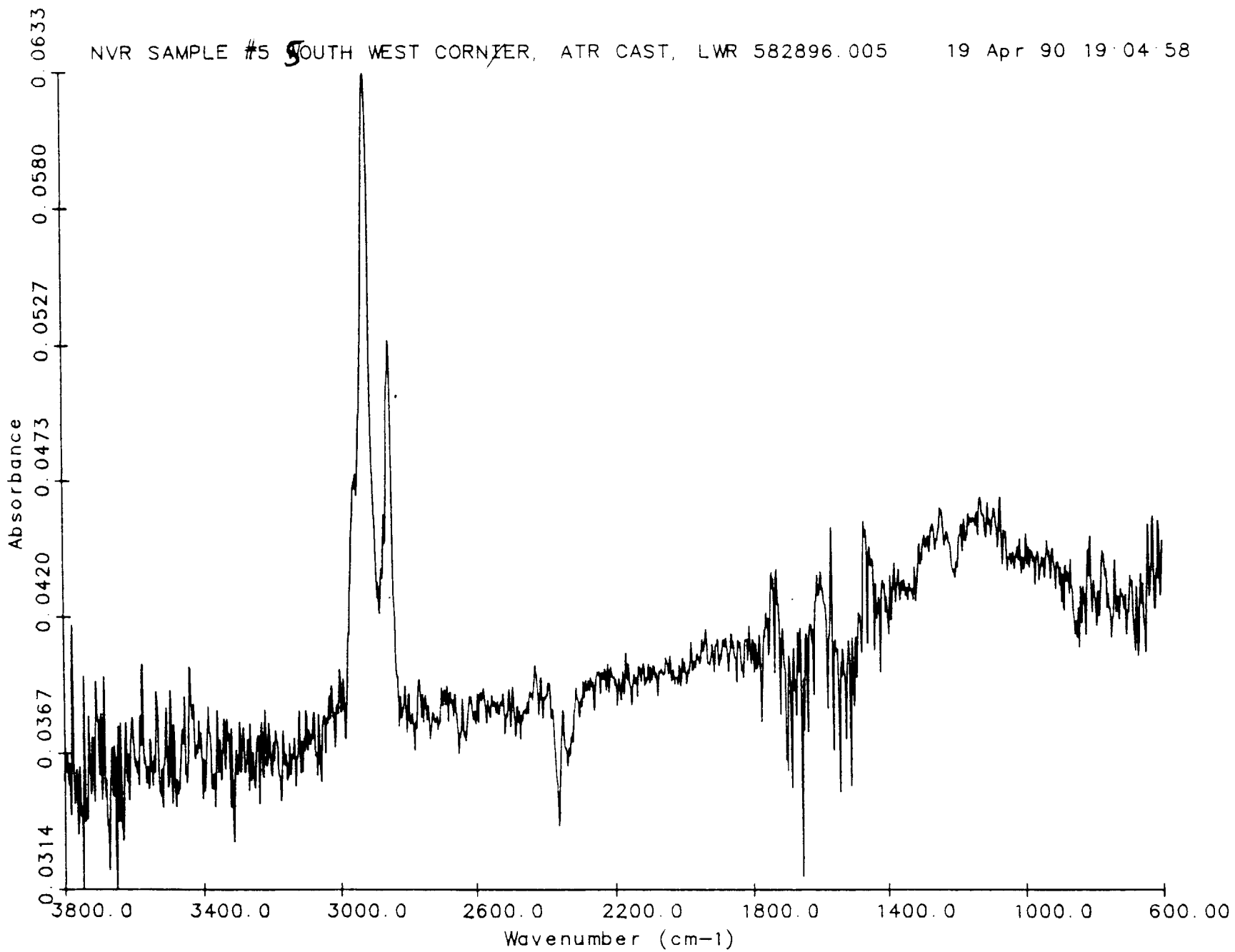
R. C. Raisor, Spectrochemical Analysis
LAB90109
B1448

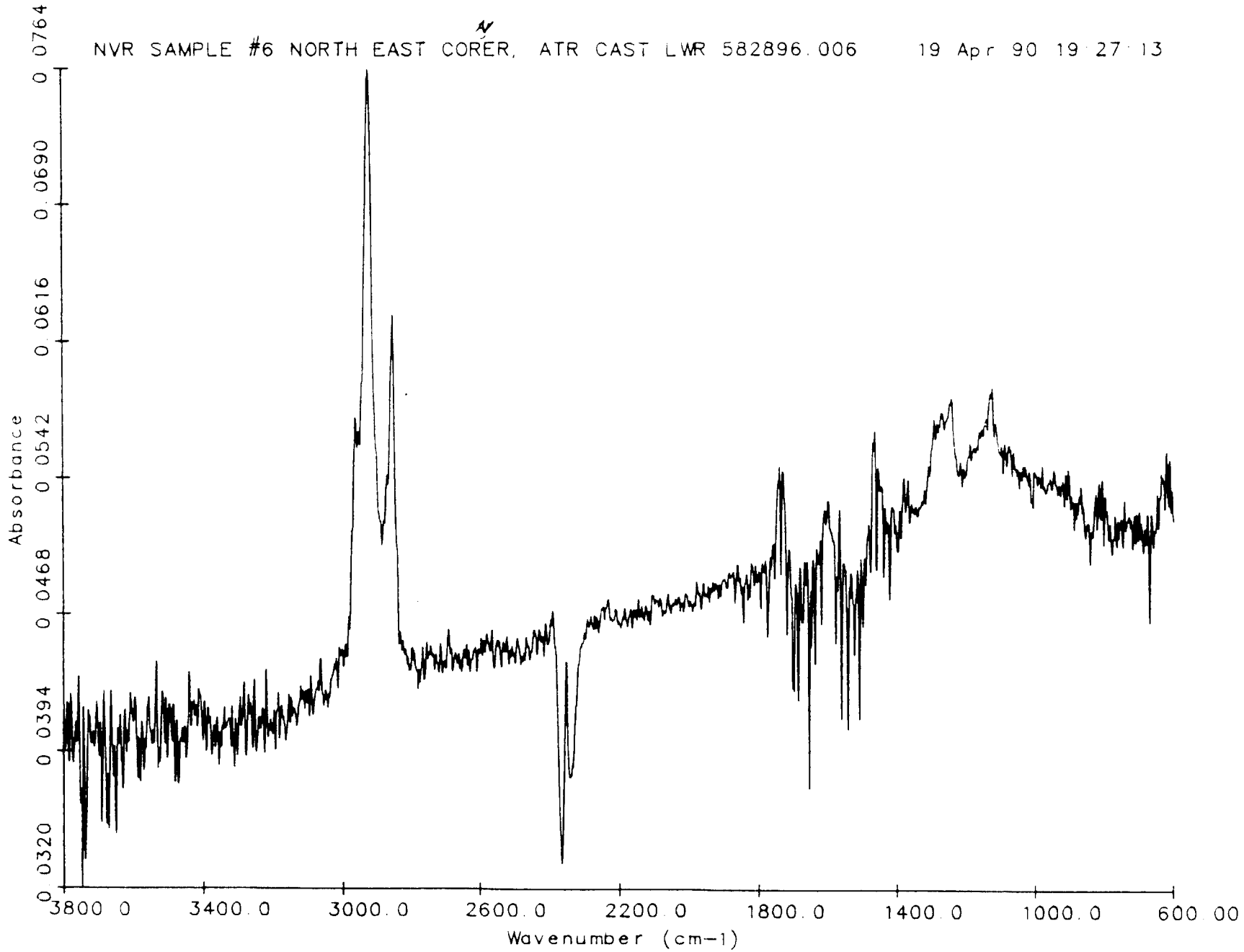

NVR SAMPLE #1 CONTROL, 1ST FREON TF CONTROL, ATR CAST, 582896.001
19 Apr 90 14:20:21
Absorbance
0.0497
0.0414
0.0331
0.0249
0.0166
0.0083
0.0000
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

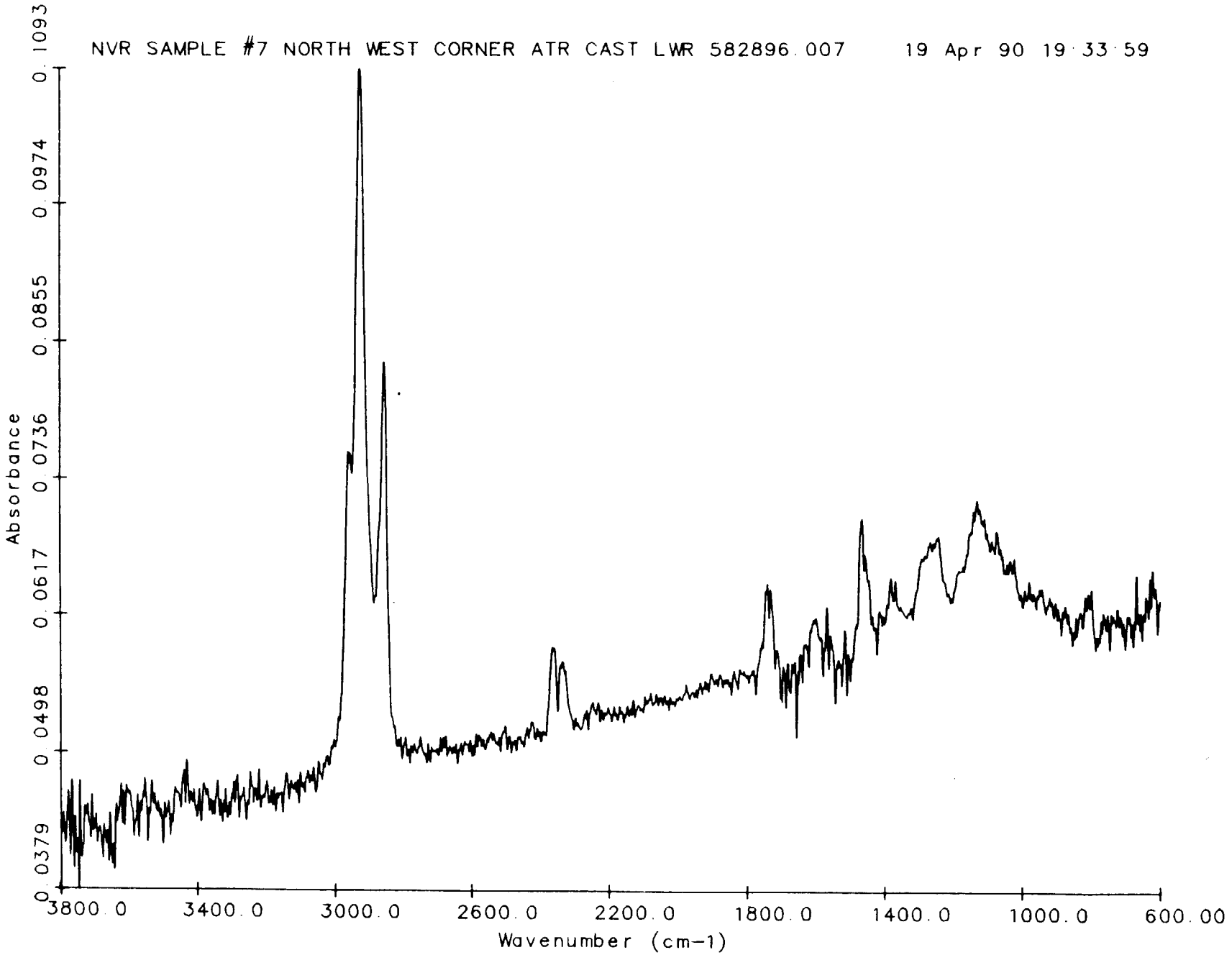

NVR SAMPLE #2 SOUTH EAST CORNER, ATR CAST, LWR 582896.002 19 Apr 90 14:33:26
Absorbance
0.0063
0.0338
0.0614
0.0890
0.1166
0.1442
0.1717
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

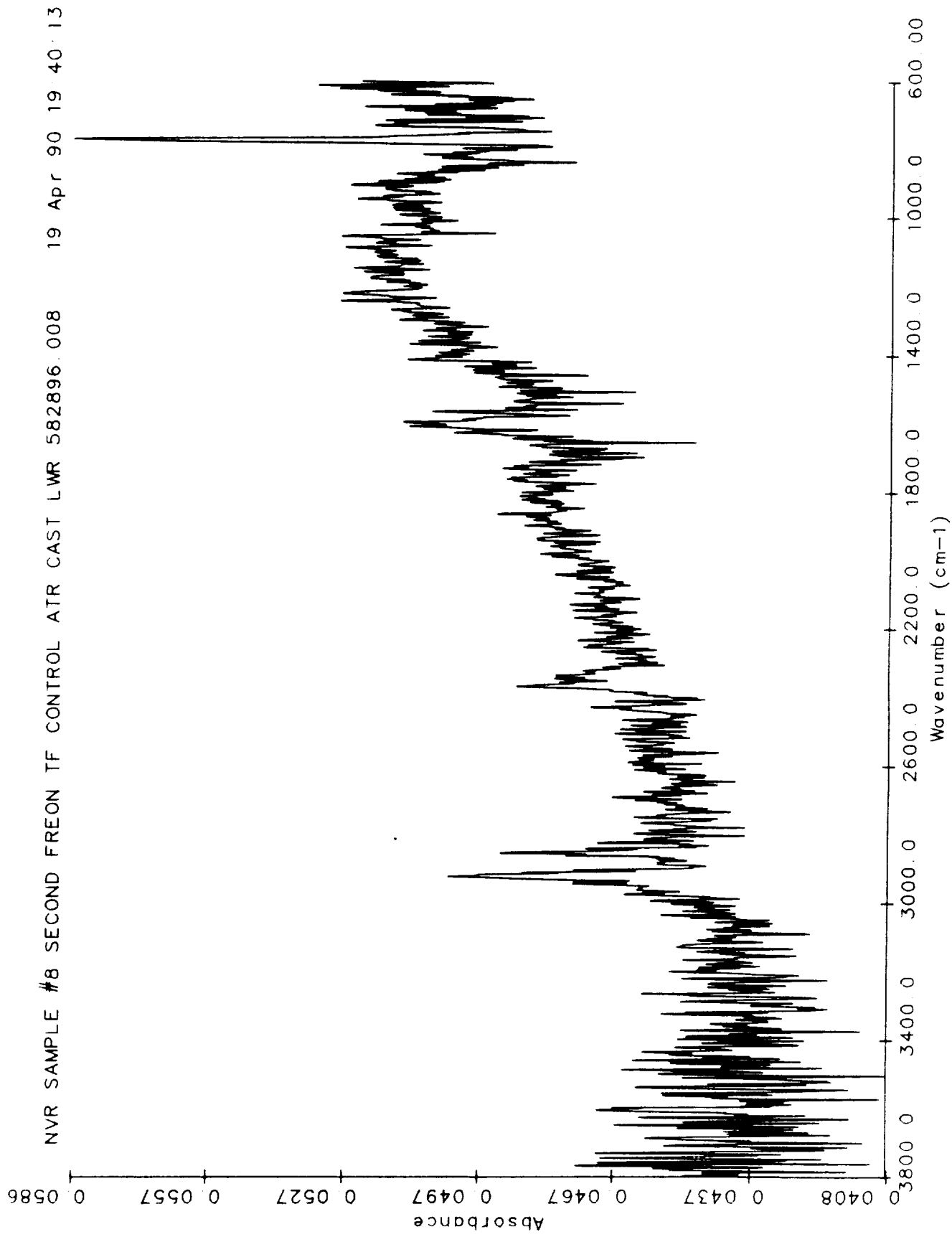

NVR SAMPLE #3 EAST SIDE MIDDLE, ATR CAST, LWR 582896.003
19 Apr 90 14:43:54
Absorbance
0.0555
0.0481
0.0407
0.0334
0.0260
0.0187
0.0113
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

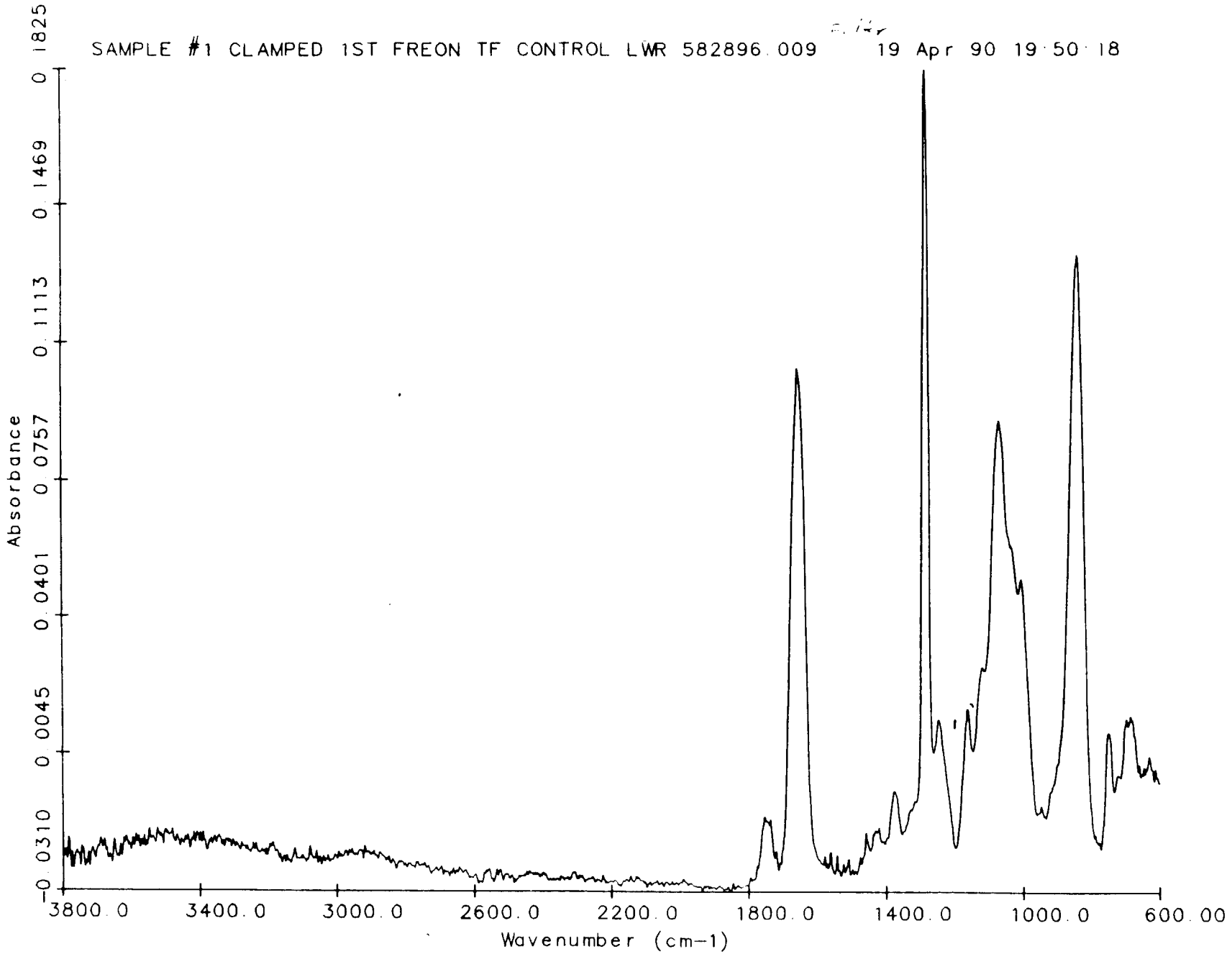

NVR SAMPLE #4 WEST SIDE MIDDLE, ATR CAST, LWR 582896.004 19 Apr 90 18:56:16
Absorbance
0.0824
0.0704
0.0585
0.0465
0.0345
0.0225
0.0105
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

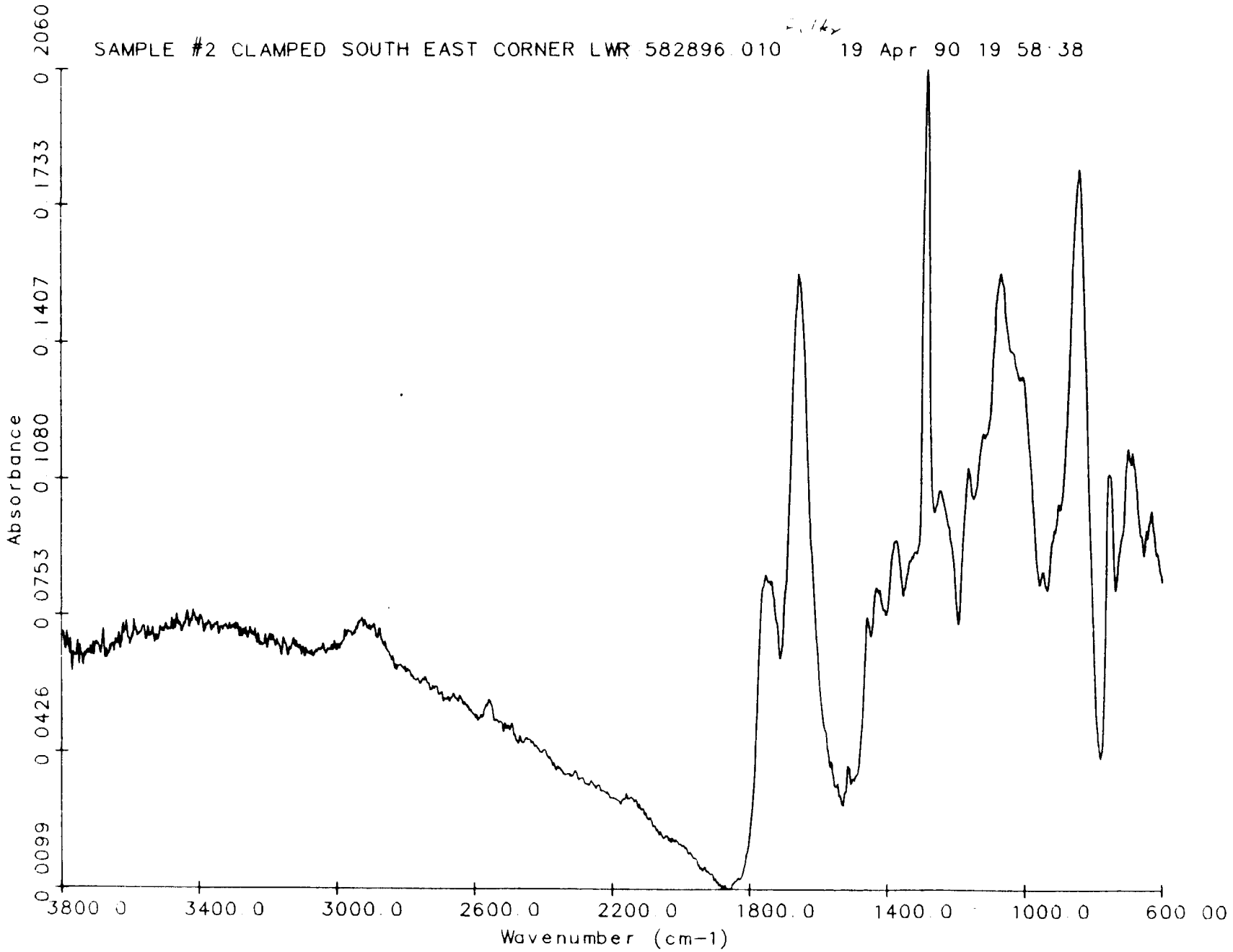

NVR SAMPLE #5 SOUTH WEST CORNER, ATR CAST, LWR 582896.005 19 Apr 90 19:04:58
Absorbance
0.0633
0.0580
0.0527
0.0473
0.0420
0.0367
0.0314
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

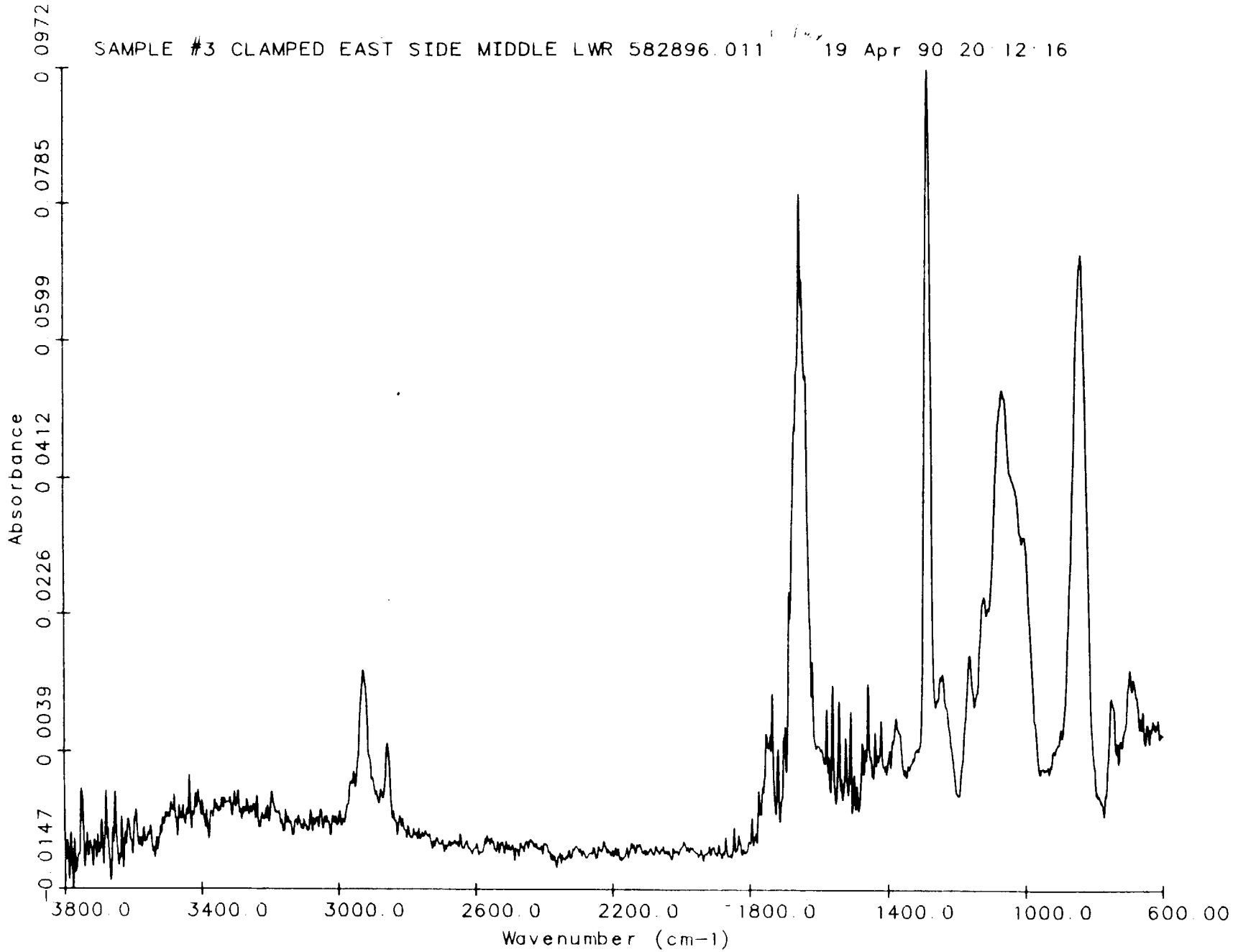

NVR SAMPLE #6 NORTH EAST CORER, ATR CAST LWR 582896.006 19 Apr 90 19:27:13
Absorbance
0.0764
0.0690
0.0616
0.0542
0.0468
0.0394
0.0320
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

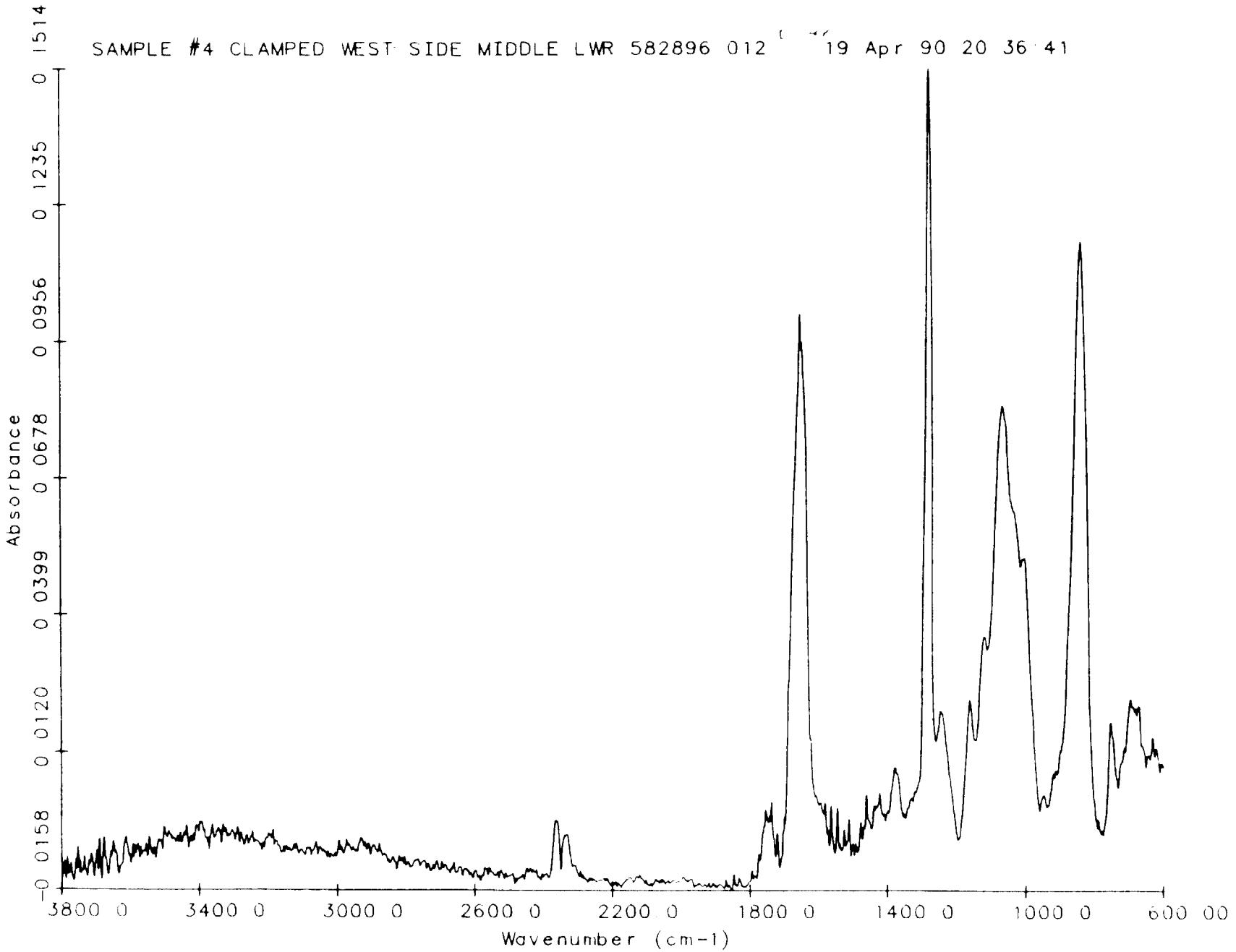

NVR SAMPLE #7 NORTH WEST CORNER ATR CAST LWR 582896.007 19 Apr 90 19:33:59
Absorbance
0.1093
0.0974
0.0855
0.0736
0.0617
0.0498
0.0379
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

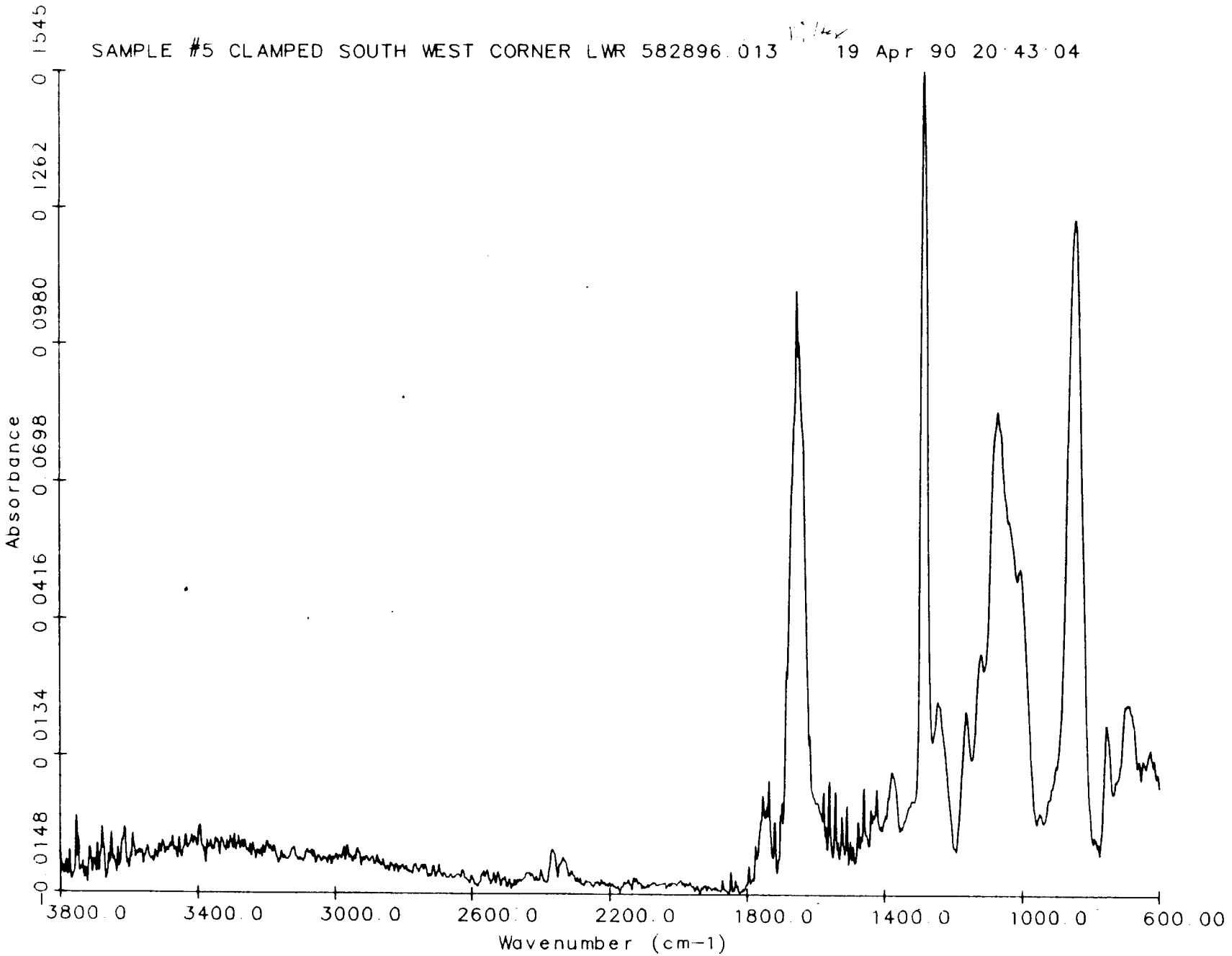

NVR SAMPLE #8 SECOND FREON TF CONTROL ATR CAST LWR 582896.008 19 Apr 90 19 40 13
Absorbance
0.0408
0.0437
0.0467
0.0497
0.0527
0.0557
0.0586
Wavenumber (cm-1)
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00

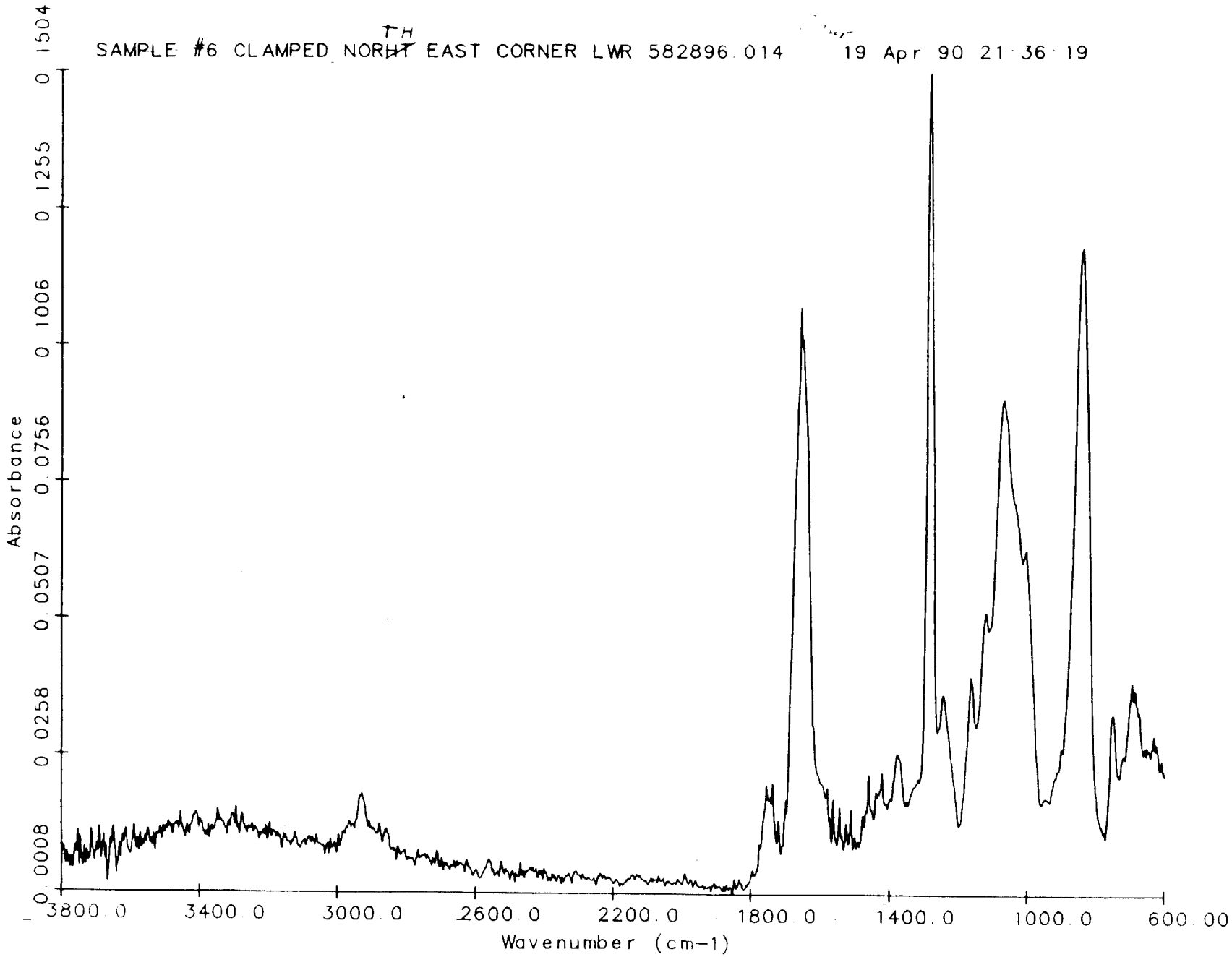

SAMPLE #1 CLAMPED 1ST FREON TF CONTROL LWR 582896.009
19 Apr 90 19:50:18
Absorbance
0.1825
0.1469
0.1113
0.0757
0.0401
0.0045
-0.0310
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

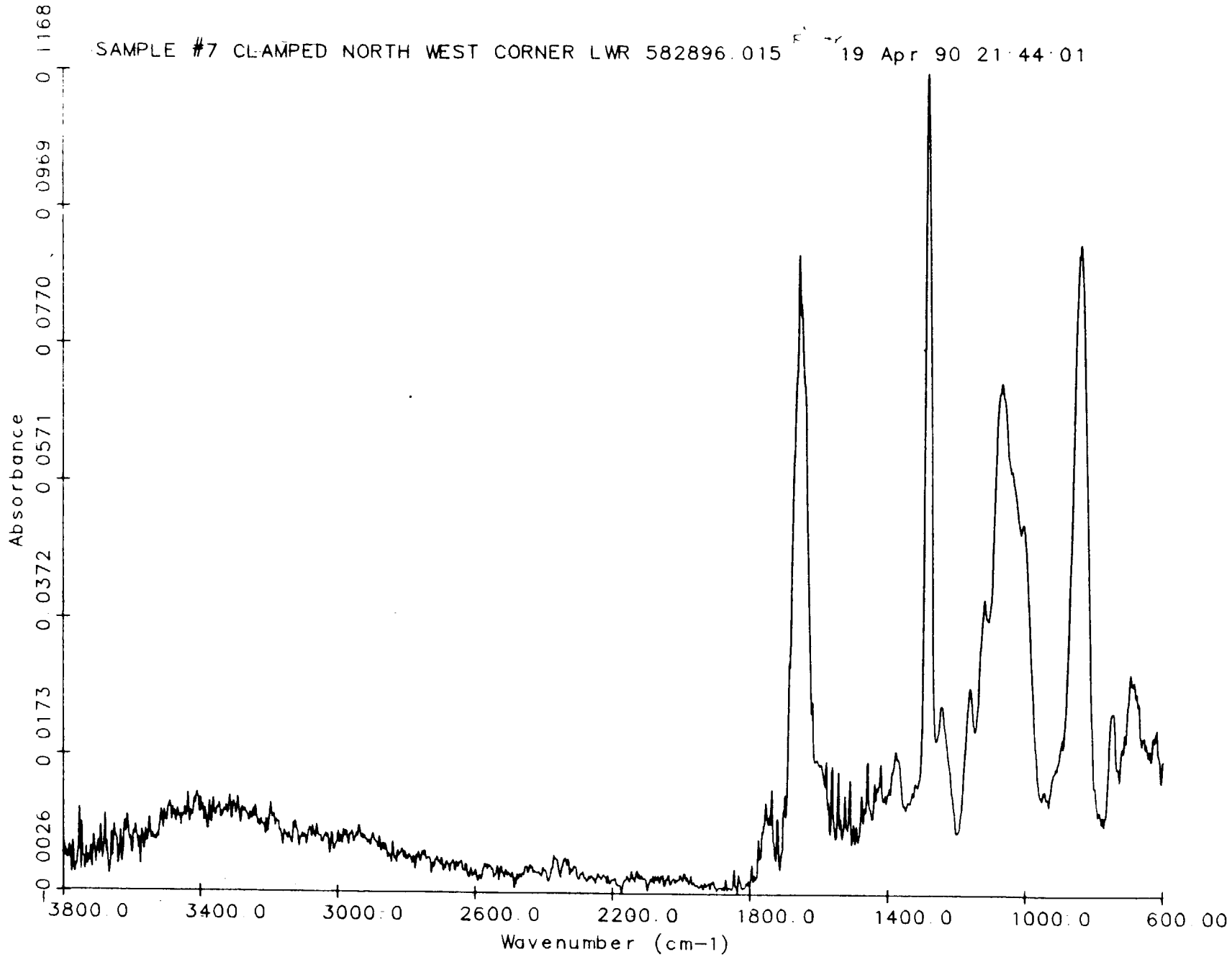

SAMPLE #2 CLAMPED SOUTH EAST CORNER LWR 582896.010 19 Apr 90 19 58 38
Absorbance
0.2060
0.1733
0.1407
0.1080
0.0753
0.0426
0.0099
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)

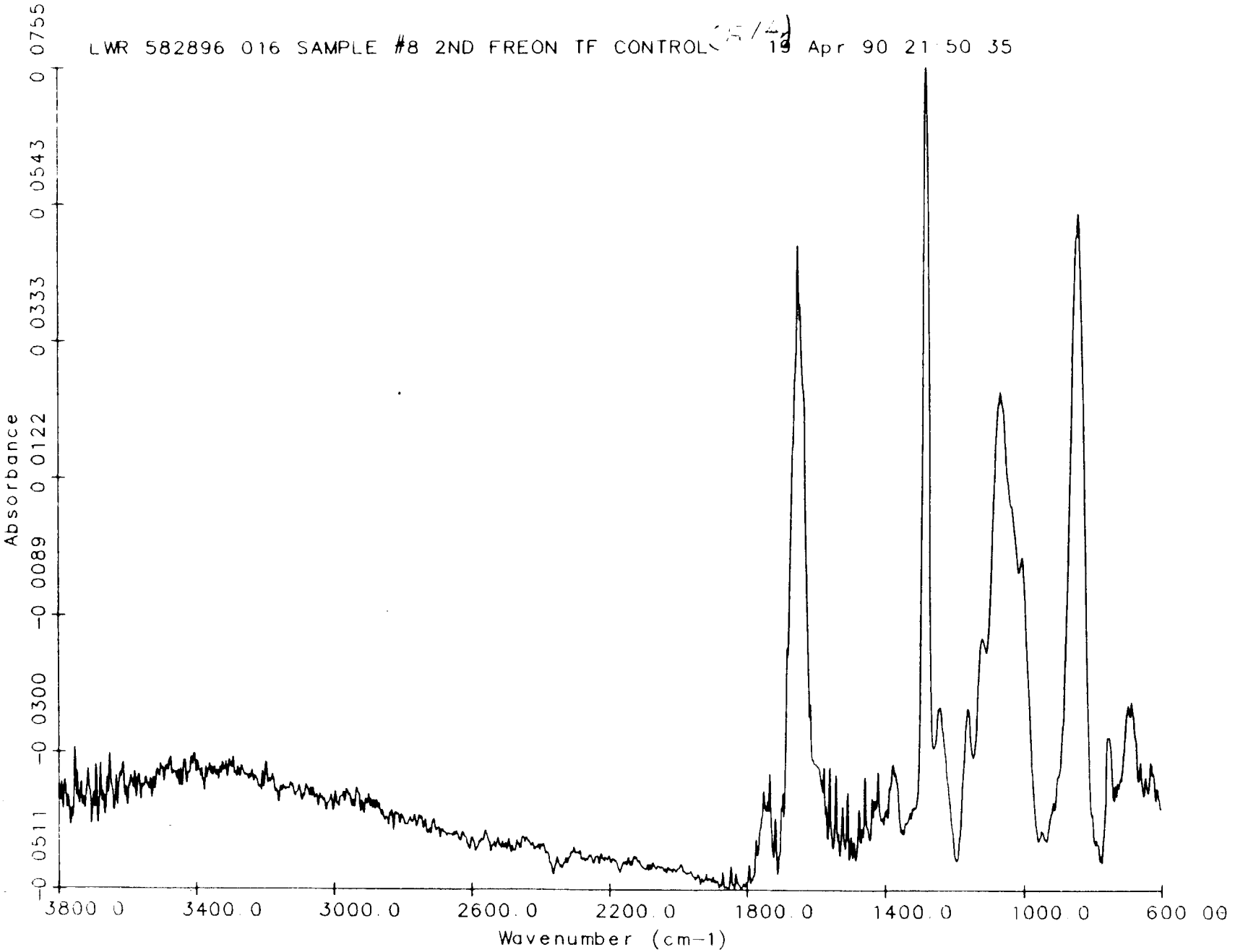

SAMPLE #3 CLAMPED EAST SIDE MIDDLE LWR 582896.011 19 Apr 90 20:12:16
Absorbance
0.0972
0.0785
0.0599
0.0412
0.0226
0.0039
-0.0147
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


SAMPLE #4 CLAMPED WEST SIDE MIDDLE LWR 582896 012
19 Apr 90 20 36 41
Absorbance
0 1514
0 1235
0 0956
0 0678
0 0399
0 0120
-0 0158
3800 0
3400 0
3000 0
2600 0
2200 0
1800 0
1400 0
1000 0
600 00
Wavenumber (cm-1)


SAMPLE #5 CLAMPED SOUTH WEST CORNER LWR 582896.013
19 Apr 90 20:43:04
Absorbance
0.1545
0.1262
0.0980
0.0698
0.0416
0.0134
-0.0148
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


SAMPLE #6 CLAMPED NORTH EAST CORNER LWR 582896.014 19 Apr 90 21:36:19
Absorbance
0.1504
0.1255
0.1006
0.0756
0.0507
0.0258
0.0008
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


SAMPLE #7 CLAMPED NORTH WEST CORNER LWR 582896.015
19 Apr 90 21:44:01
Absorbance
0.1168
0.0969
0.0770
0.0571
0.0372
0.0173
-0.0026
3800.0
3400.0
3000.0
2600.0
2200.0
1800.0
1400.0
1000.0
600.00
Wavenumber (cm-1)


LWR 582896 016 SAMPLE #8 2ND FREON TF CONTROL
19 Apr 90 21 50 35
Absorbance
0 0755
0 0543
0 0333
0 0122
-0 0089
-0 0300
-0 0511
3800 0
3400 0
3000 0
2600 0
2200 0
1800 0
1400 0
1000 0
600 00
Wavenumber (cm-1)

Appendix P

CTP-0142, Revision B, Conscan Data

SHOP TRAVELER (CONTINUATION)

SERIAL NO.	THRU SERIAL NO.	W/O	USER	PROD.CONTL
N/A	N/A	HR61A	71	0001

BLDG NO.	OPER NO.	W/C	OPERATION DESCRIPTION	USER	COST CENTER	STD HOURS	CYCLE HOURS SET-UP	CYCLE HOURS HRS/PC	ADCA	BUY OFF STAMP	BUY OFF DATE
			methylchloroform using the double wipe technique.								
			"SOLVENT CLEANING WARNING"								
			TCA IS HIGHLY TOXIC. WEAR NBR GLOVES AND CHEMICAL MONO-GOGGLES. USE IN WELL VENTILATED AREA. USE AIR MOVERS AS NEEDED TO REMOVE VAPOR BUILD-UP.								
			3. Reclean as required to obtain reading above 433. Record panels that needed recleaning to obtain a reading above 433:								

PANEL	RECLEAN YES OR NO	ORIGINAL READING
A	NO	748
B	NO	728
C	NO	753
D	NO	595
E	NO	603
F	NO	565
G	NO	577
H	NO	771

FORM TC 1794

C-4

ORIGINAL PAGE IS
OF POOR QUALITY

SHOP TRAVELER (CONTINUATION)

SERIAL NO.	THRU SERIAL NO.	PAGE 14 OF 26	
N/A	N/A	W/O HR61A	USER 71 / PROD. CONTL 0001

BLDG NO.	OPER NO.	W/C	OPERATION DESCRIPTION	USER	COST CENTER	STD HOURS	CYCLE HOURS SET-UP	CYCLE HOURS HRS/PC	ADCR	BUY OFF STAMP	BUY OFF DATE
			PANEL RECLEAN YES OR NO ORIGINAL READING								
			I NO 773								
			J NO 712								
			4. Record final readings above 433 in chart below.		8241					16728 W	1 8 MAY 90

PANEL	1	2	3	4	5	AVE
A	606	801	914	748	796	773
B	681	794	776	728	806	757
C	753	772	839	781	810	791
D	595	701	833	794	747	734
E	793	876	603	917	838	805
F	776	783	853	565	804	756
G	760	845	959	577	787	786
H	771	906	937	813	893	864
I	793	836	913	773	857	834
J	712	776	850	761	713	762

Appendix Q

CTP-0142, Revision B, Witness Panel Pull Test Data

LWR # : CTP-0A
Work Order: HR61A
Originator: V. FITCH

Failure Mode key
1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	A 0001405	1.12500	0.999	4503	4512	10	90								P
2	CTP-0142	A 0001405	1.12500	0.999	4970	4974		100								
3	CTP-0142	A 0001405	1.12500	0.999	5251	5254		100								
4	CTP-0142	A 0001405	1.12500	0.999	4392	4395	10	90								P
5	CTP-0142	A 0001405	1.12500	0.999	4540	4543	10	90								P
6	CTP-0142	A 0001405	1.12500	0.999	4771	4774		100								
7	CTP-0142	A 0001405	1.12500	0.999	5385	5389		100								
8	CTP-0142	A 0001405	1.12500	0.999	5318	5322	5	95								P
9	CTP-0142	A 0001405	1.12500	0.999	2847	2849	60	40								P
10	CTP-0142	A 0001405	1.12500	0.999	4251	4254	20	80								P
11	CTP-0142	A 0001405	1.12500	0.999	5458	5462		100								
12	CTP-0142	A 0001405	1.12500	0.999	4750	4753	10	90								P
Average (PSI):						4748	10	90								
Standard Deviation:						708.9										
Coeff. of Var:						14.9										

Prepared by the Space Contamination Control Laboratory

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
F = Panel Side
IT = Invalid Test

LWR # : CTP-0F
Work Order: HR61A
Originator: V. FITCH

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	F 0001582	1.12800	0.999	5669	5672		100								
2	CTP-0142	F 0001582	1.12600	0.999	5318	5322		100								
3	CTP-0142	F 0001582	1.12800	0.999	5565	5568		100								
4	CTP-0142	F 0001582	1.12800	0.999	5464	5468		100								
5	CTP-0142	F 0001582	1.12800	0.999	5719	5723		100								
6	CTP-0142	F 0001582	1.12600	0.999	6041	6045		100								
7	CTP-0142	F 0001582	1.12800	0.999	5081	5084	5	95								F
8	CTP-0142	F 0001582	1.12800	0.999	5115	5119	10	90								F
9	CTP-0142	F 0001582	1.12600	0.999	5621	5625		100								
10	CTP-0142	F 0001582	1.12900	0.999	5650	5654		100								
11	CTP-0142	F 0001582	1.12800	0.999	5717	5721		100								
12	CTP-0142	F 0001582	1.12800	0.999	5214	5217		100								
Average (PSI):						5583	1	99								
Standard Deviation:						267.5										
Coeff. of Var:						4.8										

Prepared by the Space Contamination Control Laboratory

LWR # : CTP-0B
Work Order: HR61A
Originator: V. FITCH

Failure Mode Key

1 = Adhesive/Metal	5 = Cohesive/Rubber	10 = Failure Comment
2 = Cohesive/Adhesive	6 = Adhesive/Rubber	TB = Tab Broke
3 = Adhesive/Phenolic	7 = Cohesive/Liner	B = Button Side
4 = Cohesive/Phenolic	8 = Adhesive/Liner	P = Panel Side
	9 = Void	IT = Invalid Test

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	B 0000226	1.12800	0.999	5035	5039		100								
2	CTP-0142	B 0000226	1.12800	0.999	4469	4472	20	80								P
3	CTP-0142	B 0000226	1.12670	0.997	5066	5078		100								
4	CTP-0142	B 0000226	1.12800	0.999	5154	5157		100								
5	CTP-0142	B 0000226	1.12900	0.999	5332	5336	10	90								P
6	CTP-0142	B 0000226	1.12800	0.999	5168	5171	10	90								P
7	CTP-0142	B 0000226	1.12630	0.999	5263	5266		100								
8	CTP-0142	B 0000226	1.12800	0.999	4863	4866		100								
9	CTP-0142	B 0000226	1.12800	0.999	4930	4933	10	90								P
10	CTP-0142	B 0000226	1.12300	0.999	4282	4285	15	85								P
11	CTP-0142	B 0000226	1.12620	0.999	5098	5102		100								
12	CTP-0142	B 0000226	1.12800	0.999	5462	5465		100								
Average (PSI):						5044	5	95								
Standard Deviation:						358.2										
Coeff. of Var:						7.1										

Prepared by the Space Contamination Control Laboratory

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

LWR # : CTF-06
Work Order: HR61A
Originator: V. FITCH

Date: 21MAY90
Technician: J. WARD

Test Machine: INSTR4505
Test Type: Type III Tensile

Temperature: 70 Deg. F
Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID.- Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTF-0142	G 0000834	1.12800	0.999	4178	4181	10	90								P
2	CTF-0142	G 0000834	1.12800	0.999	4100	4103	30	70								F
3	CTF-0142	G 0000834	1.12800	0.999	4645	4648	15	85								P
4	CTF-0142	G 0000834	1.12800	0.999	5326	5329		100								
5	CTF-0142	G 0000834	1.12800	0.999	4781	4785	10	90								F
6	CTF-0142	G 0000834	1.12800	0.999	6003	6007		100								
7	CTF-0142	G 0000834	1.12800	0.999	5743	5747		100								
8	CTF-0142	G 0000834	1.12800	0.999	5965	5969		100								
9	CTF-0142	G 0000834	1.12800	0.999	5128	5132		100								P
10	CTF-0142	G 0000834	1.12800	0.999	5624	5627	5	95								
11	CTF-0142	G 0000834	1.12800	0.999	5484	5488		100								
12	CTF-0142	G 0000834	1.12800	0.999	5889	5893		100								
						5242	6	94								
Average (PSI):						674.6										
Standard Deviation:						12.9										
Coeff. of Var:																

Prepared by the Space Contamination Control Laboratory

LWR # : CTP-0C
Work Order: HR61A
Originator: V. FITCH

Failure Mode Key

1 = Adhesive/Metal	5 = Cohesive/Rubber	10 = Failure Comment
2 = Cohesive/Adhesive	6 = Adhesive/Rubber	TB = Tab Broke
3 = Adhesive/Phenolic	7 = Cohesive/Liner	B = Button Side
4 = Cohesive/Phenolic	8 = Adhesive/Liner	P = Panel Side
	9 = Void	IT = Invalid Test

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	C 0000081	1.12800	0.999	4498	4501	10	90								P
2	CTP-0142	C 0000081	1.12800	0.999	4355	4358	20	80								P
3	CTP-0142	C 0000081	1.12800	0.999	4232	4235	20	80								P
4	CTP-0142	C 0000081	1.12800	0.999	4129	4132	25	75								P
5	CTP-0142	C 0000081	1.12800	0.999	4894	4897	10	90								P
6	CTP-0142	C 0000081	1.12800	0.999	5036	5039	10	90								P
7	CTP-0142	C 0000081	1.12800	0.999	5484	5488		100								
8	CTP-0142	C 0000081	1.12800	0.999	4447	4450	15	85								P
9	CTP-0142	C 0000081	1.12800	0.999	5184	5187	10	90								P
10	CTP-0142	C 0000081	1.12800	0.999	5533	5537	10	90								P
11	CTP-0142	C 0000081	1.12800	0.999	5141	5144	10	90								P
12	CTP-0142	C 0000081	1.12800	0.999	4666	4669	10	90								P
Average (PSI):						4800	13	88								
Standard Deviation:						479.3										
Coeff. of Var:						10.0										

epared by the Space Contamination Control Laboratory

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

LWR # : CTP-8H
Work Order: HR61A
Originator: V. FITCH

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-8142	H 0001471	1.12800	0.999	5451	5455		100								
2	CTP-8142	H 0001471	1.12800	0.999	5180	5184		100								
3	CTP-8142	H 0001471	1.12800	0.999	5003	5007	10	90								P
4	CTP-8142	H 0001471	1.12800	0.999	5692	5696		100								
5	CTP-8142	H 0001471	1.12800	0.999	4950	4954	10	90								P
6	CTP-8142	H 0001471	1.12800	0.999	5690	5694		100								
7	CTP-8142	H 0001471	1.12800	0.999	5966	5970		100								
8	CTP-8142	H 0001471	1.12800	0.999	5411	5415	5	95								B
9	CTP-8142	H 0001471	1.12800	0.999	3866	3869	45	55								P
10	CTP-8142	H 0001471	1.12800	0.999	5848	5852	5	95								B
11	CTP-8142	H 0001471	1.12800	0.999	5761	5765		100								
12	CTP-8142	H 0001471	1.12800	0.999	4861	4864	5	95								P
Average (PSI):						5327	7	93								
Standard Deviation:						602.6										
Coeff. of Var:						11.3										

Prepared by the Space Contamination Control Laboratory

LWR # : CTP-0D
Work Order: H03H8
Originator: V. FITCH

Failure Mode Key
1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

Date: 21MAY90 Test Machine: INSTRN4505 Temperature: 70 Deg. F
Technician: V.WARNER Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	D 0001280	1.12800	0.999	4335	4338	10	90								P
2	CTP-0142	D 0001280	1.12800	0.999	5388	5391	5	95								P
3	CTP-0142	D 0001280	1.12800	0.999	4302	4305	10	90								P
4	CTP-0142	D 0001280	1.12800	0.999	5005	5008		100								
5	CTP-0142	D 0001280	1.12800	0.999	5421	5425		100								
6	CTP-0142	D 0001280	1.12800	0.999	5468	5472		100								
7	CTP-0142	D 0001280	1.12800	0.999	4285	4288	10	90								P
8	CTP-0142	D 0001280	1.12800	0.999	5370	5374		100								
9	CTP-0142	D 0001280	1.12800	0.999	5825	5829		100								
10	CTP-0142	D 0001280	1.12800	0.999	4342	4345	10	90								P
11	CTP-0142	D 0001280	1.12800	0.999	5403	5406		100								
12	CTP-0142	D 0001280	1.12800	0.999	4986	4989	5	95								P
Average (PSI):						5008	4	96								
Standard Deviation:						557.2										
Coeff. of Var:						11.1										

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Brake
B = Button Side
P = Panel Side
IT = Invalid Test

LWR # : CTP-01
Work Order: HR61A
Originator: V. FITCH

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID:	Panel ID: Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	I 0001238	1.12800	0.999	5233	5236	5	95								P
2	CTP-0142	I 0001238	1.12800	0.999	5373	5377		100								
3	CTP-0142	I 0001238	1.12800	0.999	4429	4431	10	90								F
4	CTP-0142	I 0001238	1.12800	0.999	5788	5791	5	95								F
5	CTP-0142	I 0001238	1.12800	0.999	5564	5567		100								
6	CTP-0142	I 0001238	1.12800	0.999	5012	5015		100								
7	CTP-0142	I 0001238	1.12800	0.999	4426	4429	20	80								P
8	CTP-0142	I 0001238	1.12800	0.999	5166	5170		100								
9	CTP-0142	I 0001238	1.12800	0.999	4873	4877	5	95								P
10	CTP-0142	I 0001238	1.12800	0.999	4061	4063	10	90								P
11	CTP-0142	I 0001238	1.12800	0.999	4643	4646	5	95								P
12	CTP-0142	I 0001238	1.12800	0.999	5377	5380	5	95								P
Average (PSI):						4999	5	95								
Standard Deviation:						521.2										
Coeff. of Var:						10.4										

Prepared by the Space Contamination Control Laboratory

LWR # 1 CTP-0E

Work Order: HR6JA

Originator: V. FITCH

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F

Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Specimen No.	Segment ID	Panel ID	Ser(a)	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	E	0001263	1.12800	0.999	4888	4883		5	95							
2	CTP-0142	E	0001263	1.12800	0.999	4874	4877		5	95							P
3	CTP-0142	E	0001263	1.12800	0.999	4918	4922		5	95							P
4	CTP-0142	E	0001263	1.12800	0.999	4904	4907			100							P
5	CTP-0142	E	0001263	1.12800	0.999	5224	5228			100							
6	CTP-0142	E	0001263	1.12800	0.999	5174	5178			100							
7	CTP-0142	E	0001263	1.12800	0.999	4769	4772		5	95							
8	CTP-0142	E	0001263	1.12800	0.999	5046	5050			100							P
9	CTP-0142	E	0001263	1.12800	0.999	5240	5243			100							
10	CTP-0142	E	0001263	1.12800	0.999	4925	4929		10	90							
11	CTP-0142	E	0001263	1.12800	0.999	5061	5064		5	95							P
12	CTP-0142	E	0001263	1.12800	0.999	4477	4480		10	90							P
																	P
Average (PSI):							4954		4	96							
Standard Deviation:							217.5										
Coeff. of Var.:							4.4										

Failure Mode Key

1 = Adhesive/Metal
2 = Cohesive/Adhesive
3 = Adhesive/Phenolic
4 = Cohesive/Phenolic
5 = Cohesive/Rubber
6 = Adhesive/Rubber
7 = Cohesive/Liner
8 = Adhesive/Liner
9 = Void
10 = Failure Comment
TB = Tab Broke
B = Button Side
P = Panel Side
IT = Invalid Test

LWR # : CTP-0J
Work Order: HR61A
Originator: V. FITCH

Date: 21MAY90 Test Machine: INSTR4505 Temperature: 70 Deg. F
Technician: J. WARD Test Type: Type III Tensile Crosshead Speed: .05 in/min

Spec No.	Segment ID.	Panel ID. - Serial	Dia (in)	Cross Section (in2)	Max Load (lbs)	Max Stress (psi)	Failure Mode Analysis 1	2	3	4	5	6	7	8	9	10
1	CTP-0142	J 0001257	1.12800	0.999	4098	4100	15	85								P
2	CTP-0142	J 0001257	1.12800	0.999	5515	5518		100								
3	CTP-0142	J 0001257	1.12800	0.999	5642	5646		100								
4	CTP-0142	J 0001257	1.12800	0.999	5019	5022	5	95								P
5	CTP-0142	J 0001257	1.12800	0.999	4366	4369	15	85								F
6	CTP-0142	J 0001257	1.12800	0.999	5120	5124		100								
7	CTP-0142	J 0001257	1.12800	0.999	5588	5592	5	95								P
8	CTP-0142	J 0001257	1.12800	0.999	4696	4699	10	90								P
9	CTP-0142	J 0001257	1.12800	0.999	4929	4932	10	90								P
10	CTP-0142	J 0001257	1.12800	0.999	5820	5824		100								
11	CTP-0142	J 0001257	1.12800	0.999	4897	4901		100								
12	CTP-0142	J 0001257	1.12800	0.999	5506	5510		100								
Average (PSI):						5103	5	95								
Standard Deviation:						537.3										
Coeff. of Var:						10.5										

Prepared by the Space Contamination Control Laboratory

Appendix R

Pass/Fail Criteria

Thiokol CORPORATION
SPACE OPERATIONS

6 June 1990
L713-FY90-M403

TO: Distribution

FROM: L. J. Manuel
Test Planning and Reports

SUBJECT: Update of Pass/fail Criteria for the M-52 Spray Booth Qualification

REFERENCE: Test Readiness Review Package, Titled "CTP-0142 Rev B, Qualification Test for Process Change Moving the Aft and Fwd Dome Painting and Adhesives Application Location from the Bottom of the Paint Pits to the M-52 Spray Booth".

The pass/fail criteria for the steel/epoxy/steel test portion of the M-52 spray booth qualification has been revised. The pass/fail criteria was:

B. Steel-Epoxy Bonds - If the exposed panel set (5 total) has significantly less bond strength at the 95% confidence level than the control panel set (5 total) then the test failed.

The revised pass/fail criteria is as follows:

Pass: If the exposed panels averages are above the systems tunnel witness panel database A-basis lower limit, or, if the exposed panel set does not have a significantly lower tensile adhesion bond strength than the control panels at the 95% confidence level.

Fail: If any of the exposed panel averages fall below the systems tunnel witness panel database A-basis lower limit, and, the exposed panel set has a significantly lower tensile adhesion bond strength than the control panels at the 95% confidence level.

The justification for this change is outlined in the attached presentation.

P.O. Box 707, Brigham City, UT 84302-0707 (801) 863-3511

A023243a

TRR Board Concurrence

for Space Division Sr. V.P.

RSRM Program Management

Space Engineering

Operations

SR & QA

Board Secretary

EE54
MSFC Representative

A023243a

DISTRIBUTION

S. Kulkarni	L00
C. Speak	E60
R. Davis	A30
R. Bontempo	600
R. Lund	200
R. Bowman	800
D. Brown	560
N. Black	L71
L. Manuel	L71
L. Lott	K68
G. Alford	E60
B. McQuivey	L72
B. Jurewicz	L70
S. Foth	824
R. Plowman	824
B. Anderson	650
V. Fitch	L62B
S. Mildenhall	E80
R. Clark	654
D. Earl	692
A. Braxton	K68
B. Meyer	K68
C. Jensen	L72
S. Moake	692
D. Call	692
K. Wilks	E63
R. Furrows	L72
J. Sutton	L72

M-52 SPRAY BOOTH QUALIFICATION
CTP-0142, REVISION B
TENSILE ADHESION TESTS

Scott D. Mildenhall
Materials and Process

Vern Fitch
Thermal Insulation Design

1 June 1990

- CTP-0142, Revision B was written to include revised witness panel tensile adhesion test
  - Two sets of five panels (12 buttons on each panel) were tested
    - One control set of five panels covered with craft paper
    - One set of five panels exposed in the M-52 spray booth
- The tests were run per the planning and did not meet the pass/fail criteria set up during the TRR.
  - The exposed panel set will not have a significantly lower tensile adhesion bond strength than the control panels at the 95% confidence level

- Show that the results of the tensile tests are technically acceptable based on the high tensile strengths obtained and how the data compares with the systems tunnel witness panel database

- Show how the tightness of the test data (low panel to panel variation) affected the calculations used to demonstrate compliance to the requirements at a 95% confidence level

- Statistical Equation

$$t = \frac{\bar{X}_c - \bar{X}_e}{\sqrt{\frac{(S_c)^2}{n_c} + \frac{(S_e)^2}{n_e}}}$$

"t" = is based on the confidence level required and based on the number of samples to be tested (obtained from statistical tables)

"X" = the mean value for the data

"S" = the standard deviation of the data

"c" = control panel sets

"e" = exposed panel sets

- "t" for a 95% confidence level and 5 samples per set equals 1.86
  - Calculated higher values of "t" indicate that the requirement at a 95% confidence level has not been met
- Calculated "t" for the two data sets was 2.936, indicating that there was a statistical difference between the two data sets at a 95% confidence level

Why the data showed a statistical difference

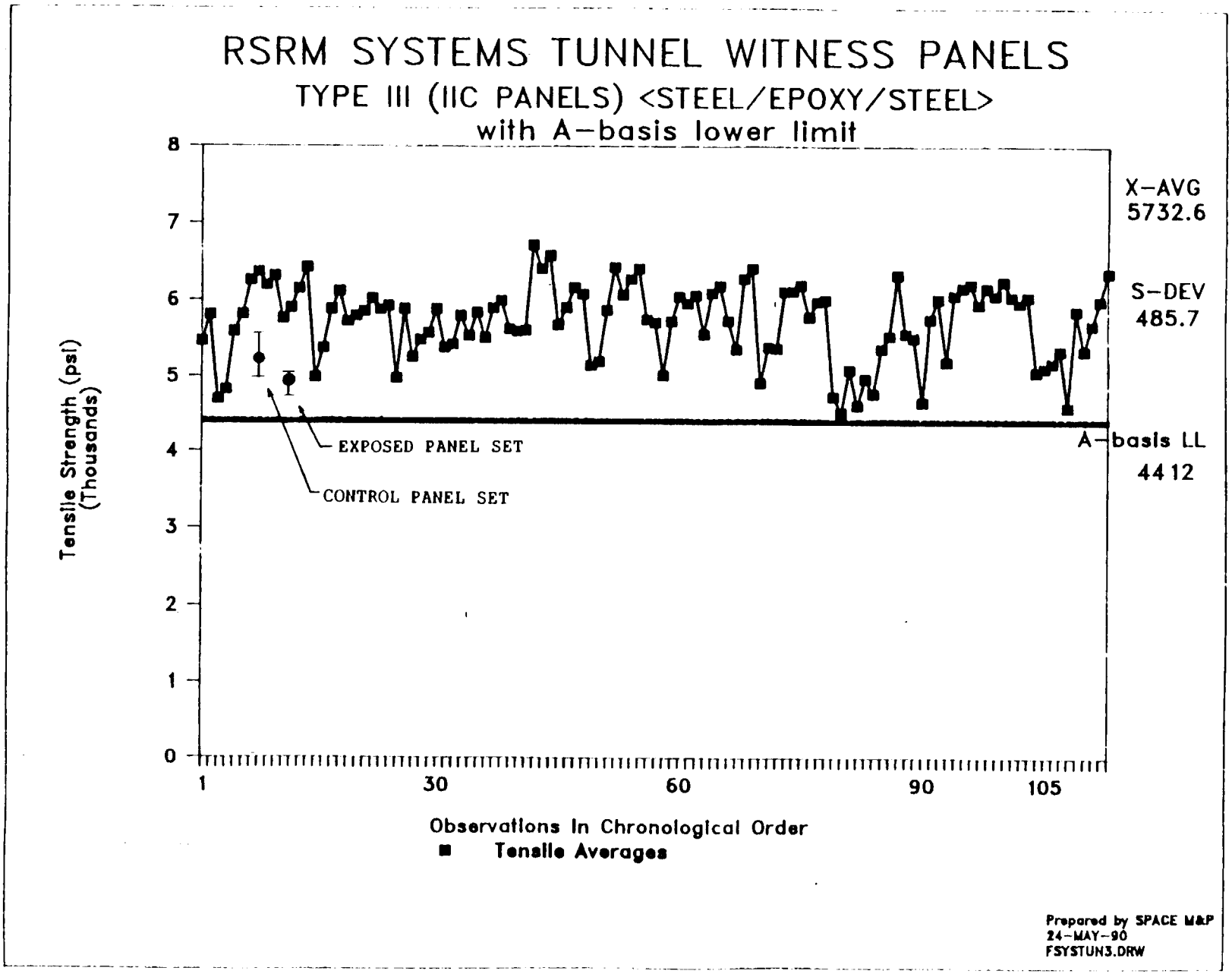
- There was a slight difference in the bond strengths of the two sets of panels
  - The exact physical cause of this difference is not known
- The panel to panel standard deviations were very small for these two data sets in comparison to the systems tunnel witness panels
  - Control set panel to panel standard deviation was 224 psi (cv 4.3%)
  - Exposed set panel to panel standard deviation was 130 psi (cv 2.7%)
  - System tunnel witness panel to panel standard deviation is 486 psi (cv 8.5%)
    - This is near the anticipated coefficient of variation of the data used in determining the pass/fail criteria
  - Recalculating "t" using the CV from the systems tunnel witness panel database (8.5%) produces an acceptable condition, $t = 1.24$
  - The exposed panels and control panels were tightly controlled and produced unexpectably low bond strength variations from panel to panel
- The statistical pass/fail criteria was not met because we underestimated the discriminatory capability of the test

EXPOSED PANEL SET	TENSILE ADHESION (psi)	STANDARD DEVIATION (psi)	COEFFICIENT OF VARIATION (percent)	*FAILURE MODE* ADHESIVE (percent)	COHESIVE (percent)
PANEL A	4748	709	14.9	10	90
PANEL B	5044	359	7.1	5	95
PANEL C	4800	479	10	13	88
PANEL D	5008	557	11.1	4	96
PANEL E	4954	218	4.4	4	96
AVERAGE	4911	130*	2.7*	7.2	93
CONTROL PANEL SET					
PANEL F	5583	268	4.8	1	99
PANEL G	5242	675	12.9	6	94
PANEL H	5327	603	11.3	7	93
PANEL I	4999	521	10.4	5	95
PANEL J	5103	537	10.5	5	95
AVERAGE	5251	224*	4.3*	4.8	95.2
SYSTEMS TUNNEL WITNESS PANELS					
AVERAGE	5733	486*	8.5*	0	100
A-BASIS LOWER LIMIT	4412				

* Standard deviation (or coefficient of variation) of the panel averages.

Why the data indicates an acceptable condition

- The individual panel average tensile strength values obtained for both the control set (4999, 5103, 5242, 5327, 5583 psi) and the exposed set (4748, 4800, 4954, 5008, 5055 psi) exceed the lower A-basis limits (4412 psi) of the closest comparable database (systems tunnel witness panels)
    - This database was earlier discounted for comparison
        - It was felt that the silane primer adhesion promoter would greatly bias the database by increasing bond strength
        - Lab studies have shown that the cleaner a bond surface is the less the improvement in bond strength can be obtained with the use of silane primer
        - The control and exposed test panel sets exhibited excellent cleanliness and as a result the bond strengths, without silane primer, were very good


RSRM SYSTEMS TUNNEL WITNESS PANELS
TYPE III (IIC PANELS) <STEEL/EPOXY/STEEL>
with A-basis lower limit
Tensile Strength (psi)
(Thousands)
8
7
6
5
4
3
2
1
0
X-AVG
5732.6
S-DEV
485.7
A-basis LL
4412
EXPOSED PANEL SET
CONTROL PANEL SET
1
30
60
90
105
Observations In Chronological Order
Tensile Averages
Prepared by SPACE M&P
24-MAY-90
FSYSTUN3.DRW

Summary

- The pass/fail criteria was not met because the discriminatory capability of the test was underestimated
- The individual average tensile strength values for the exposed panels all exceed the A-basis lower limit of the systems tunnel witness panel database

Conclusions

- The results of the witness panel tensile tests conducted per CTP-0142 Revision B are technically acceptable
- The total data package accumulated per CTP-0142 Revision A and CTP-0142 Revision B verify that the M-52 spray booth is acceptable for spraying domes

- Write a memo which documents the proposed changes to the pass/fail criteria established in the TRR. (CTP-0142, Revision B)
  - All TRR board members will sign-off on this memo, documenting their acceptance of the changes to the pass/fail criteria.
  - Pass/Fail Criteria

    Pass:
    If the exposed panels averages are above the systems tunnel witness panel database A-basis lower limit,

    - or -

    If the exposed panel set does not have a significantly lower tensile adhesion bond strength than the control panels at the 95% confidence level.

    Fail:

    If any of the exposed panel averages fall below the systems tunnel witness panel database A-basis lower limit,

    - and -

    The exposed panel set has a significantly lower tensile adhesion bond strength than the control panels at the 95% confidence level.

- Certify the M-52 spray booth acceptable for spraying forward and aft domes based on the testing conducted per CTP-0142 Revision A, CTP-0142 Revision B, and based on the TRR board memo.

DISTRIBUTION

Recipient	No. of Copies	Mail Stop
Print Crib	5	Q51B1
R. Papasian	40	E62A
N. Black	1	L71
L. Manuel	2	L71
F. Miller	3	L72B
B. Howard	3	337A
R. Furrows	1	L72
K. Wilks	1	E63
J. Seiler	1	L72
S. Marsh	1	E63
J. Jeppsen	1	693
L. Siedner	1	693
V. Fitch	1	L62
F. Baugh	1	L62
T. Lewis	1	565
P. Petty	1	L10
D. Call	1	692
K. Lowry	1	695
R. Marrs	1	L90
C. Herrick	1	887A
C. Whitworth	1	L90
S. Mildenhall	1	L90
D. Earl	1	692
Data Management	5	L72B