Illinois Department of
Public Health

John R. Lumpkin, M.D., M.P.H., Director

525-535 West Jefferson Street • Springfield, Illinois 62761-0001

#903149501

March 4, 1996

Mr. Dennis Garber, Principal
Hoffman Estates High School
1100 West Higgins
Hoffman Estates, IL 60195

Dear Mr. Garber:

The Illinois Department of Public Health (IDPH) conducted an evaluation of indoor air quality (IAQ) at the Hoffman Estates High School in Hoffman Estates, Illinois, from February 2 through February 9, 1996. This evaluation used Ventilation Efficiency Monitoring Systems (VEMS) manufactured by Telaire for continuous air monitoring to measure temperature (°F), relative humidity (%RH), and carbon dioxide (CO_2) levels. A Q-trak instrument (model #8551) manufactured by TSI, Inc. was set up in the art department which measured for the above mentioned constituents and carbon monoxide (CO). The graphs generated from the continuous sampling are attached. To help interpret the VEMS graphs, the line marked with a diamond symbol represents the temperature over the sampling period. The line marked with a square symbol represents the level of carbon dioxide and the line marked with a triangle symbol represents relative humidity. The maximum, minimum, and average values over the sample period are shown in the lower left corner of the graph.

The purpose of this sampling was to determine if the heating, ventilation, and air conditioning (HVAC) system was operating properly. A properly designed HVAC system provides thermal comfort; distributes adequate amounts of outdoor air to meet ventilation needs of all building occupants; and isolates and removes odors and contaminants through pressure control, filtration, and exhaust fans. Acceptance of the thermal environment and the perception of comfort and temperature are related to metabolic heat production, its transfer to the environment, and the resulting physiological adjustments and body temperatures. The heat transfer is influenced by the environmental factors of air temperature, thermal radiation, air speed, humidity, and by the personal factors of activity and clothing. Because of individual differences, it is impossible to specify a thermal environment that will satisfy everyone. The purpose of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) standard is to specify a thermal environment that is acceptable to at least 80% of the occupants. ASHRAE defines acceptable indoor air quality as air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

Since CO_2 is a normal constituent of exhaled breath, measurements can be used to determine if the quantity of outdoor air that is being delivered to occupants is adequate. CO_2 is produced by human respiration and can be reduced significantly only by ventilation of the building. The concentration of CO_2 in indoor air is, therefore, closely related to the ventilation rate. The degree of ventilation needed to maintain CO_2 at a low level within a building also helps to reduce the levels of other indoor pollutants and to improve overall indoor air quality. High concentrations of CO_2 indicate that outside air is not being adequately supplied to the building to mix with recirculated air. If indoor CO_2 concentrations are more than 1000 parts per million (ppm), complaints such as headaches, fatigue, and eye, nose and throat irritations may be anticipated. The elevated CO_2 concentration itself is not responsible for the complaints; however, high CO_2 concentrations are indicative of stale, stagnant air, which does contribute to occupant complaints.

The ASHRAE *Ventilation for Acceptable Indoor Air Quality* (62-1989) recommends the amount of outdoor air that should be supplied to buildings. These guidelines are recognized throughout the country and some states have adopted these guidelines into legislation. These guidelines recommend that school classrooms be supplied with 15 cubic feet per minute (CFM) of outside air per person. This volume of make-up air roughly corresponds with a CO_2 concentration of 1000 ppm. All of the rooms tested had CO_2 levels well below the recommended 1000 ppm level. The graphs for the English Department and Girl's Locker room indicated a maximum level of CO_2 above 1000 ppm. These high levels occurred when the equipment was turned on and it was in the process of stabilizing. They are not an indication of the actual CO_2 level.

Relative humidity is also routinely sampled in indoor air investigations. Relative humidity exerts a powerful effect on building inhabitants. The direct consequence of high humidity is discomfort. Highly saturated warm air reduces the body's ability to lose heat, and can increase levels of body odors. Olfactory sensitivity to odors increases with increased humidity, as do off-gassing and the desorption of gases for some building materials. The chief problem with high indoor humidity (above 60%) from a health standpoint, however, is the potential for increased microbial buildup. Low humidity creates its own problems. Dry air can dehydrate skin and mucous membranes, leading to irritation of sensitive areas. The upper nose and throat airways are responsible for the humidification and warming of air breathed into the respiratory system. Many indoor pollutants are exacerbated by lower humidity. Recent studies have found higher rates of nasal, eye, skin, and mucous membrane symptoms, lethargy, and headaches in low relative humidity environments. Occupants who wear contact lenses often have problems with low relative humidities, due to lenses irritating the eyes from lack of moisture. The ASHRAE 62-1989 Ventilation Standard recommends that relative humidity be maintained between 30% and 60%. Relative humidity is often considered a major controlling factor for indoor allergens. Control of relative humidity in occupied space and in the HVAC system is an important part of allergen control in buildings. The relative humidities found during the sampling could be part of the reason for occupant discomfort. The average relative humidities found in each area were below 20%.

In general, the classroom temperatures were maintained within the comfort zone recommended by ASHRAE (*Thermal Environmental Conditions for Human Occupancy* 55-1992). During the heating season, the ASHRAE thermal comfort range is from about 68 to 74 degrees Fahrenheit (°F). Slightly elevated temperatures were shown during the continuous sampling in the girl's

locker room, training room, and media center. The special education room averaged 66°F, which is slightly cooler that recommended. The special education room and the art department had wide variations in temperature, ranging from 59 to 77°F.

Carbon monoxide (CO) was indicated as a concern due to the bus exhaust odor. The exhaust emissions from a diesel engine, found in 98% of the buses at Hoffman Estates High School, consist of gases and particulates (soot). The gaseous form of the exhaust contains carbon monoxide, oxides of sulfur and nitrogen, and unburned or partially burned hydrocarbons. Some people will not experience any serious health effects when exposed to CO at very low levels, typically considered one to 15 ppm. Symptoms of CO poisoning become progressively worse the longer an individual is exposed or the higher the concentration of CO in the air. Initial signs include headache or dizziness. Later symptoms include tightness in the chest and nausea. The extent to which anyone is affected by exposure to CO depends on physiology, exercise, and exposure patterns, those persons with conditions of pre-existing oxygen-debt (e.g.: anemia, asthma, angina, and the unborn) and heart disease, as well as smokers are among those at greater risk of CO exposure. According to ASHRAE a concentration of no more than 9 ppm of CO is permissible in residential living spaces. The Occupational Safety and Health Administration (OSHA) has set a work place eight-hour time weighted average of 35 ppm. The CO levels monitored in the art department classroom indicated an average concentration of 0.21 ppm, with a maximum of 3 ppm.

Based on our sampling, our observations and conversations, and the concerns of the building occupants, IDPH recommends the following:

1. The frequently touted "fresh air" solution to indoor air problems can become a source of humidity problems. Additional outdoor air requires additional treatment and additional loads for both heating and cooling cycles. Infiltration, either by design or by accident, adds to humidity discomfort. Building "tightness" can help mitigate the effects of extremely dry outdoor air. Humidification of dry air becomes a double-edged IAQ problem. Some argue that humidification reduces risks of irritation and possible infection, while others maintain that humidification systems can become sources of bacterial and fungal buildup. From a health standpoint, the latter argument is of most concern because increased microbial growth can lead to more serious potential health effects. HVAC systems struggle to maintain acceptable indoor conditions during extreme outdoor temperatures. Solutions may be to ask for patience when temporary extreme conditions exist.

2. Activate the HVAC system earlier in the day to help stabilize temperatures before the building is occupied. This will reduce the fluctuations in temperature variations.

3. To help control various odors (diesel exhaust, kitchen, auto mechanics, art) from dissemination: remove odor sources, raise or move exhaust stacks, move air intakes, balance the HVAC system, keep building under positive pressure, use local exhaust of contaminants, or provide additional dilution air. An HVAC contractor may need to be consulted to inspect the system to improve air distribution and mixing. Ventilating systems should be designed to prevent re-entrainment of exhaust contaminants. Makeup (outdoor) air inlets and exhaust air outlets shall be located to avoid contamination of the makeup air. The buses may be moved further north, away from outdoor air intakes.

Also, CO monitors can be placed in hallways and rooms of concern to monitor the actual levels in those areas. This may help alleviate some of the occupants fears of CO exposure. Although, if levels of CO are lower than that which would cause health concerns, occupants may still be effected by odor of exhaust. (For additional information, a fact sheet on CO is attached)

4. For individuals who are sensitized to various allergens that may be brought into the building through the outdoor air intakes and/or exacerbated by the low humidity, they may find some relief by using portable air cleaners. Personal humidifiers may be attempted to be used for relief from low humidity, but caution should be used so these units will not cause a more harmful situation to building occupants due to possible microbial problems. (Please find attached information on humidifiers and air cleaners)

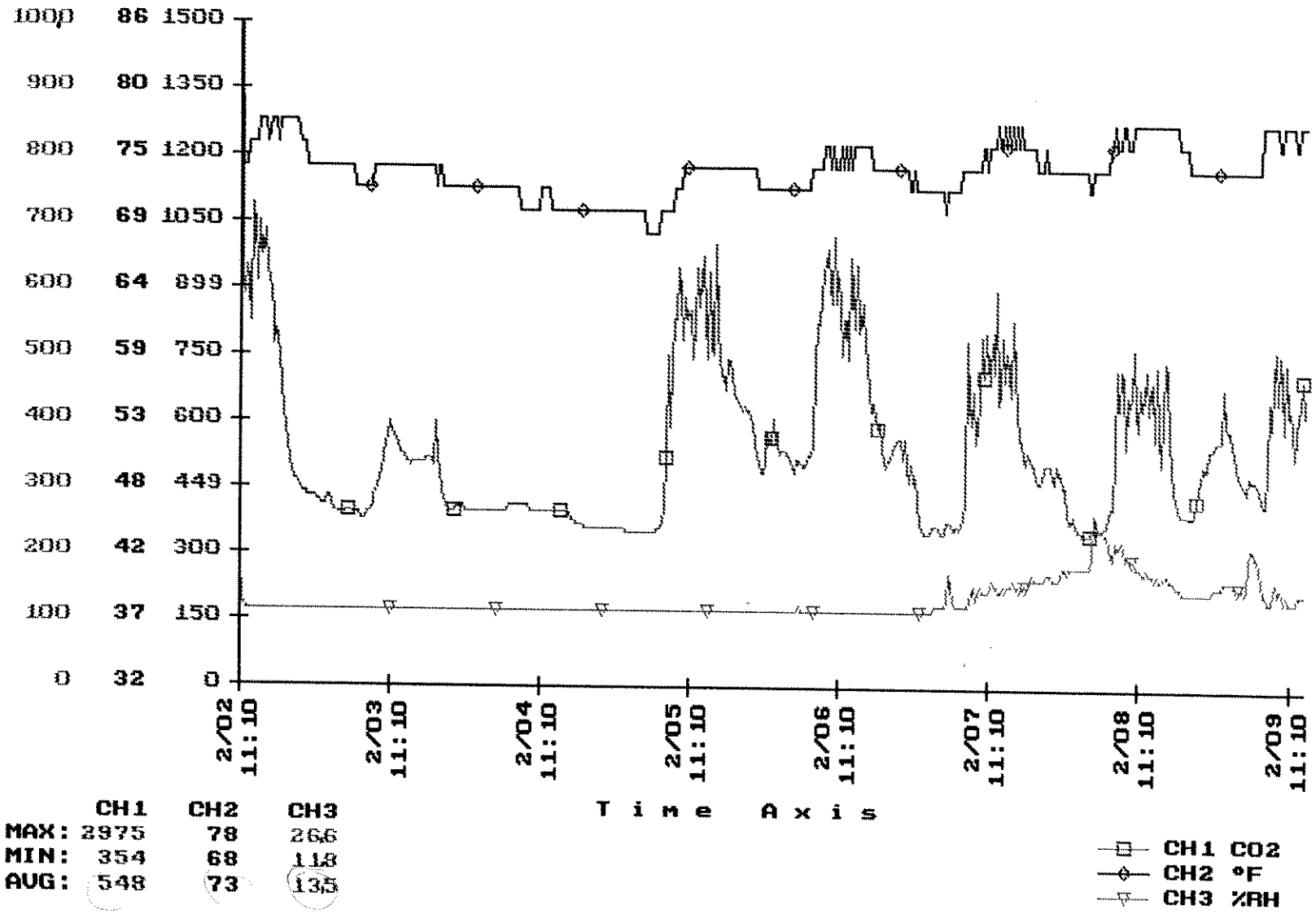
Further sampling can be conducted if complaints and adverse health effects continue. Please contact me if problems persist. If you have any questions or require additional information, feel free to contact me at (217) 782-5830.

Sincerely,

Monica J. Rebbe
Environmental Toxicologist

Attachments
cc: IDPH W. Chicago Regional Office

Hoffman Estates High School
Girl's Locker Room
File: 9660 February 2, 1996 11:10



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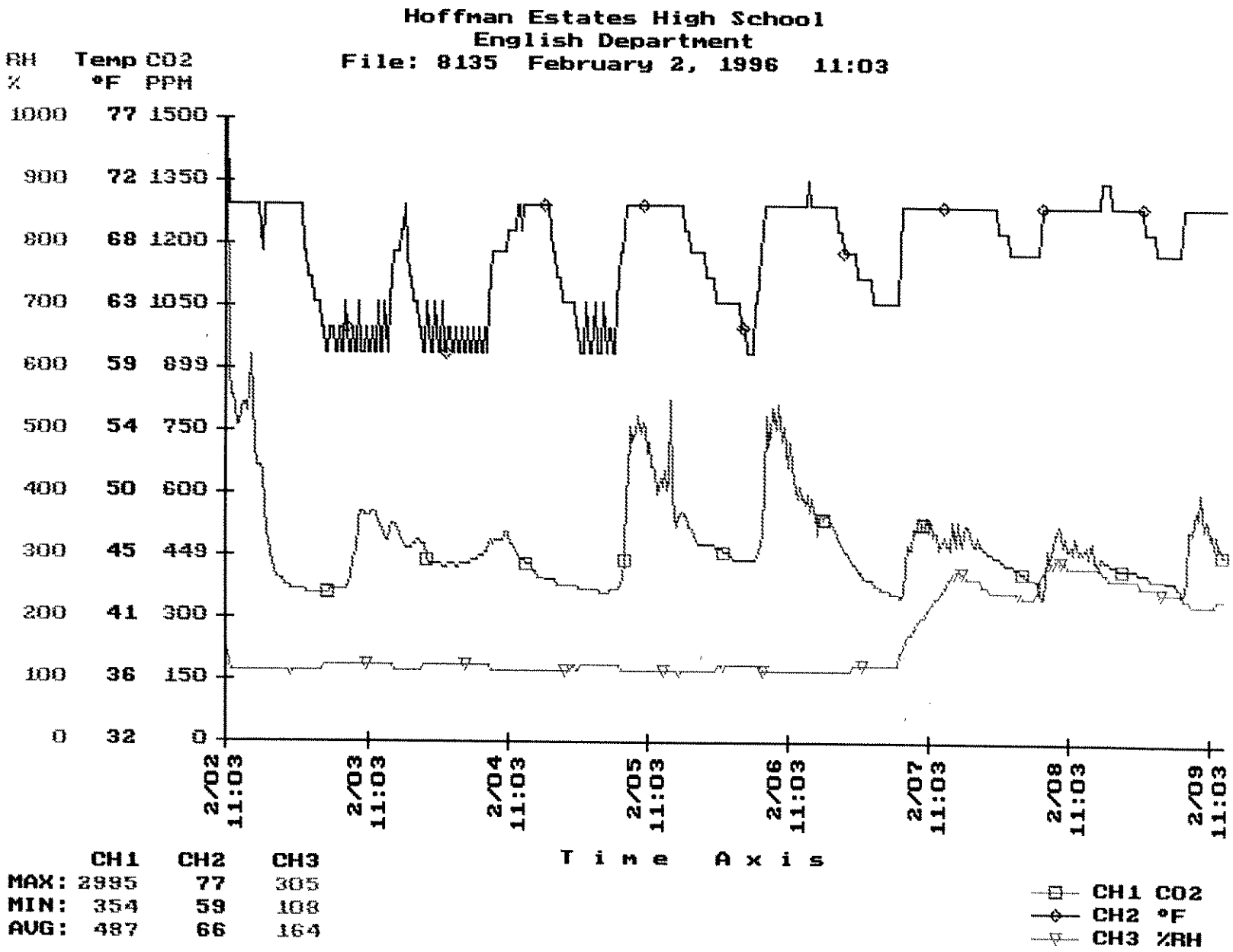
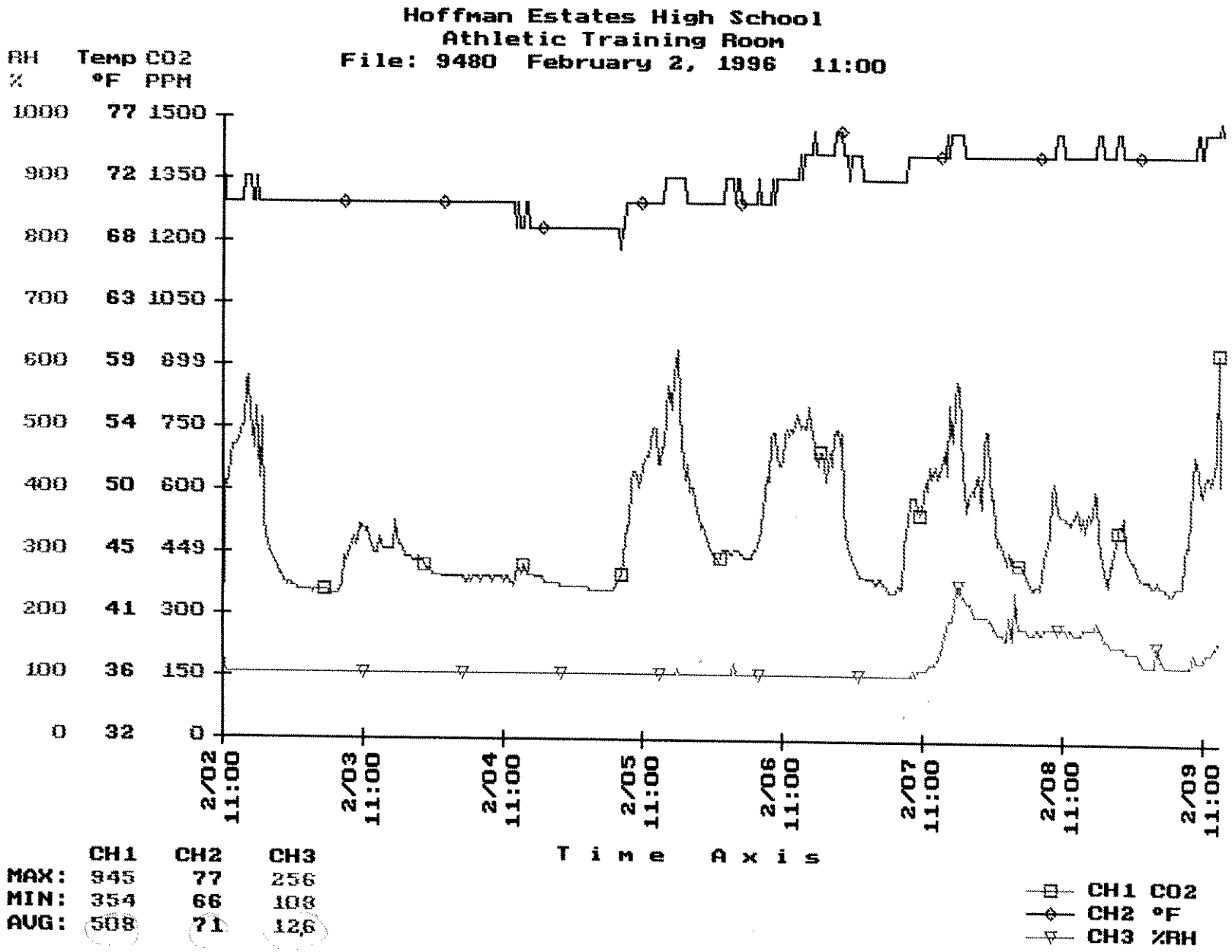
MIN:	354	68	11.8
AVG:	548	73	13.5


Hoffman Estates High School
English Department
File: 8135 February 2, 1996 11:03
RH % Temp °F CO2 PPM
1000 77 1500
900 72 1350
800 68 1200
700 63 1050
600 59 899
500 54 750
400 50 600
300 45 449
200 41 300
100 36 150
0 32 0
2/02 11:03
2/03 11:03
2/04 11:03
2/05 11:03
2/06 11:03
2/07 11:03
2/08 11:03
2/09 11:03
Time Axis
CH1 CH2 CH3
MAX: 2995 77 305
MIN: 354 59 108
AVG: 487 66 164
CH1 CO2
CH2 °F
CH3 %RH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Athletic Training Room
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RH % Temp °F CO2 PPM
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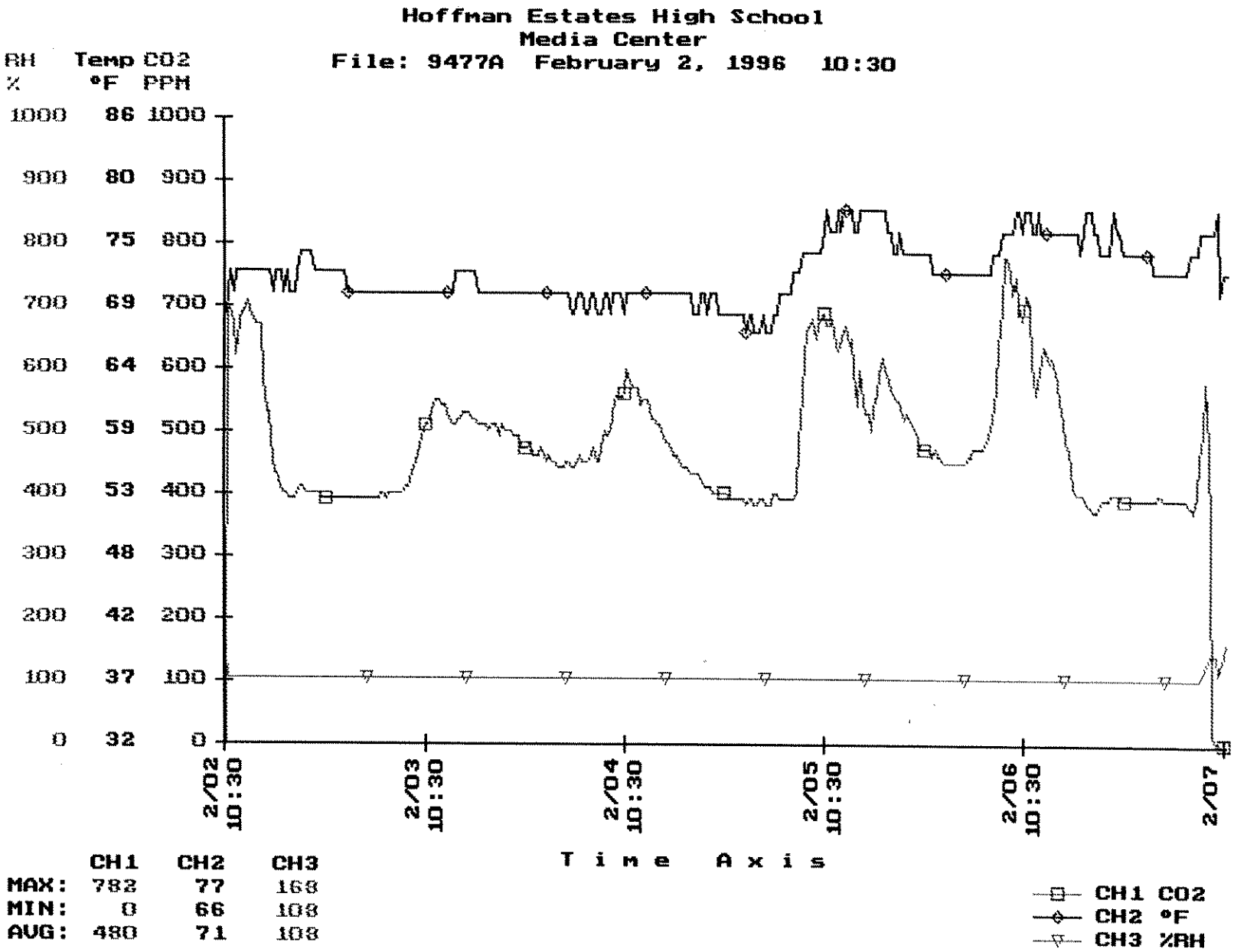
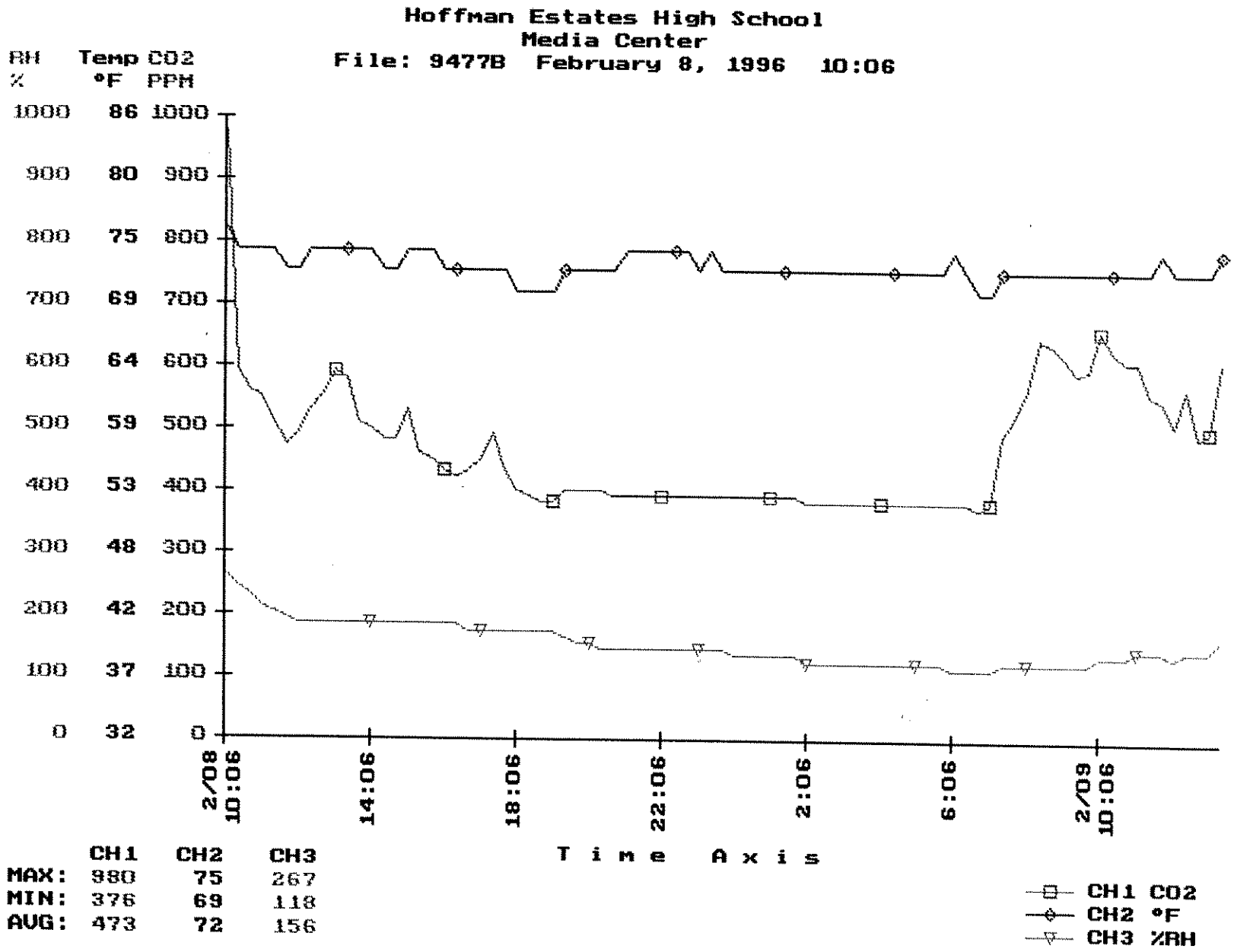
900 72 1350
800 68 1200
700 63 1050
600 59 899
500 54 750
400 50 600
300 45 449
200 41 300
100 36 150
0 32 0
2/02 11:00
2/03 11:00
2/04 11:00
2/05 11:00
2/06 11:00
2/07 11:00
2/08 11:00
2/09 11:00
Time Axis
CH1 CH2 CH3
MAX: 945 77 256
MIN: 354 66 108
AVG: 508 71 126
CH1 CO2
CH2 °F
CH3 %RH


Hoffman Estates High School
Media Center
File: 9477A February 2, 1996 10:30
RH % Temp °F CO2 PPM
1000 86 1000
900 80 900
800 75 800
700 69 700
600 64 600
500 59 500
400 53 400
300 48 300
200 42 200
100 37 100
0 32 0
2/02 10:30
2/03 10:30
2/04 10:30
2/05 10:30
2/06 10:30
2/07
Time Axis
CH1 CH2 CH3
MAX: 782 77 168
MIN: 0 66 108
AVG: 480 71 108
CH1 CO2
CH2 °F
CH3 %RH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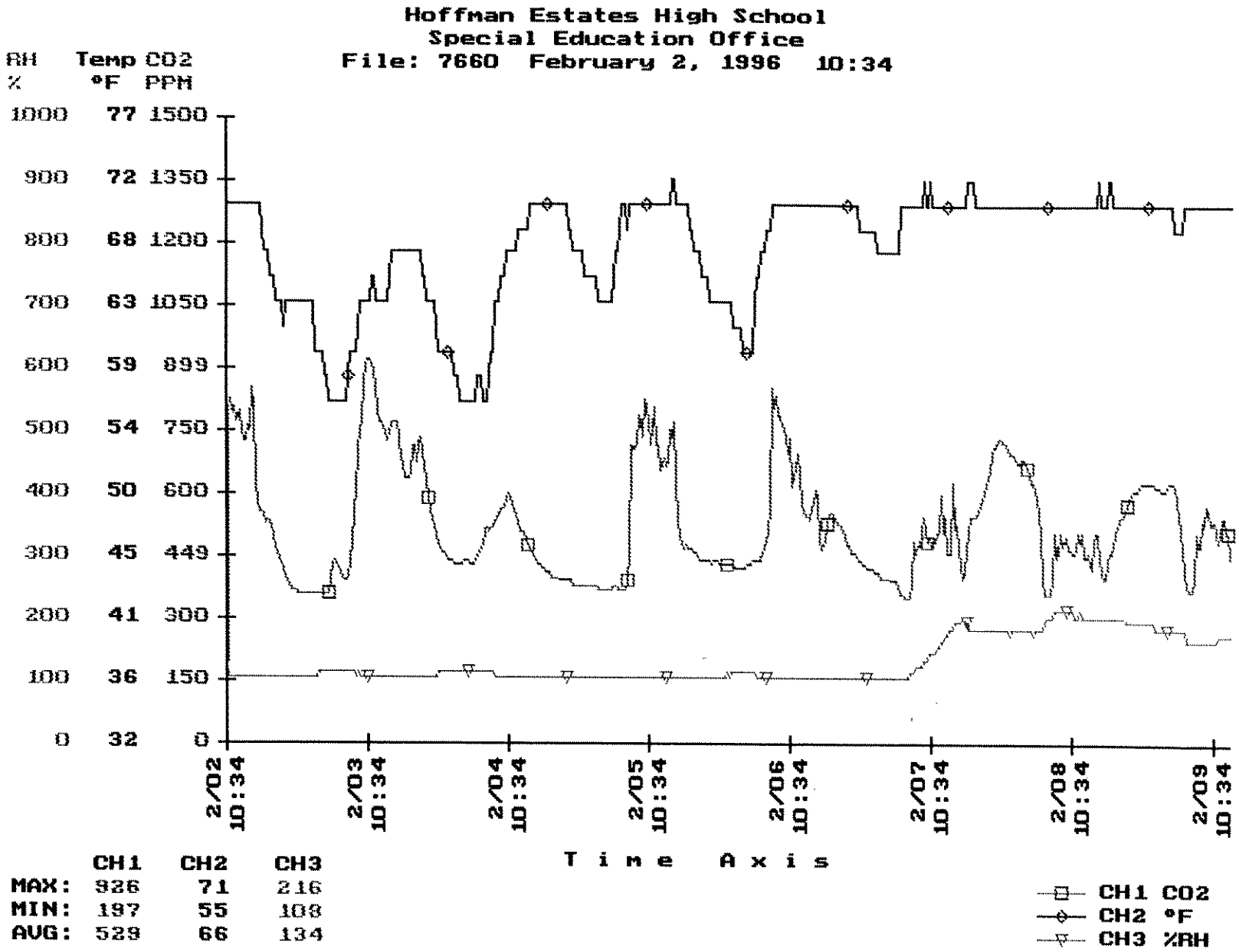
700 69 700
600 64 600
500 59 500
400 53 400
300 48 300
200 42 200
100 37 100
0 32 0
2/08 10:06
14:06
18:06
22:06
2:06
6:06
2/09 10:06
Time Axis
CH1 CH2 CH3
MAX: 980 75 267
MIN: 376 69 118
AVG: 473 72 156
CH1 CO2
CH2 °F
CH3 %RH


Hoffman Estates High School
Special Education Office
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RH % Temp °F CO2 PPM
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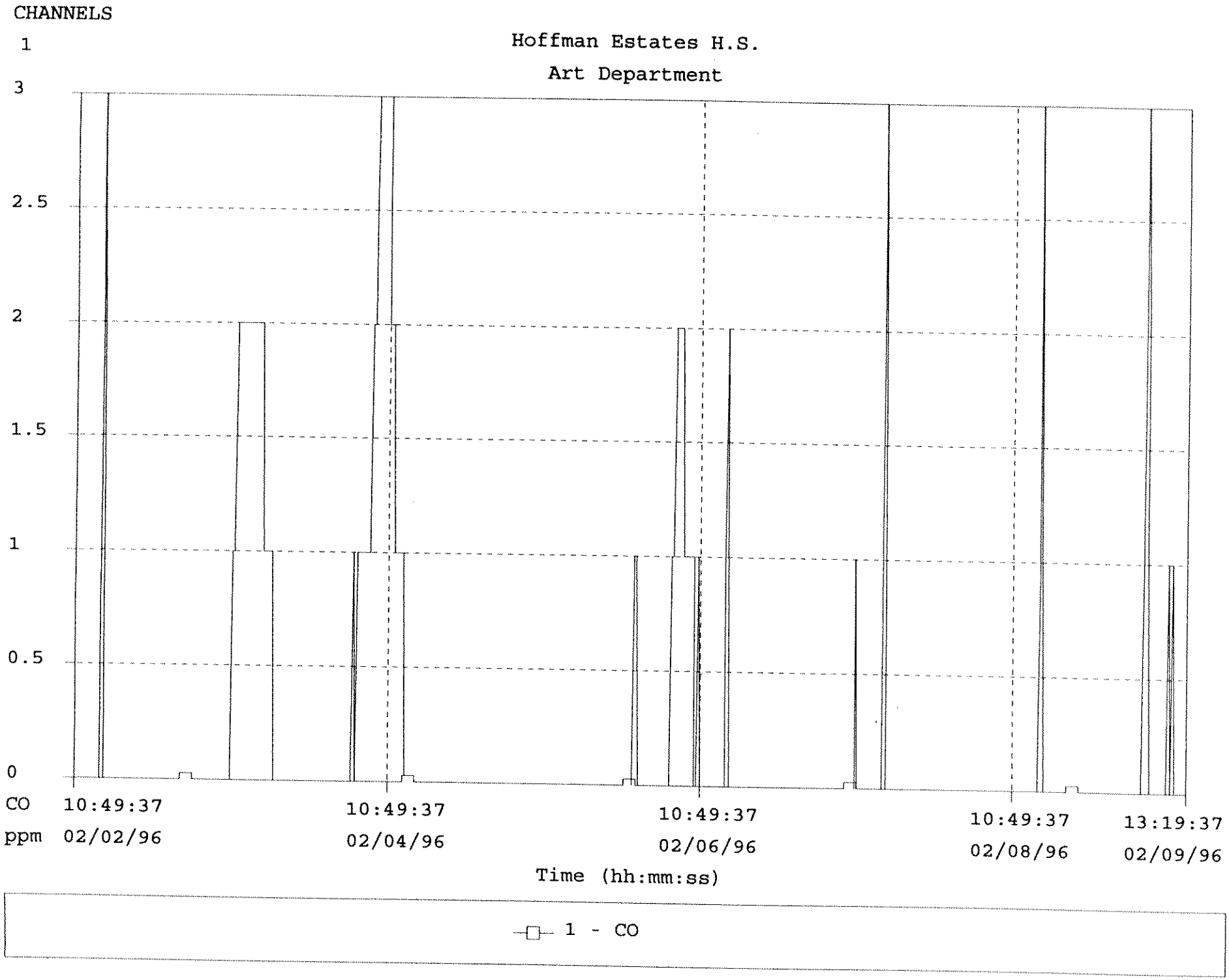
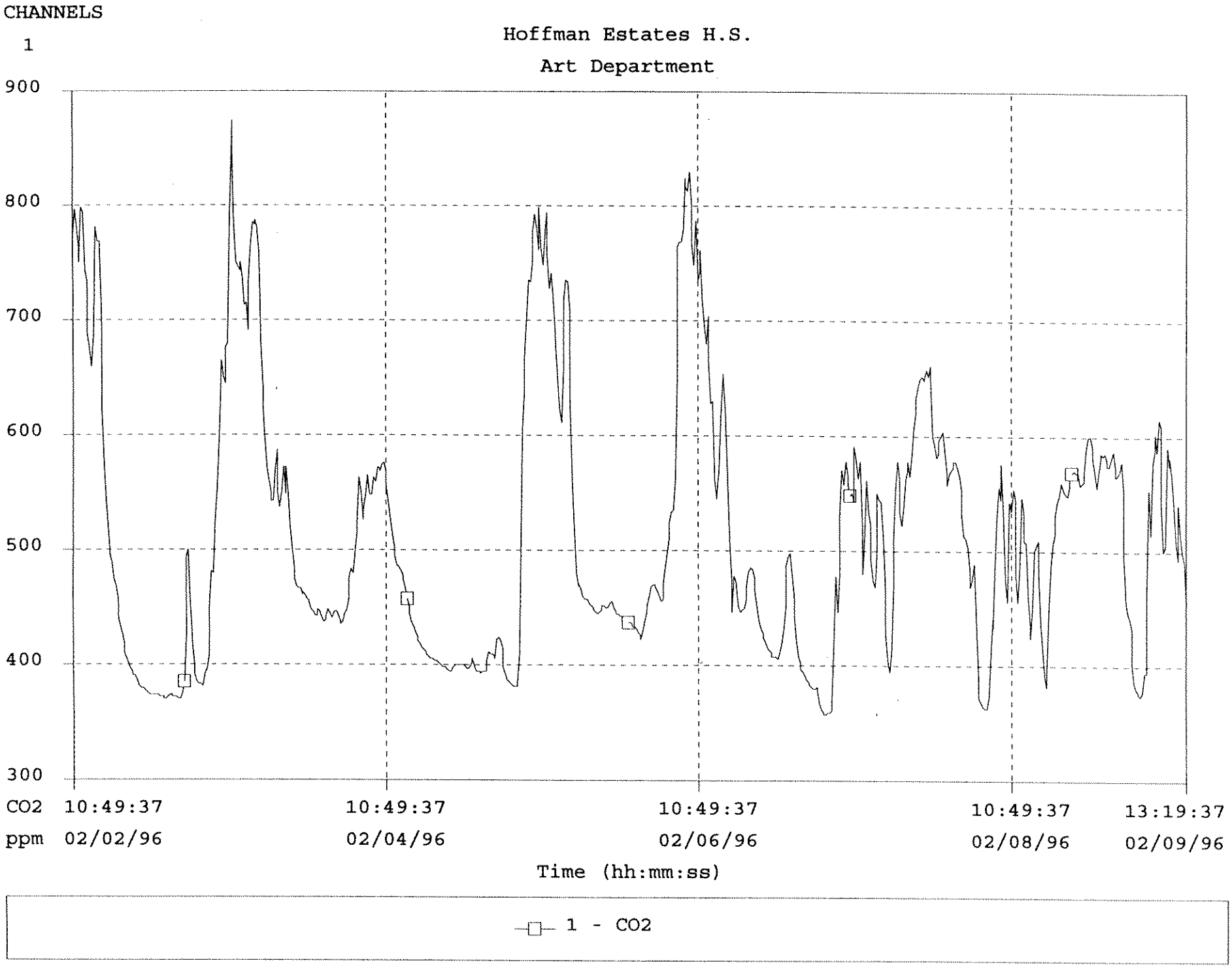
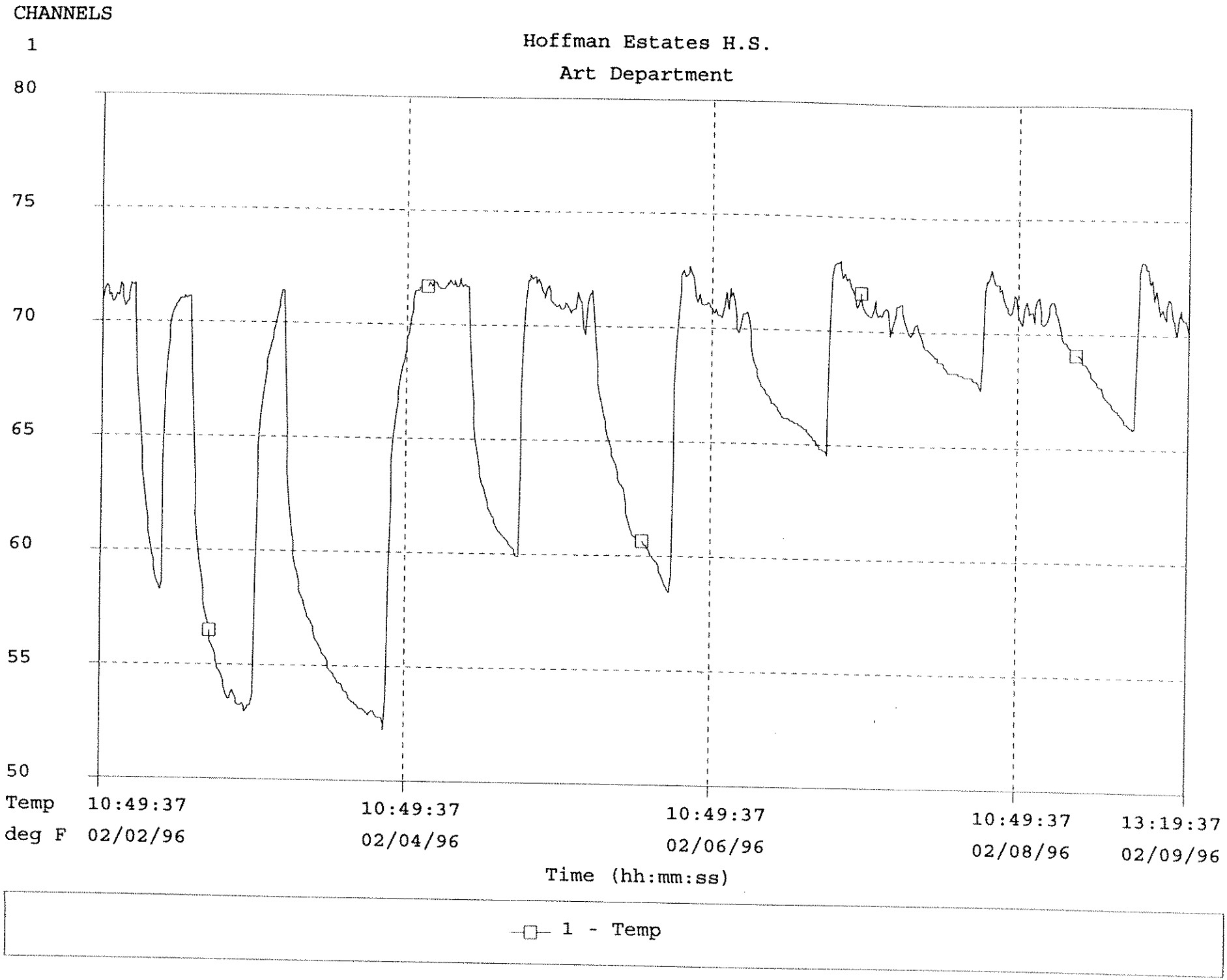
900 72 1350
800 68 1200
700 63 1050
600 59 899
500 54 750
400 50 600
300 45 449
200 41 300
100 36 150
0 32 0
2/02 10:34
2/03 10:34
2/04 10:34
2/05 10:34
2/06 10:34
2/07 10:34
2/08 10:34
2/09 10:34
Time Axis
CH1 CH2 CH3
MAX: 926 71 216
MIN: 197 55 108
AVG: 529 66 134
CH1 CO2
CH2 °F
CH3 %RH


CHANNELS
1
Hoffman Estates H.S.
Art Department
3
2.5
2
1.5
1
0.5
0
CO
ppm
10:49:37
02/02/96
10:49:37
02/04/96
10:49:37
02/06/96
10:49:37
02/08/96
13:19:37
02/09/96
Time (hh:mm:ss)
1 - CO


CHANNELS
1
Hoffman Estates H.S.
Art Department
900
800
700
600
500
400
300
CO2
ppm
10:49:37
02/02/96
10:49:37
02/04/96
10:49:37
02/06/96
10:49:37
02/08/96
13:19:37
02/09/96
Time (hh:mm:ss)
1 - CO2


CHANNELS
1
Hoffman Estates H.S.
Art Department
80
75
70
65
60
55
50
Temp
deg F
10:49:37
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10:49:37
02/04/96
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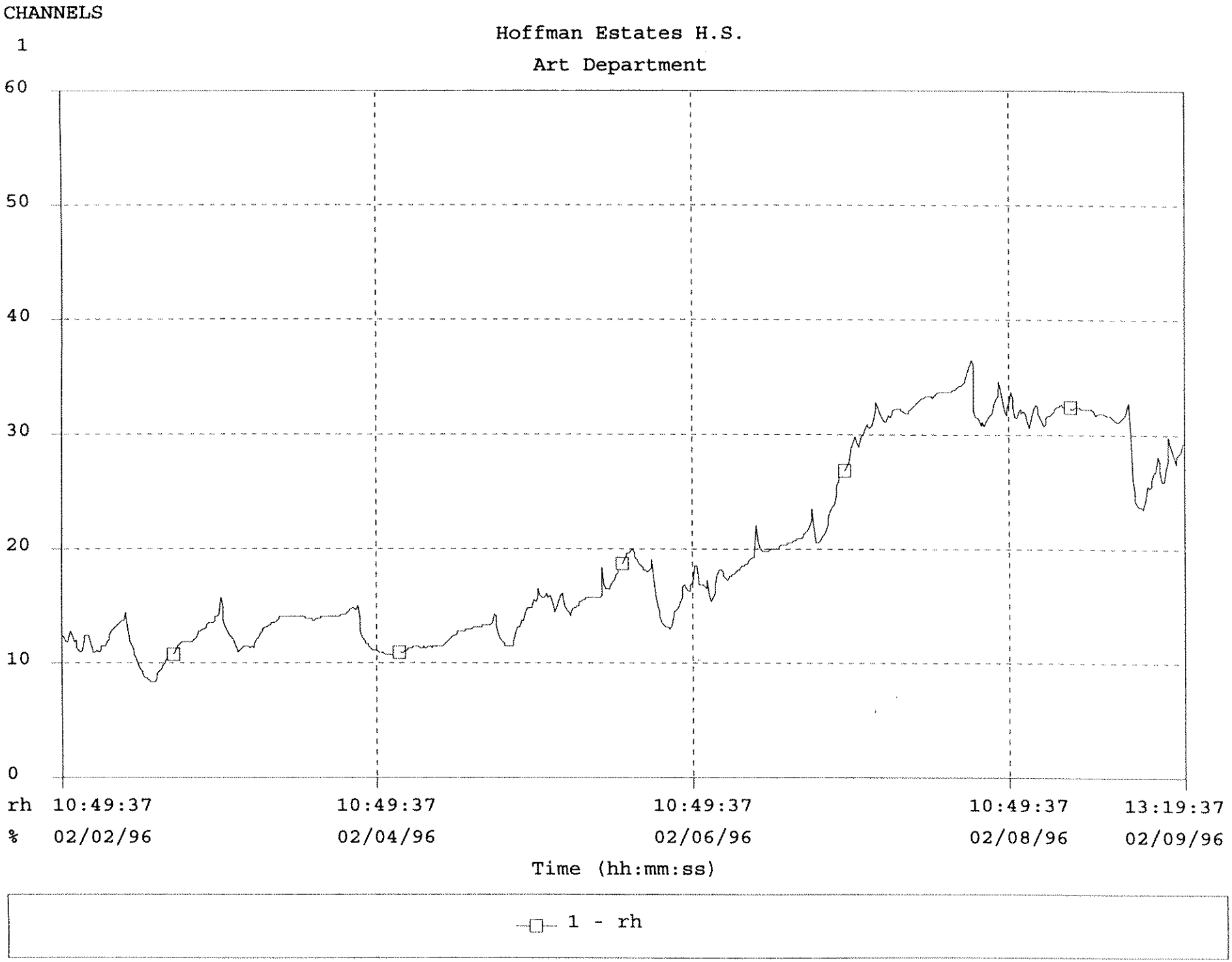
13:19:37
02/09/96
Time (hh:mm:ss)
1 - Temp


CHANNELS
1
Hoffman Estates H.S.
Art Department
60
50
40
30
20
10
0
rh
%
10:49:37
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10:49:37
02/04/96
10:49:37
02/06/96
10:49:37
02/08/96
13:19:37
02/09/96
Time (hh:mm:ss)
1 - rh