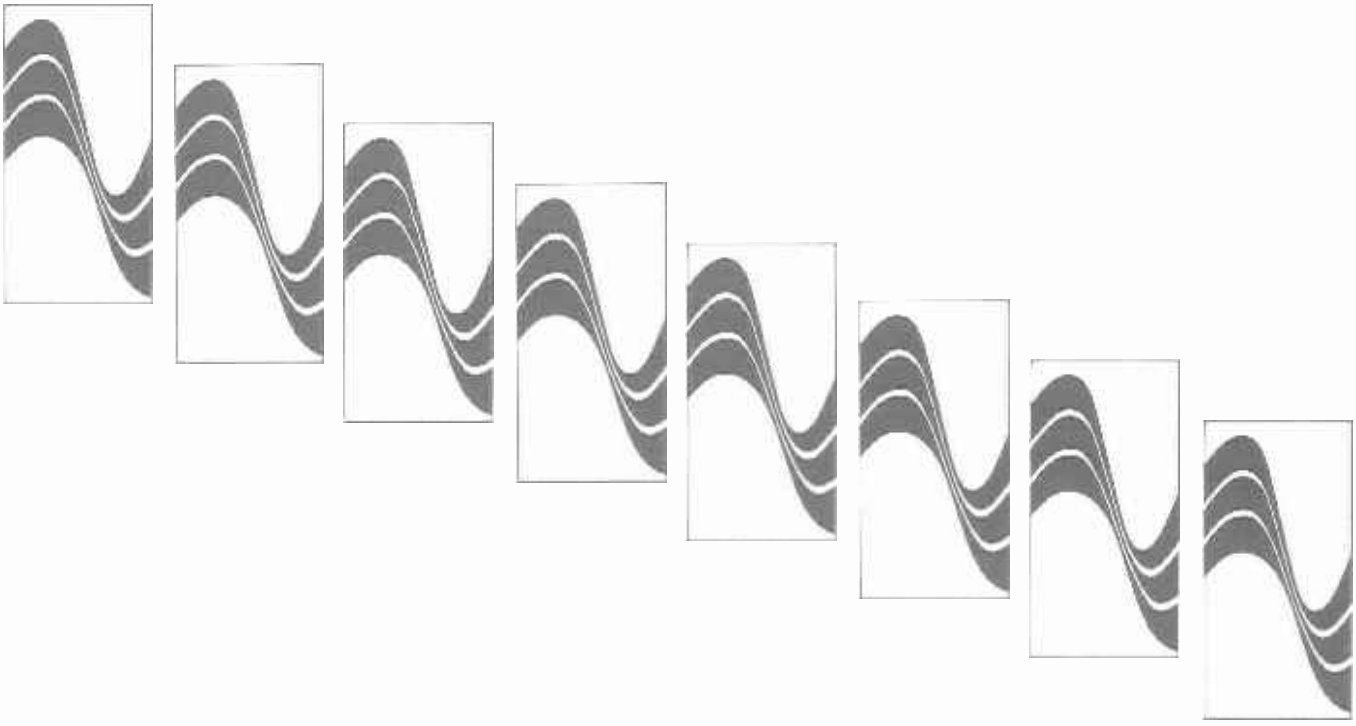

WILSON, IHRIG & ASSOCIATES, INC.

ACOUSTICAL CONSULTANTS

AN ASSESSMENT OF EXISTING AND PROJECTED NOISE AND VIBRATION LEVELS NEAR STUDIOS AND OTHER SENSITIVE FACILITIES ON SUNSET BOULEVARD

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

DRAFT REPORT
OCTOBER 1987

WILSON, IHRIG & ASSOCIATES, INC.
ACOUSTICAL CONSULTANTS

5776 BROADWAY
OAKLAND, CA
U.S.A. 94618
(415) 658-6719

AN ASSESSMENT OF EXISTING AND PROJECTED NOISE AND VIBRATION LEVELS NEAR STUDIOS AND OTHER SENSITIVE FACILITIES ON SUNSET BOULEVARD

DRAFT REPORT
for the
Southern California Rapid Transit District

October 5, 1987

Submitted to:

Mr. Nadeem Tahir, Planning Manager
Metro Rail Project
Southern California Rapid Transit District
425 South Main Street
Los Angeles, California 90013

John C. Shearer
Senior Consultant

Steven L. Wolfe
Project Manager

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This report presents the results of an analysis of existing noise and vibration levels near representative radio and television studios, and other noise-sensitive facilities, that may be impacted by transit train operations on the proposed Metro Rail Sunset Boulevard Alignment. The prime purpose of this analysis was to determine the effectiveness of the existing building constructions at these facilities in reducing noise from existing vehicular traffic on Sunset Boulevard, and to compare existing exterior and interior noise and vibration levels with projected noise and vibration levels from train passbys. To this end, simultaneous exterior and interior noise and vibration measurements were taken at the following locations on 8 and 10 September 1987:

- KTTV Channel 11 (Stage 6 and Stage 7)
- KMPC AM Studios (Control Room B and Production Studio)
- KWHY Channel 22 (Studio A and Studio B)
- KTLA Channel 5 (Stage 9)
- The Self Realization Fellowship Premises (Meeting Area and Temple)

Exterior and interior noise and vibration measurements were also taken at the CBS Studios (Stage 22 and Stage 23) on 18 August 1987. The results of those measurements were presented in our letter to SCRTD dated 31 August 1987.

As part of this investigation, noise and vibration measurements were also taken at the following facilities, which are located near, and co-exist with, existing rapid transit systems in other cities, during the period 15-17 September 1987:

- The Cedars Medical Center, Miami
- The South Miami Hospital
- The Silvercup Recording Studios, New York City
- The ABC (WLS-TV) Studios in Chicago

This report presents the results of measurements taken in September 1987 and a discussion of their implications.

1. SUMMARY

The investigation resulted in the following conclusions.

1.1 Most studios along Sunset Boulevard that we visited, including the CBS Studios (Stage 22 and Stage 23), KTTV Channel 11 (Stage 6) and the KMPC AM and FM Studios (apart from the AM Production Studio), have a high degree of sound isolation from existing road traffic noise. In these studios we expect that noise from train operations on the proposed Metro Rail Sunset Boulevard Alignment will be inaudible and will not affect audio pickup or recording in the studios.

1.2 In studios and other noise-sensitive facilities along Sunset Boulevard where traffic noise is currently audible, such as the KMPC AM Production Studio, KWHY Channel 22 (Studio A and Studio B) and the Self Realization Fellowship Premises, train noise may also be audible. However, the train passby noise levels inside these facilities will be less than from existing noisy vehicles, such as buses, trucks and motorcycles.

1.3 Groundborne vibration from train passbys will have no adverse impact on studio operations.

1.4 Our visits to studios and other noise sensitive buildings located next to rapid transit systems in Miami and Chicago have confirmed that neither train noise nor vibration has any adverse impact on these facilities.

2. SURVEY PROCEDURES AND BACKGROUND INFORMATION

At all locations, apart from the Silvercup Recording Studios in New York City (where only exterior measurements were obtained), simultaneous exterior and interior noise measurements were taken using two sets of the field instrumentation shown in Figure 1. Each set comprised a precision Nagra IV SJ tape recorder, which was used to record airborne noise on channel 1 and ground or floor vibration on channel 2. The interior measurements were generally taken in the center of the studio or room in question (with the area unoccupied and access doors closed, where possible), while the exterior measurements were taken outside the closest part of the building to Sunset Boulevard (in Hollywood), or the closest part of the building to the existing rapid transit system (in other cities). Photos of all measurement locations are presented in Appendix A, while a glossary of acoustical terms is provided in Appendix B.

The noise and vibration data were subsequently analyzed in the WIA laboratory using a GenRad 1/3 octave band real time analyzer interfaced to a DEC PDP-11/35 Minicomputer. Strip charts showing time-histories of the A-weighted (dBA) noise levels, and of the overall vibration velocity levels, were also obtained from each recording, as indicated in Figure 1.

The field measurements were generally taken over periods ranging from 20 to 45 minutes, long enough to give statistically meaningful samples. However, on two occasions (at KTTV Channel 11, Stage 6 and KTLA Channel 5, Stage 9), samples of only five minutes duration were obtained due to the limited time that these studios were available to us.

3. NOISE MEASUREMENT RESULTS

3.1 KTTV Channel 11, Los Angeles

Measurements were taken in Stage 6 and Stage 7 at the KTTV Channel 11 complex at 5746 Sunset Boulevard during the morning of Tuesday, 8 September 1987. As noted earlier, a sample of only five minutes duration was obtained in Stage 6, due to the time constraints. However, a 45 minutes long sample was taken in the adjacent Stage 7. Simultaneous exterior recordings were made on the sidewalk in front of the studio building, next to Sunset Boulevard.

Although both Stages are located relatively close to Sunset Boulevard, we noted that traffic noise was generally inaudible in these areas. Figure 2 shows A-weighted time histories of both the exterior and the interior noise during a representative four minute section of our measurement in

Stage 7. The noise outside the building exhibits wide fluctuations in level due to traffic on Sunset Boulevard while the interior noise is relatively constant, confirming that there is little, if any, correlation between the interior and exterior noise levels.

Figures 3 and 4 show the A-weighted exterior and interior octave band noise levels that were exceeded 1% and 10% of the time (L_1 and L_{10}, respectively). (A discussion of the significance of statistical levels, including L_1 and L_{10}, is provided in Appendix B.) The spectra have been A-weighted to show the relative contributions of the octave band levels to the overall A-weighted noise levels (which are shown on the right hand axis of each graph). Also shown are the estimated A-weighted octave band levels from a six-car train, at 40 ft distance, travelling at 55 mph on an aerial structure incorporating sound barrier walls.

The estimated train noise is less than the L_1 traffic noise level, but comparable with the L_{10} traffic noise. Thus, the maximum train passby noise will be less than that from existing noisy vehicles, such as trucks, buses and motorcycles. In addition, the A-weighted octave band spectra in Figures 3 and 4 show that the traffic noise levels at 63, 125, and 250 Hz are significantly higher than the estimated train passby noise levels in those octave bands. Because the airborne sound insulation provided by building structures is typically far greater in the higher frequency octave bands, this means that the overall exterior to interior noise reduction in dBA will be somewhat higher for train noise than for traffic noise. Thus, we expect that train movements will be inaudible inside Stages 6 and 7 at KTTV Channel 11.

3.2 The Self Realization Fellowship

The Self Realization Fellowship's facilities at 4886 Sunset Boulevard comprise a meeting, dining and administrative area located directly on Sunset Boulevard, and a temple which is set back approximately 100 ft from the roadway. Noise measurements of 20 minutes duration were taken inside the Meeting Area and inside the Temple during the early afternoon of Tuesday, 8 September 1987. Exterior measurements were taken on the sidewalk in front of the meeting/administration building.

Figures 5 and 6 show representative sections of the A-weighted time histories of both the exterior and interior noise and Figures 7 and 8 show the L_1 and L_{10} exterior and interior noise levels, in terms of the A-weighted octave band spectra. The estimated train passby noise levels are also shown in Figures 7 and 8.

These data confirm that interior noise levels from road traffic on Sunset Boulevard are relatively high inside the Meeting Area, due to its proximity to the roadway and the large window area facing the traffic. Noise levels inside the Temple are far lower, although traffic on Sunset Boulevard is, at times, audible.

We expect that train noise will be clearly audible inside the Meeting Area, although interior noise levels from train passbys will be less than from existing noisy vehicles, such as buses, trucks and motorcycles. Train passbys may be just audible inside the Temple, although, again, interior train passby noise levels will be less than from existing noisy vehicles.

3.3 KMPC AM Studios

The KMPC AM and KUTE FM Studios are located in a building facing Sunset Boulevard in front of the KTLA Channel 5 complex. A 20 minute measurement was taken inside Control Room B during the afternoon of Tuesday, 8 September 1987. A further reading, of 45 minutes duration, was taken inside the AM Production Studio on the morning of Thursday, 10 September 1987. On both occasions, simultaneous exterior measurements were taken just in front of the building, i.e. adjacent to Sunset Boulevard.

We observed that Control Room B is typical of a number of the AM and FM studios that are, acoustically, well isolated from Sunset Boulevard. The AM Production Studio appears to be the only studio which is, at present, adversely impacted by traffic noise. The results, presented in Figures 9 through 14, confirm that there is no significant correlation between exterior noise levels and noise levels inside Control Room B. Note that at certain times during the measurements in Control Room B, the telephone rang and music from an adjacent area was audible, conditions over which we had no control. These data also show the interior noise levels from road traffic to be relatively high in the AM Production Studio, due to its close proximity to the roadway and the inadequate sound isolation provided by its construction.

We expect train noise will be just audible in the AM Production Studio, although interior noise from train passbys will be less than from existing noisy vehicles. Train movements will be inaudible in other studios in the KMPC/KUTE building.

3.4 KWHY Channel 22

Measurements were taken in Studios A and B at the KWHY Channel 22 premises at 5545 Sunset Boulevard on the afternoon of Tuesday, 8 September 1987. Exterior measurements were taken on the sidewalk in front of the premises, adjacent to Sunset Boulevard.

The results, shown in Figures 15 through 18, confirm our subjective findings that traffic noise was at times audible in both studios, due to their close proximity to Sunset Boulevard and the inadequate sound isolation provided by the existing building construction. The A-weighted time-histories, shown in Figures 15 and 16, show that there is some correlation between the exterior and interior noise levels, particularly in Studio A. Thus, we expect that train movements may be just audible in both studios, although interior noise from train passbys will be less than from existing noisy vehicles.

3.5 KTLA Channel 5

A five minute measurement was made inside Stage 9 at KTLA Channel 5 on the morning of Tuesday, 10 September 1987. Unfortunately, Stage 7 was occupied during our measurements and the exterior door was open. Thus, the results were affected by noise from activities and conversations in the stage area, and also by noise from vehicular traffic on Van Ness Avenue. Nevertheless, for completeness, we have presented the results from the five minute sample in Figures 19 and 20.

3.6 Cedars Medical Center, Miami

Simultaneous measurements were taken inside and outside the Cedars Medical Center, 1400 NW 12th Avenue, Miami on Tuesday 15 September 1987. Two samples were taken of 45 and 20 minutes duration, respectively.

The measurement locations were adjacent to the Miami Rapid Transit Rail System, just south of the Civic Center Station. The rail alignment in this area comprises an aerial structure running along the center of 12th Avenue. Exterior measurements were made outside the main entrance to the hospital building, adjacent to the vehicle approach ramps on the second level. Interior measurements were made at the end of the corridor on the 4th Floor, next to the Pathology Library. The interior measurement position was about 4 ft from the double-glazed corridor window and overlooked the exterior measurement position. The measurement locations were approximately 150 ft from the center of the near side (southbound) track. Northbound train speeds were typically 20-30 mph, as trains were decelerating approaching Civic Center Station. Southbound trains were accelerating away from the station at about 25-40 mph. Headways in each direction were typically 20 minutes. There was no trackside sound barrier wall in this area.

Northbound train movements were virtually inaudible inside the building while southbound movements were just audible. Train passbys were often masked by noise generated inside the building, particularly by P.A. system announcements. In addition, exterior ambient noise levels were generally high due to traffic on 12th Avenue and frequent aircraft flyovers. From our discussions with hospital staff, we understand that train noise has no adverse impact on hospital operations.

Representative samples of the time-histories of the A-weighted exterior and interior noise levels are shown in Figure 21. Figures 22 and 23 show the A-weighted octave band exterior and interior levels exceeded for 1% and 10% of the time (L_1 and L_{10}, respectively), and Figure 24 shows typical A-weighted, octave band exterior and interior train passby noise levels. These data confirm that interior noise levels from train movements are generally low in relation to ambient noise levels due to road traffic, aircraft flyovers and P.A. system announcements.

3.7 South Miami Hospital

The South Miami Hospital comprises three wings located adjacent to the Miami Rapid Transit Rail System alignment, south of the South Miami Station. Trains run on two, independent aerial structures which have been retro-fitted with sound barrier walls, i.e. with one sound barrier wall on each structure. Train speeds in this area were typically 55-60 mph and headways in each direction were 6-7 minutes.

Exterior and interior measurements were made on the afternoon of Tuesday, 15 September 1987. The measurements were taken at the north wing, which is the closest part of the hospital to the rail alignment. Exterior readings were taken at ground level at about 40 ft from the center of the near side (southbound) track, while the interior measurements were made in the center of Room 465 on the 4th Floor of the building, at about 50 ft from the center of the near side track. Room 465 is normally used for physical therapy, but was unoccupied during our measurements. The operable, double-glazed window was closed during our measurements, in accordance with normal conditions.

Train passbys were quite audible inside the building, particularly from northbound trains which are not effectively screened by the sound barrier walls fitted adjacent to the southbound track. Our measurement results, presented in Figures 25 through 28, show that the maximum interior noise level due to northbound train passbys was 56 dBA. Although this is higher than the generally accepted criterion of 50 dBA for short-term or transient noise transmitted from outside to inside hospitals, we understand, from conversations with Mr. Dennis Grady, Director of Facilities, that train noise has no adverse impact on hospital operations. The results also show that the A-weighted, train passby noise levels were almost identical to the L_1 levels in most octave bands (apart from 63 and 125 Hz), confirming that train passbys were the dominant noise source during our measurements.

3.8 Silvercup Recording Studios, New York City

A 45 minute exterior measurement was made at the Silvercup Recording Studios, 4245 21st Street, Queens, during the afternoon of Wednesday, 16 September 1987. The Silvercup Recording Studios are a large complex, with a northern facade located approximately 40 ft from the Queensboro Bridge (a multi-deck structure carrying road traffic and NYCTA trains between Long Island and Manhattan). We were not able to obtain permission to take interior measurements, nor to inspect the studios.

The measurement location was on the corner of 21st Street and Queens Plaza South, right next to the studio building and about 100-120 ft from the train tracks (which are located on the north side of the bridge). Train speeds were 10-20 mph with headways of typically 3-5 minutes in each direction.

Our measurement results, presented in Figures 29 through 31, show that the A-weighted, octave band train passby noise levels were on the same order as the L_1 noise levels recorded during our sample, indicating that the train passbys on the Queensboro Bridge are the main source of environmental noise in this area. The maximum train passby noise levels were 90-95 dBA, which are quite high considering the low train speeds. This is due to noise radiation from the lightly-damped steel bridge structure, since for this type of structure, at train speeds above approximately 10 mph, the noise radiated by the vibration of the structure components predominates.

The walls of the Silvercup Recording Studios building are masonry and the original window openings have been fully bricked in, so it appears that considerable attention has been given to "sound proofing" the studios. However, we were not able to determine if these high exterior noise levels, due to train movements on the Queensboro Bridge, currently have any adverse impact on studio operations.

3.9 ABC (WLS-TV) Studios, Chicago

The ABC (WLS Channel 7) Studios at 190 North State Street in Chicago (corner of Lake and North State Streets) are located adjacent to the State Street Subway, and are also located close to the old steel elevated structure used by CTA trains running along Lake Street. Simultaneous exterior and interior measurements of 45 minutes duration were made on the morning of Thursday, 17 September 1987.

The exterior measurement location was adjacent to the revolving doors at the main building entrance on North State Street. This position had direct line-of-sight to the Lake Street Elevated Structure and was also close to subway ventilation shaft grills on North State Street. Interior measurements were made inside Studio 2, a new facility used primarily for the Oprah Winfrey Show. Studio 2 is located approximately 100 ft from the State Street Subway and some 200 ft from the elevated structure on Lake Street. North State Street in this area is closed to vehicular traffic apart from CTA buses.

The results of our measurements are presented in Figures 32 through 35. Exterior noise from bus movements on North State Street and train movements on the elevated structure was inaudible inside Studio 2, although subway trains were, at times, just audible. Mr. Joe Kresnicka, Director of Engineering at WLS-TV, Channel 7, advised us that neither noise nor vibration from CTA trains had any adverse impact on their operations.

4. VIBRATION MEASUREMENT RESULTS

Considerable background information on low-level transient vibration and its perception by people is contained in our reports, "Noise and Vibration Analysis for the Metro Rail Project CORE Study" of March 1987 and "Noise and Vibration Survey for the Metro Rail Project CORE Study" of August 1987, so only a brief discussion of vibration from transit trains is presented here.

Although the perception of vibration by people has been discussed extensively in the literature, most of the criteria are based on results obtained from steady-state sinusoidal vibration excitation in laboratory environments. Relatively little information is

available on the response of humans to low level random vibration or to transient vibration levels. Recently, more information on this type of vibration has been obtained from the results of measurements and subjective evaluations of transit train vibration in Toronto, Washington, D.C., Chicago, San Francisco, Atlanta and Pueblo, Colorado (The Transportation Test Center).

As for the subjective response to noise, the human sensitivity to vibration varies with frequency. Therefore, the frequency must be taken into consideration in assessing annoyance due to vibration. A number of studies have indicated that at frequencies above approximately 12 to 16 Hz, sensitivity to vibration is primarily determined by the amplitude of velocity and is relatively independent of frequency. Since the frequency range over which human sensitivity is approximately proportional to velocity amplitude covers the range of principal vibration components from transit trains and since the noise level generated by the vibration of building surfaces is approximately proportional to vibration velocity level, it is appropriate to present vibration criteria and data in terms of velocity level.

A curve of human response to vibration has evolved from the studies which have been done and has been documented in the International Standards Organization document 2631 and ANSI Standard S3.29-1983. Additional information on human sensitivity to vibration is contained in the Committee on Hearing, Bioacoustics and Biomechanics (CHABA) Publication, "Guidelines for Preparing Environmental Impact Statements on Noise", which has utilized much of the information contained in the ISO Standard. These standards and publications do indicate that, below about 12 to 16 Hz, the sensitivity to vibration velocity is somewhat lower. This is characterized in Figure 36.

Vibration levels below the "range of maximum acceptable vibration in residential buildings" as shown on this figure are generally imperceptible or just perceptible as vibration to the average person under normal conditions.

Exterior vibration sources include automobiles, trucks, buses, transit trains, underground mechanical equipment, and, on a local scale, pedestrians. Interior vibration results from building mechanical equipment, local occupant activity and ground-borne vibration generated by exterior activities, such as vibration from automobiles, trucks, buses and trains, which is transmitted into the building. Most of the vibration sources, except stationary mechanical equipment operating continuously, create transient vibration levels similar to, or analogous to transient noise levels produced by noise sources and the observed levels of vibration at a particular location are the summation of the vibration created by the various sources near and far.

As noted earlier, vibration data were also recorded at each measurement location discussed in Section 3 of this report. The results of these measurements, shown in Figures 37 through 70, are presented in a similar format to the noise data. Time histories of both the exterior and interior vibration velocity levels during representative four minute sections of the measurements are presented, together with the exterior and interior octave band vibration velocity levels that were exceeded 1% and 10% of the time (L_1 and L_{10}, respectively). In addition, the octave band exterior and interior train passby vibration levels are also presented, where applicable.

The overall vibration velocity levels, which are shown on the left hand axis of the octave band plots, were in most cases less than 70 dB, the level below which vibration is normally imperceptible to persons. Locations where the overall vibration level exceeded 70 dB included the Meeting Area at the Self Realization Fellowship

premises (where some movement of people occurred during our measurement), outside the Silvercup Recording Studios in New York City (due to high vibration levels from train operations on the adjacent Queensboro Bridge) and inside the ABC (WLS-TV) Studios (Studio 2) in Chicago, where the unusually high levels appear to be associated with building mechanical equipment. Although the overall vibration velocity level in the Production Studio at KMPC-AM was less than 70 dB, the vibration in this area was dominated by building mechanical equipment.

Although the ground-borne vibration from transit train operations in subway or on at-grade track can be sufficient to create vibration levels which are unacceptable inside nearby buildings with vibration sensitive uses, we are aware of no situations where the vibration from transit trains operating on a modern aerial structure has been of a sufficient level to be feelable or cause any problems in nearby buildings. To this end, the most relevant vibration data for the current study are the levels recorded outside the South Miami Hospital, at about 40 ft from the center of the nearside track. The results from these measurements are presented in Figure 63. As noted earlier, trains run at speeds of 55-60 mph in this area, on two independent aerial structures, i.e., at similar speeds and on similar structures to those proposed for Sunset Boulevard. The overall vibration velocity levels recorded outside the South Miami Hospital were less than 60 dB during train passbys. Note that the vibration levels from the Metro Rail trains should be even lower since they will have a "soft" primary suspension. At the exterior measurement locations adjacent to Sunset Boulevard, the overall L_1 vibration velocity levels due to vehicular traffic were typically in the range of 60-70 dB. These data confirm that ground vibration levels due to train operations on the proposed aerial structure will be less than from existing heavy vehicles (buses and trucks). Thus, groundborne vibration, from train operations on the proposed Metro Rail Sunset Boulevard Alignment, will have no adverse impact on studio operations.

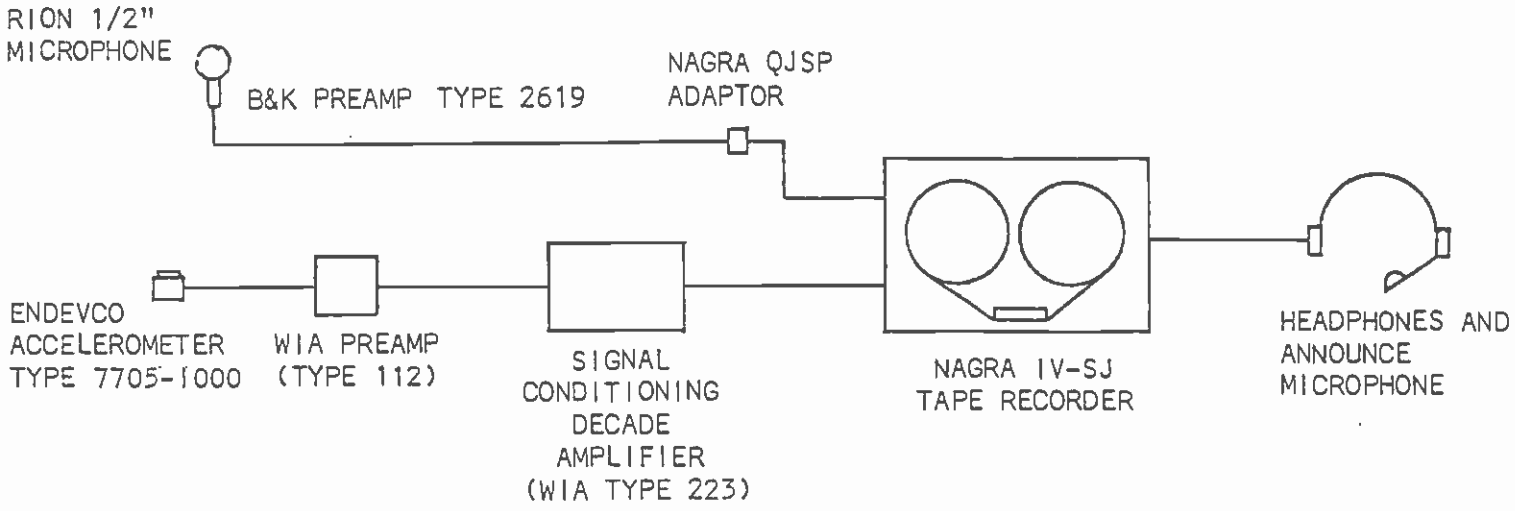
5. CONCLUSIONS

Our measurements at a number of radio and television studios along Sunset Boulevard in Hollywood have shown that most studios that we visited, including the CBS Studios (Stage 22 and Stage 23), KTTV Channel 11 (Stage 6) and the KMPC AM and FM Studios (apart from the AM Production Studio), have a high degree of sound isolation from existing traffic noise. Traffic noise was generally inaudible inside these studios, although in other studios, such as the KMPC AM Production and KWHY Channel 22 (Studio A and Studio B), noise from road traffic was noticeable due to the inadequate sound insolation provided by their construction.

The expected exterior noise levels from train operations on the proposed Metro Rail Sunset Boulevard Alignment are less than levels we recorded for existing noisy vehicles, such as buses, trucks and motorcycles. Because the noise from train passbys contains relatively less low frequency energy than noise from road traffic, train noise is more readily attenuated by building structures. Therefore interior noise levels due to train movements will be less than now experienced for existing noisy vehicles. Thus, in studios (or other noise-sensitive buildings) along Sunset Boulevard where traffic noise is at present inaudible, or barely audible, we expect that train passbys will also be inaudible. In studios where traffic noise is presently audible due to inadequate sound isolation provided by the building structures, we expect that train noise may also be audible. However, the interior train passby noise levels will be less than from existing noisy vehicles. Groundborne vibration from train passbys will have no adverse impact on studio operations.

Our observations and measurements at studios and other noise-sensitive buildings located next to rapid transit systems in Miami and Chicago have shown that train noise and vibration have no adverse impact on these facilities.

FIELD INSTRUMENTATION



LABORATORY INSTRUMENTATION

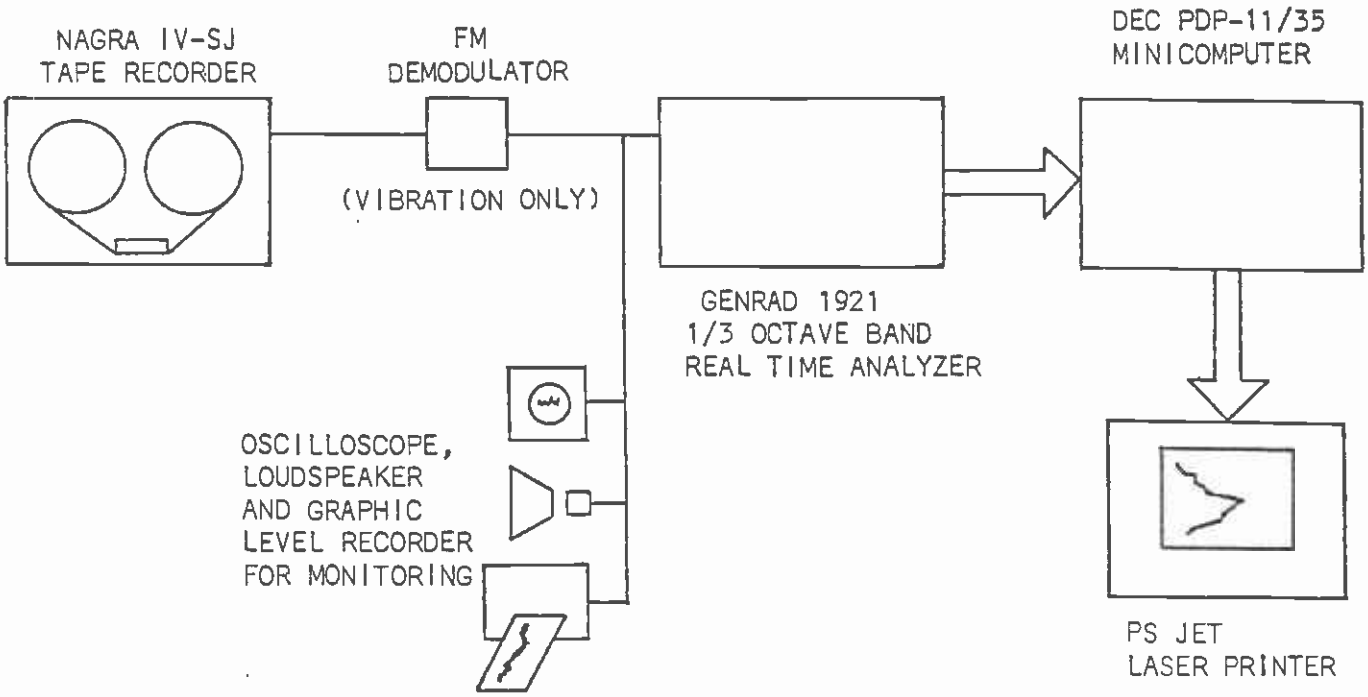


FIGURE 1 NOISE AND VIBRATION INSTRUMENTATION

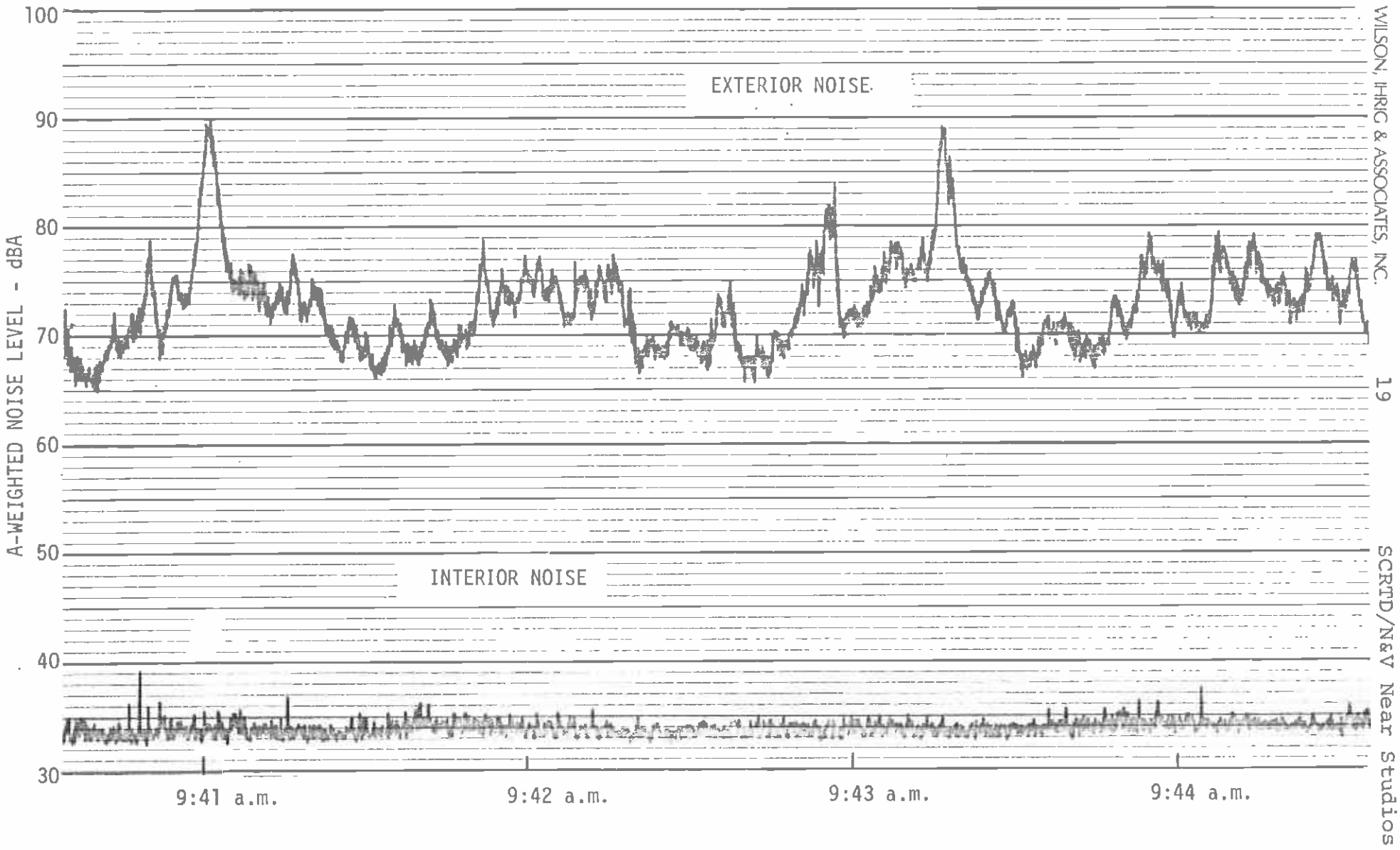


FIGURE 2 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE KTTV CHANNEL 11 (STAGE 7), MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

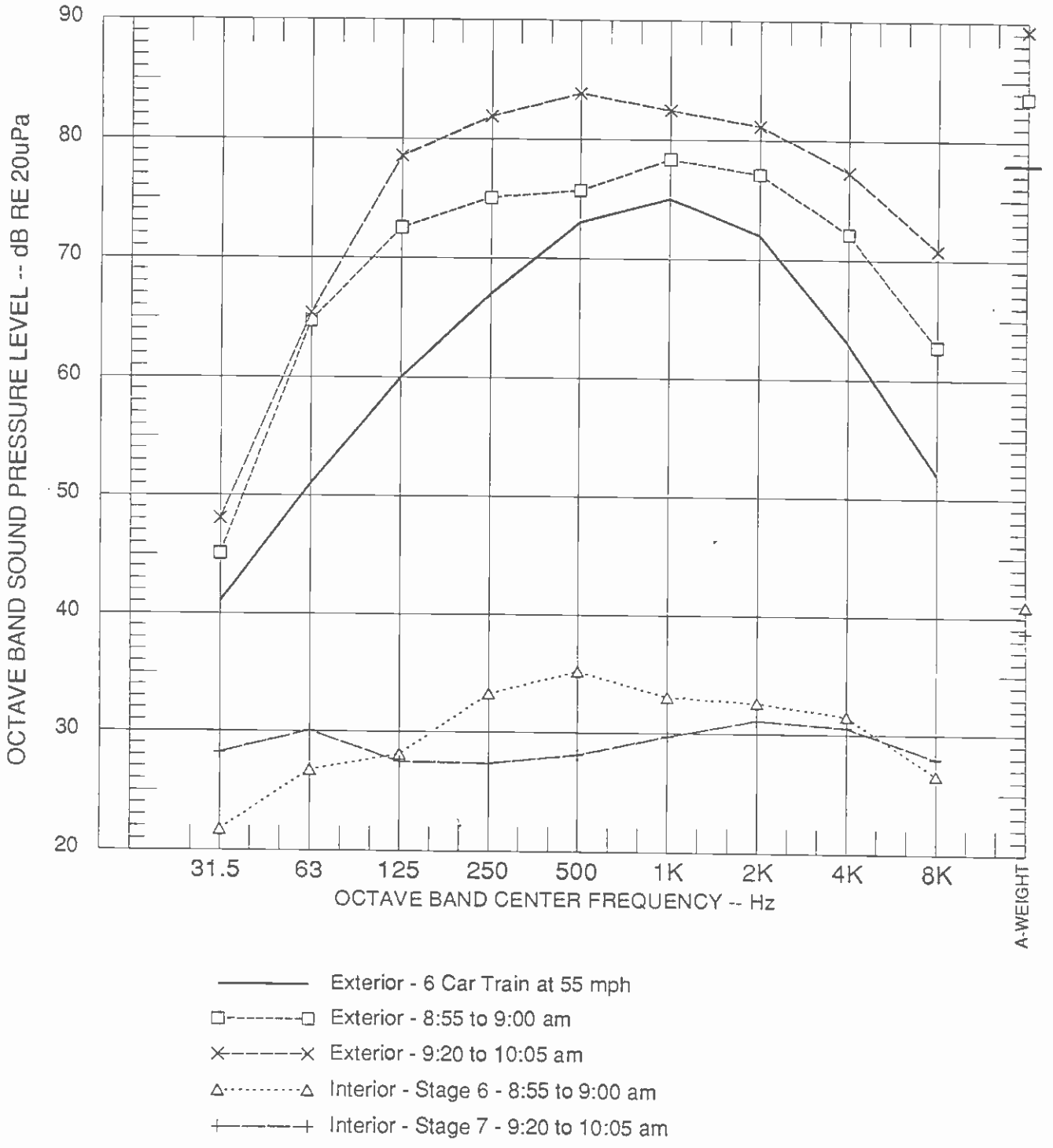


FIGURE 3 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT KTTV CHANNEL 11 ON TUESDAY, 8 SEPTEMBER, 1987

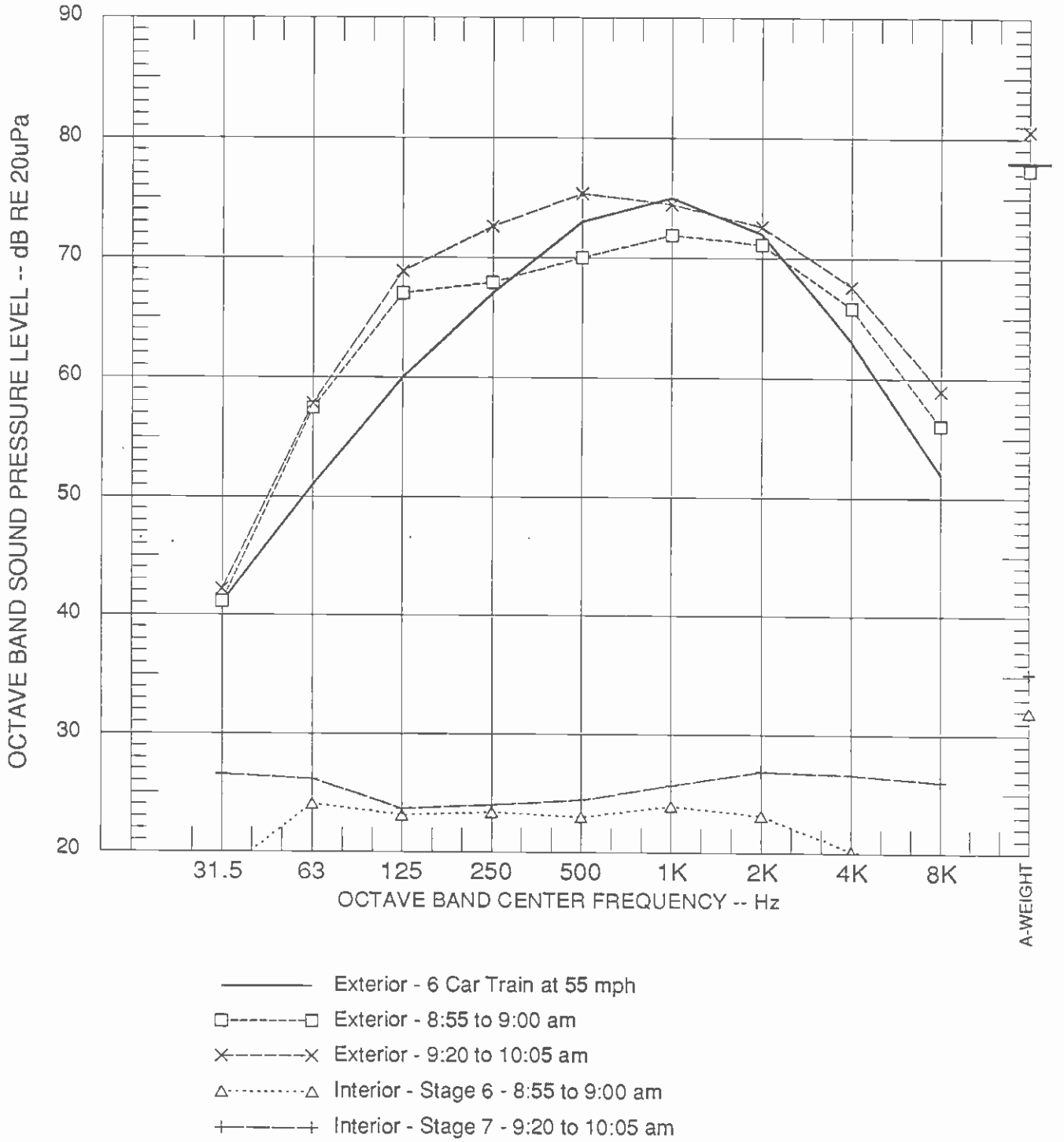


FIGURE 4 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT KTTV CHANNEL 11 ON TUESDAY, 8 SEPTEMBER, 1987

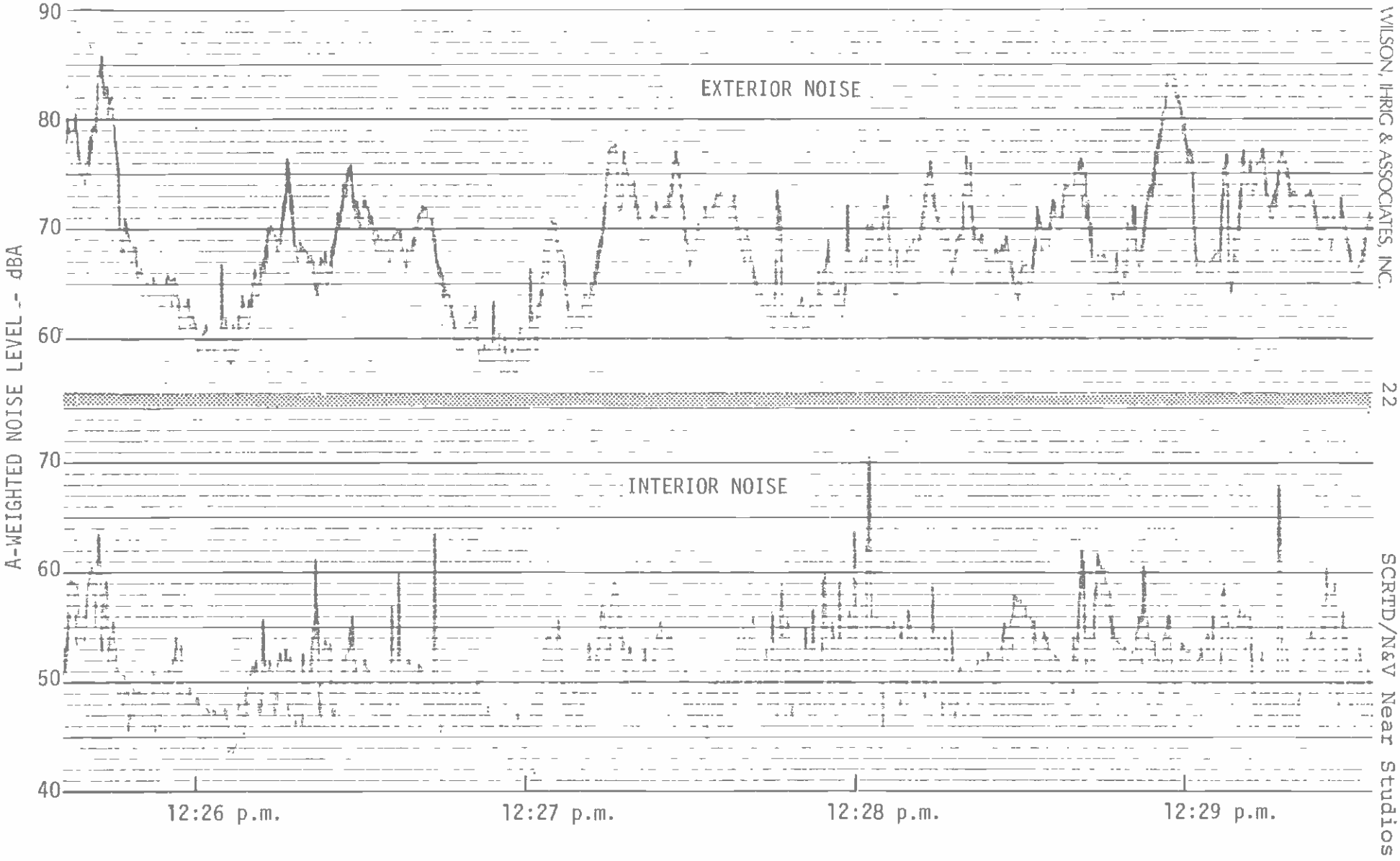


FIGURE 5 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE SELF REALIZATION FELLOWSHIP MEETING AREA, MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

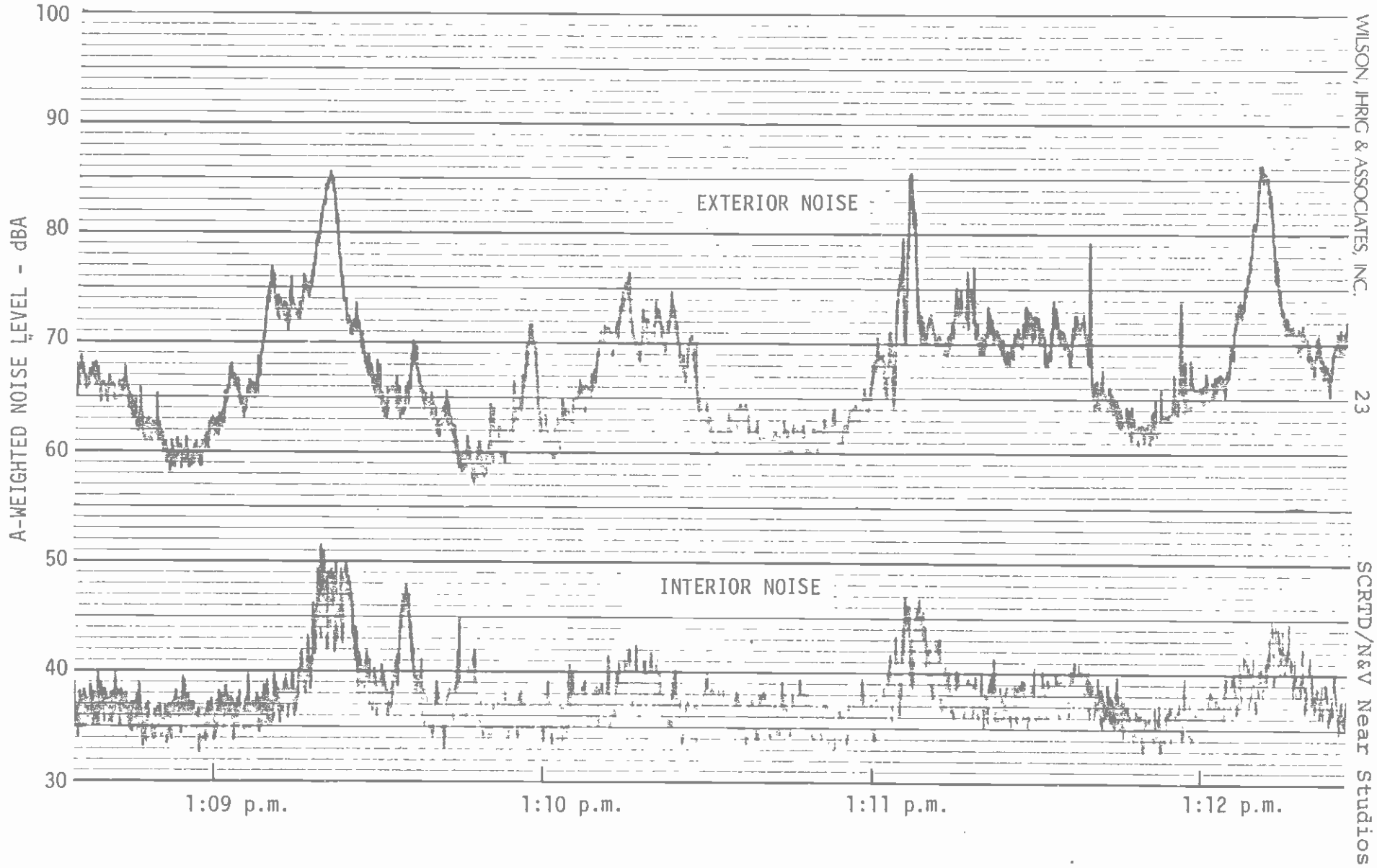


FIGURE 6 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE SELF REALIZATIDN FELLOWSHIP TEMPLE, MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

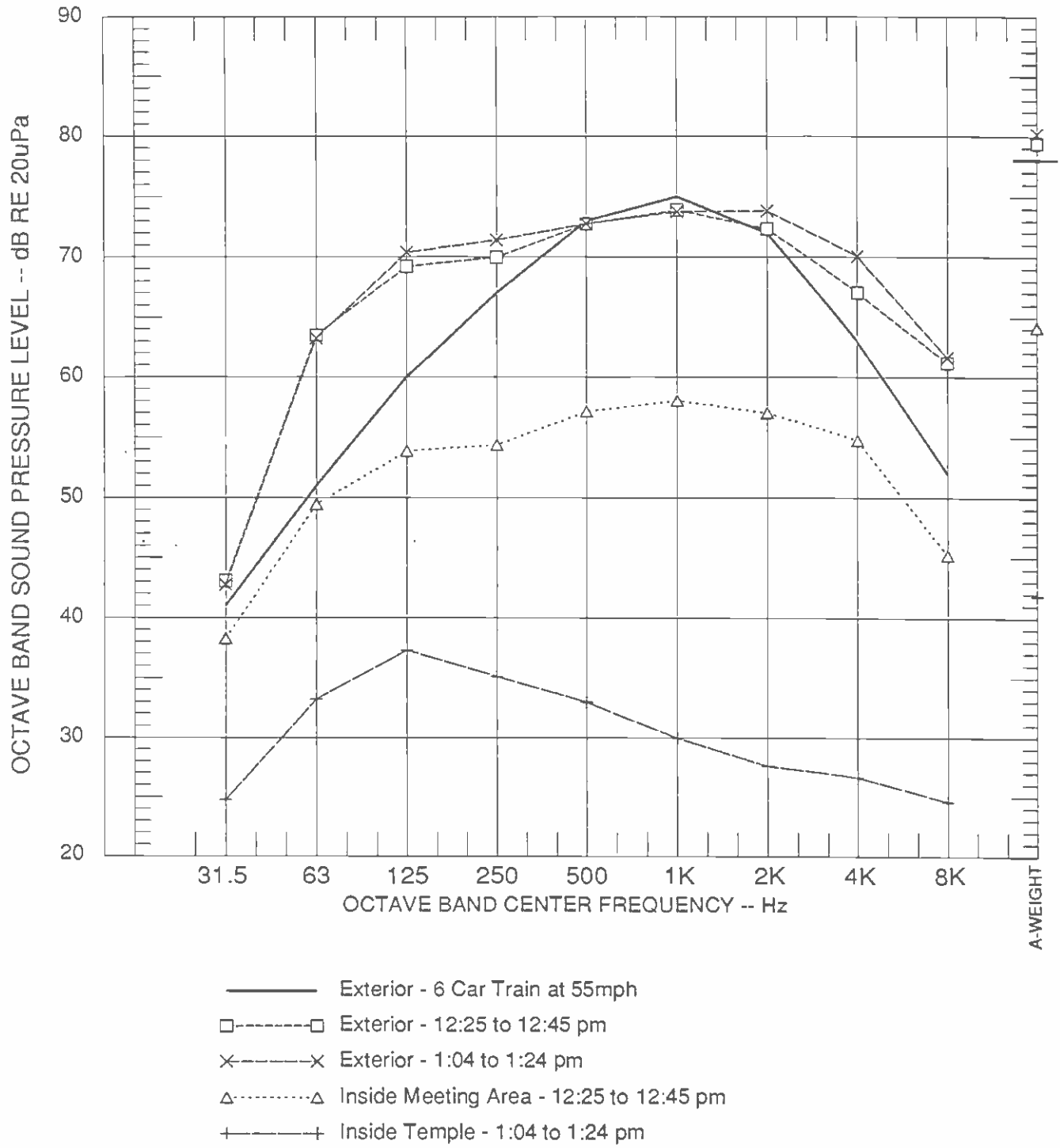


FIGURE 7 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE SELF REALIZATION FELLOWSHIP PREMISES ON TUESDAY, 9/8/87

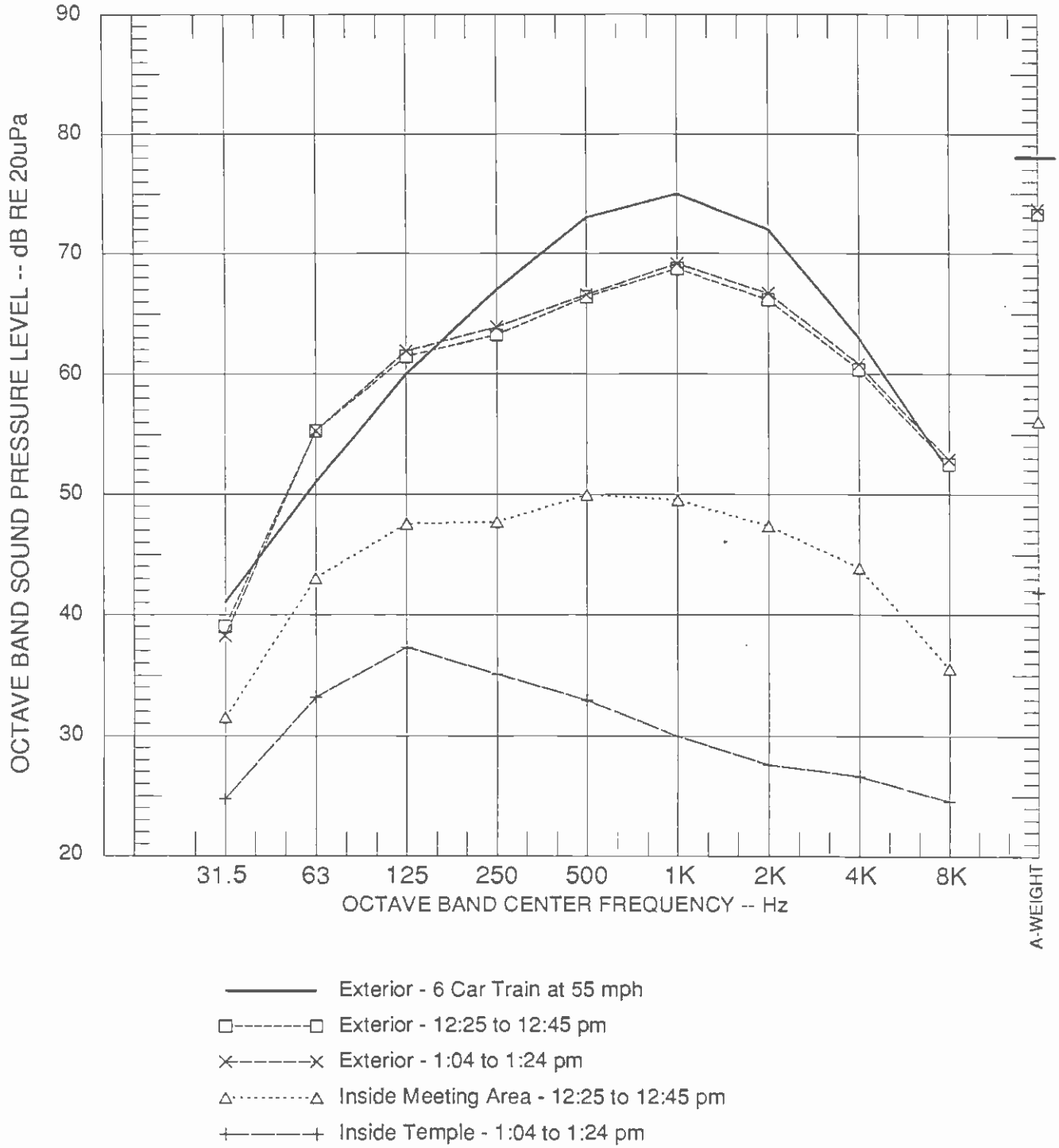


FIGURE 8 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE SELF REALIZATION FELLOWSHIP PREMISES ON 9/8/87

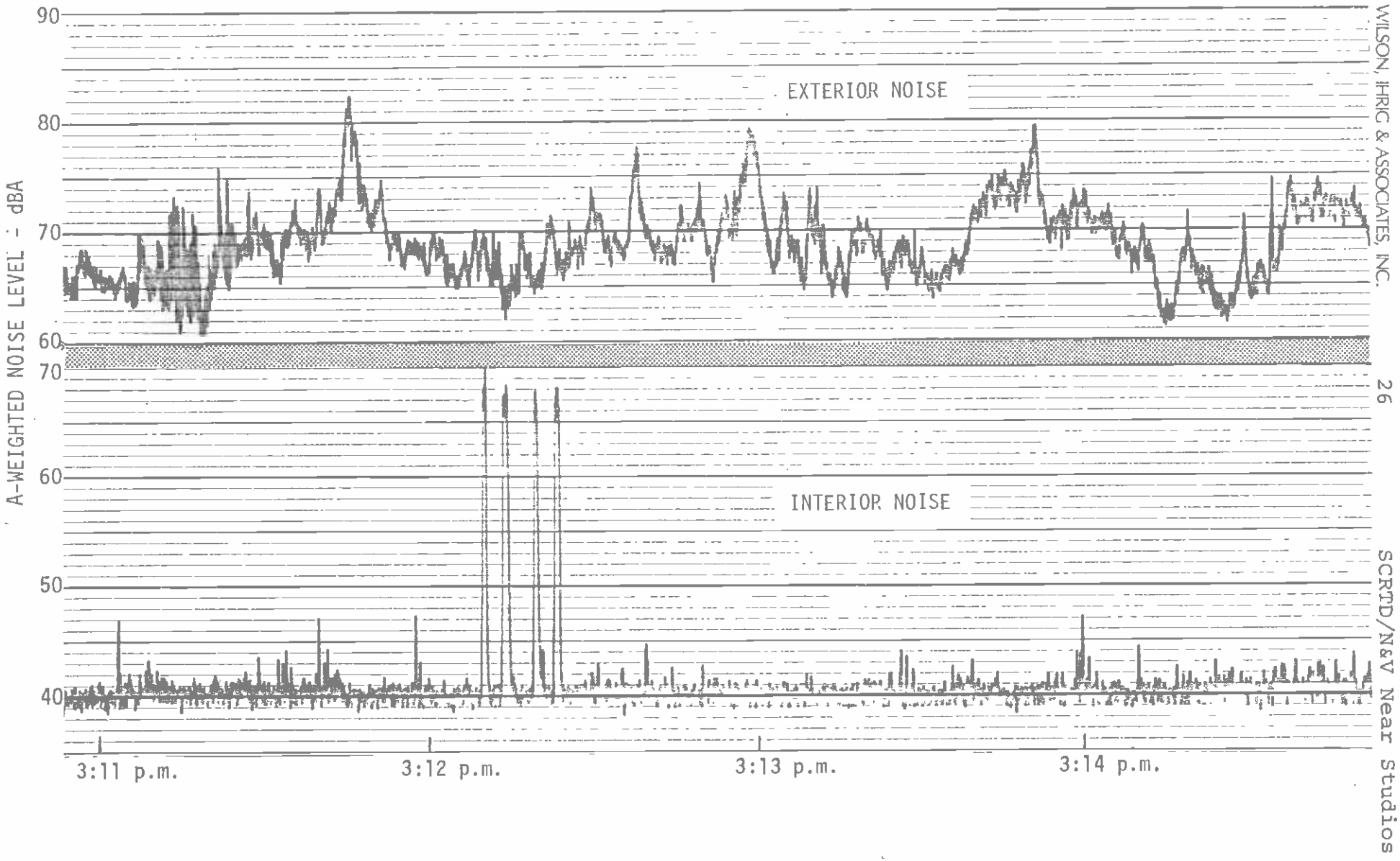


FIGURE 9 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE KMPC AM STUDIOS (CONTROL ROOM B), MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

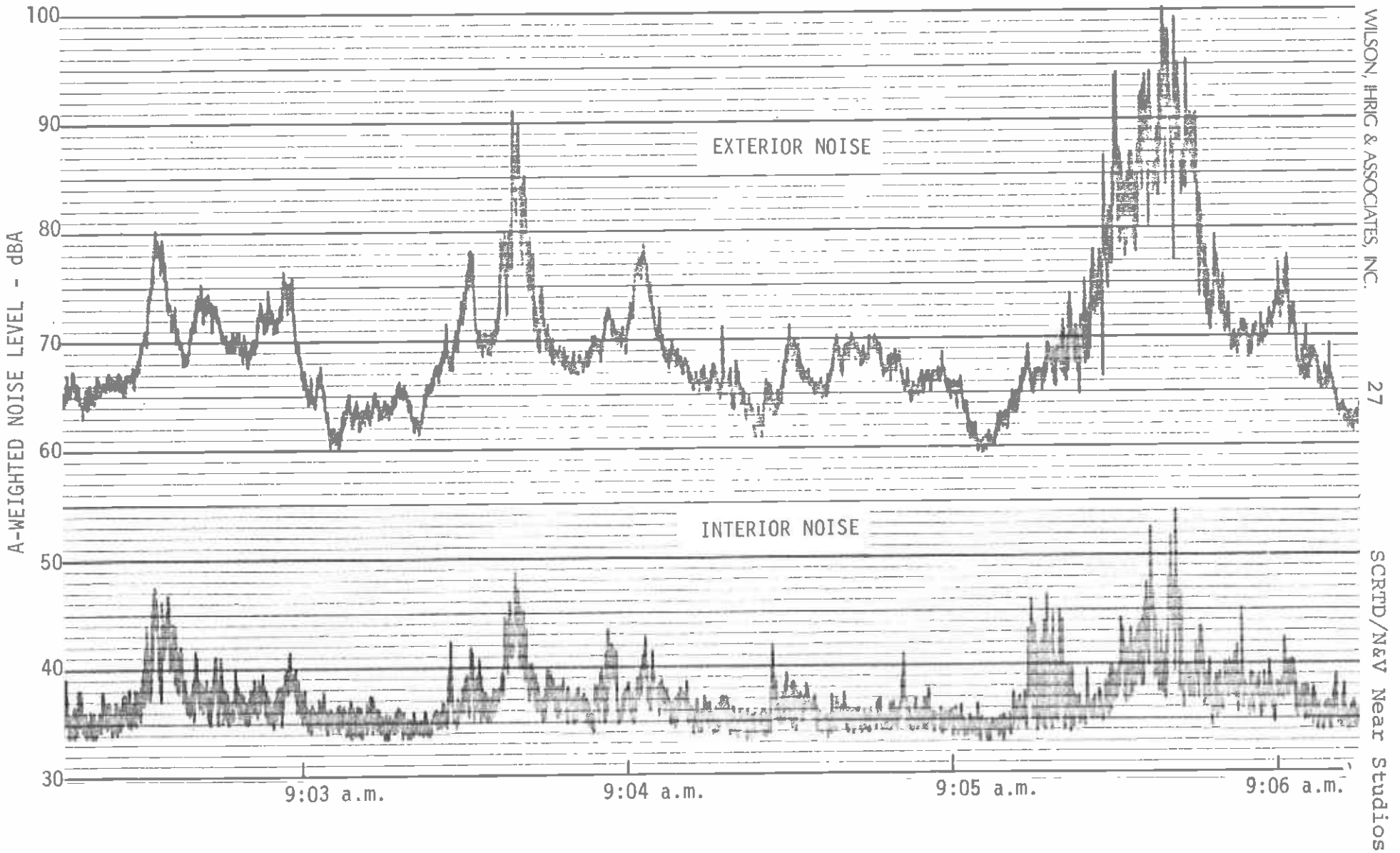


FIGURE 10 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE KMPC AM STUDIOS (PRODUCTION STUDIO), MEASURED ON THURSDAY, 10 SEPTEMBER 1987.

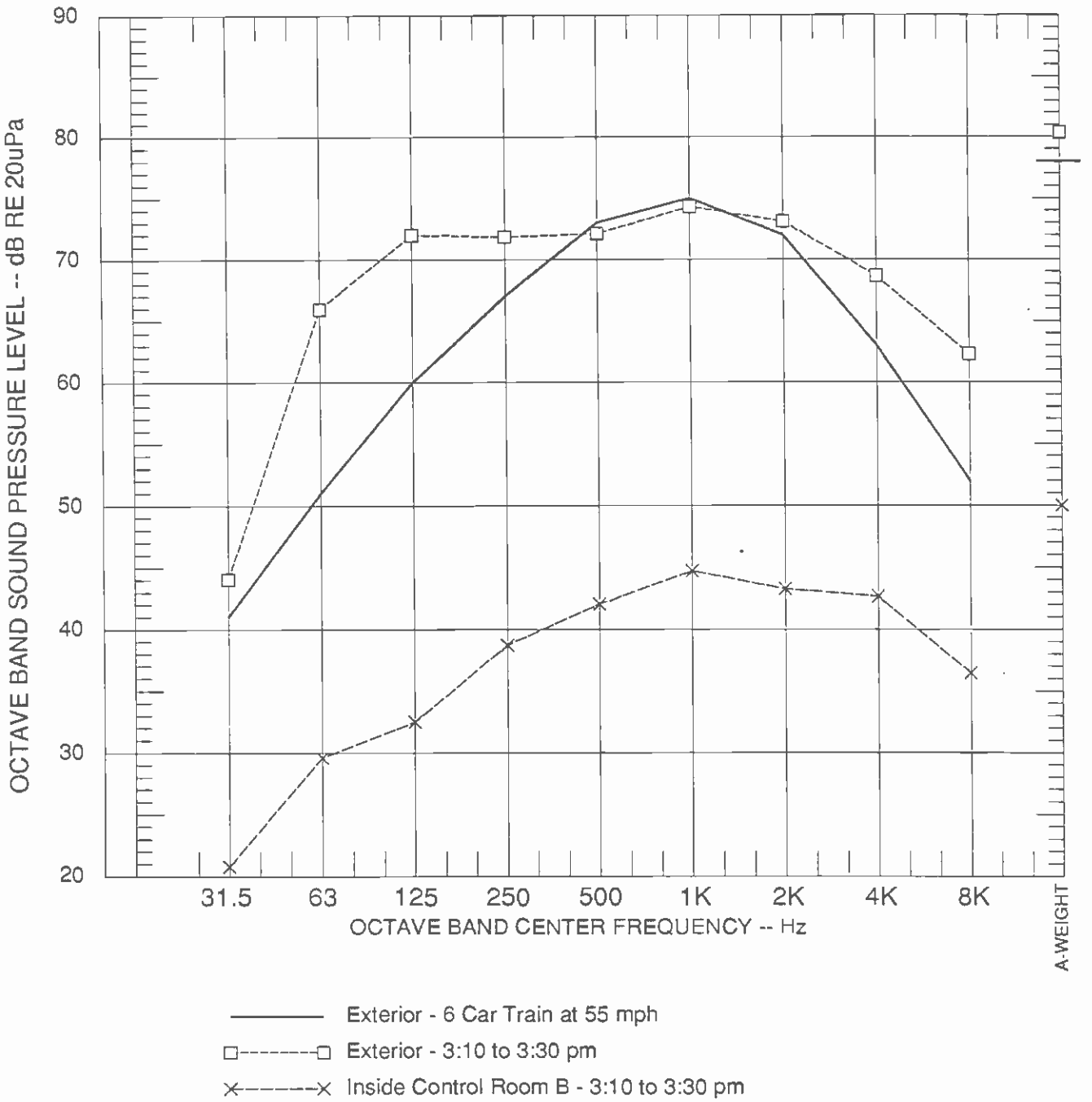


FIGURE 11 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON TUESDAY, 8 SEPTEMBER, 1987

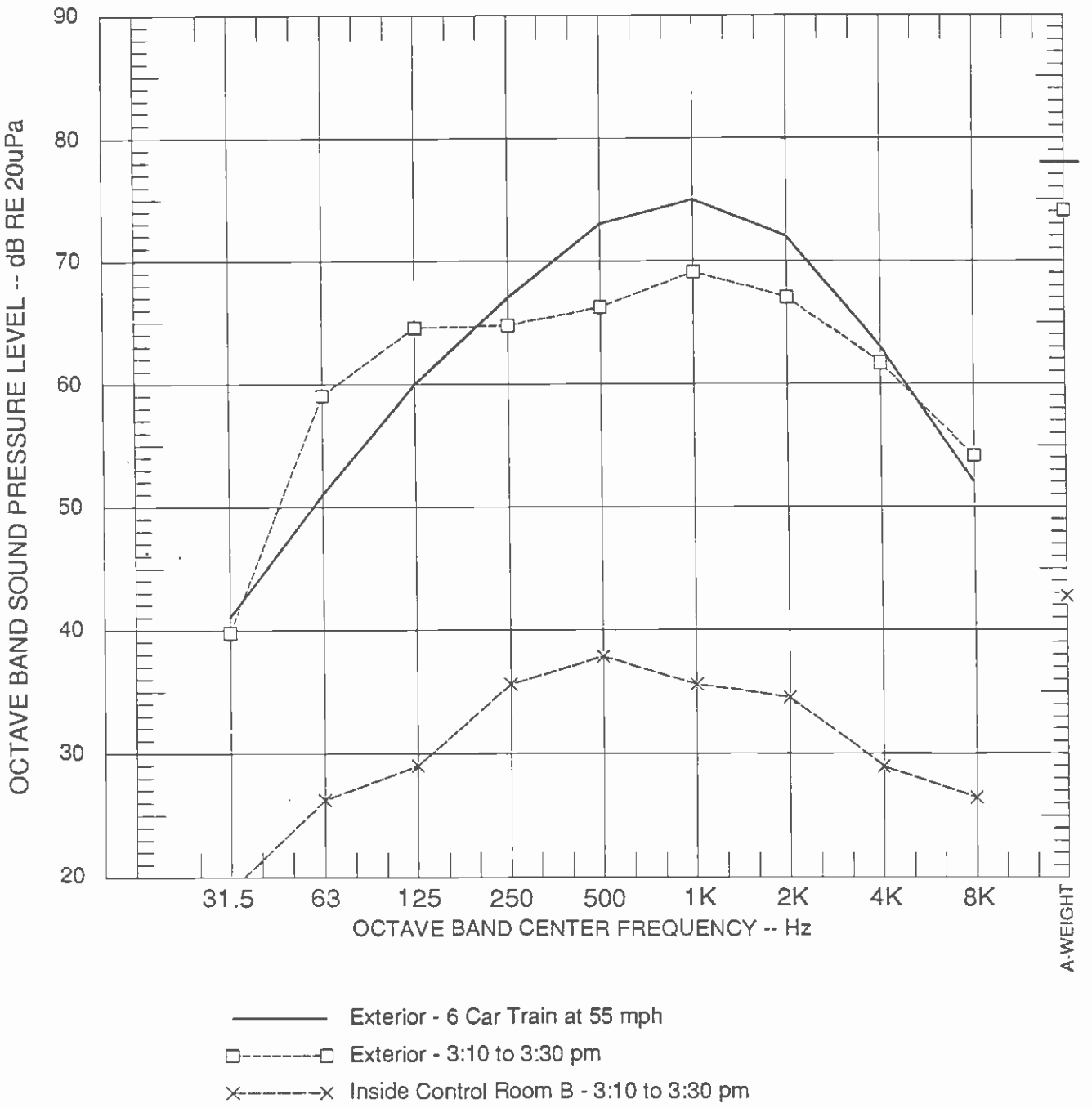


FIGURE 12 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON TUESDAY, 8 SEPTEMBER, 1987

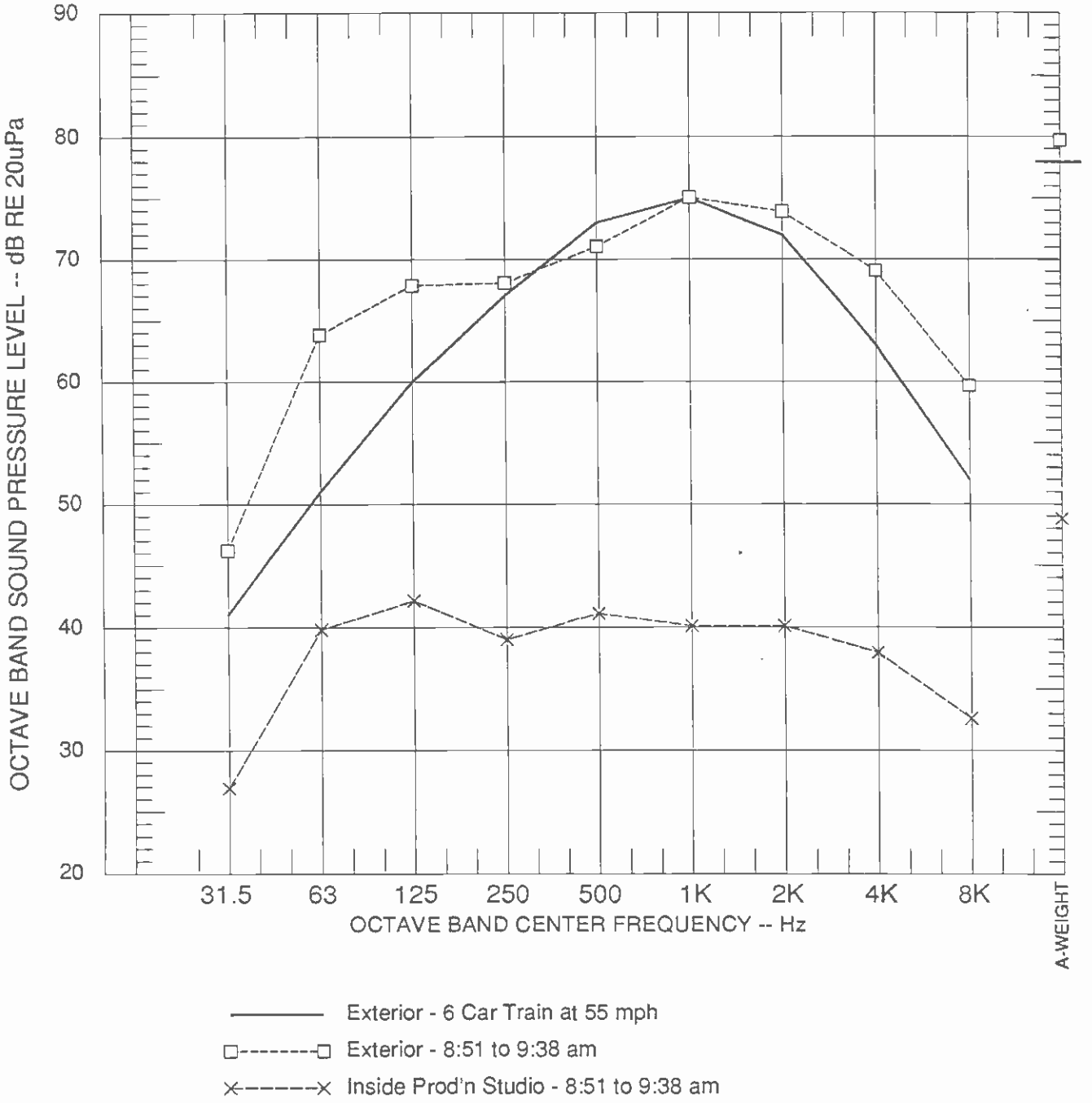


FIGURE 13 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON THURSDAY, 10 SEPTEMBER, 1987

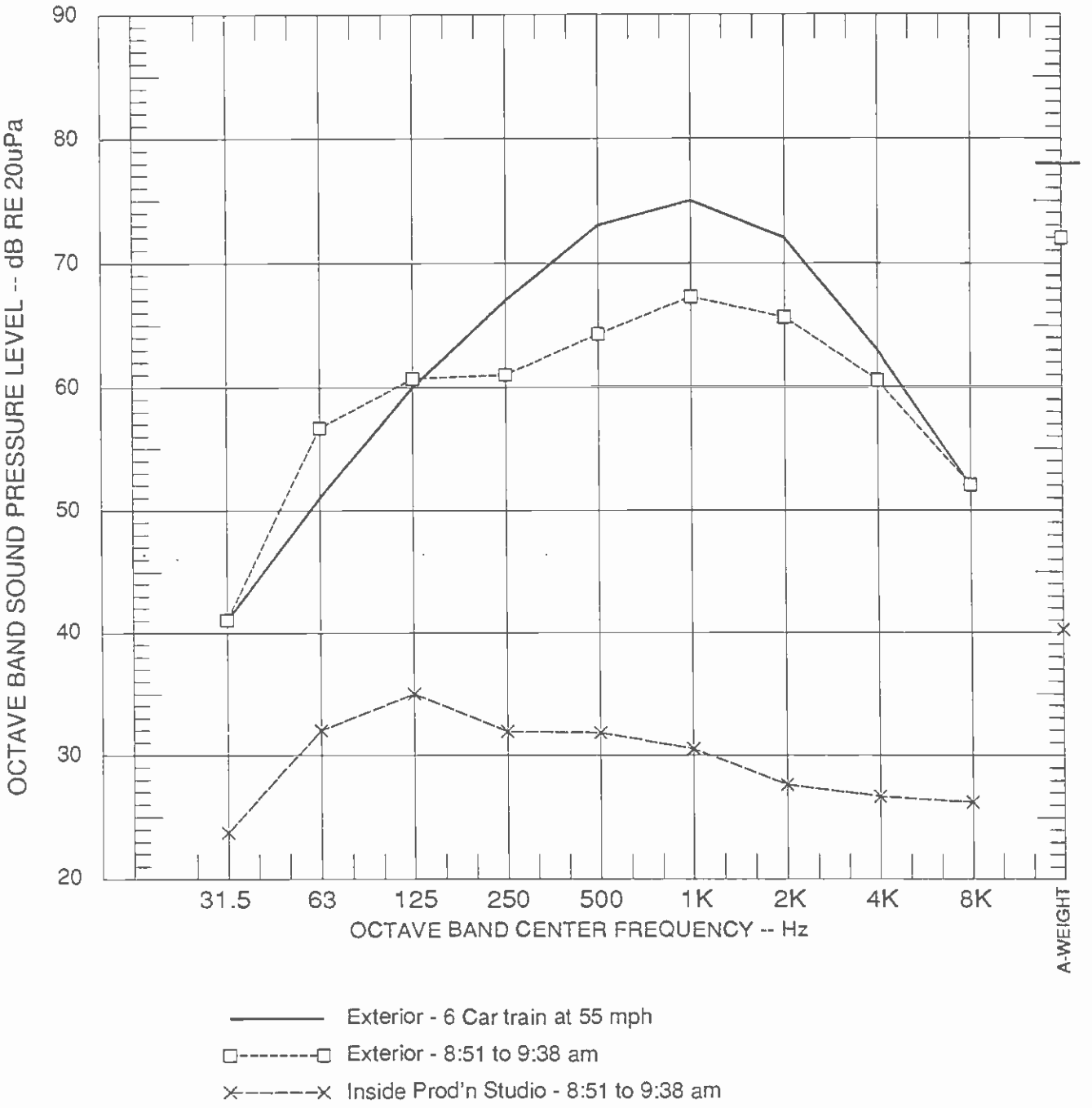


FIGURE 14 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON THURSDAY, 10 SEPTEMBER, 1987

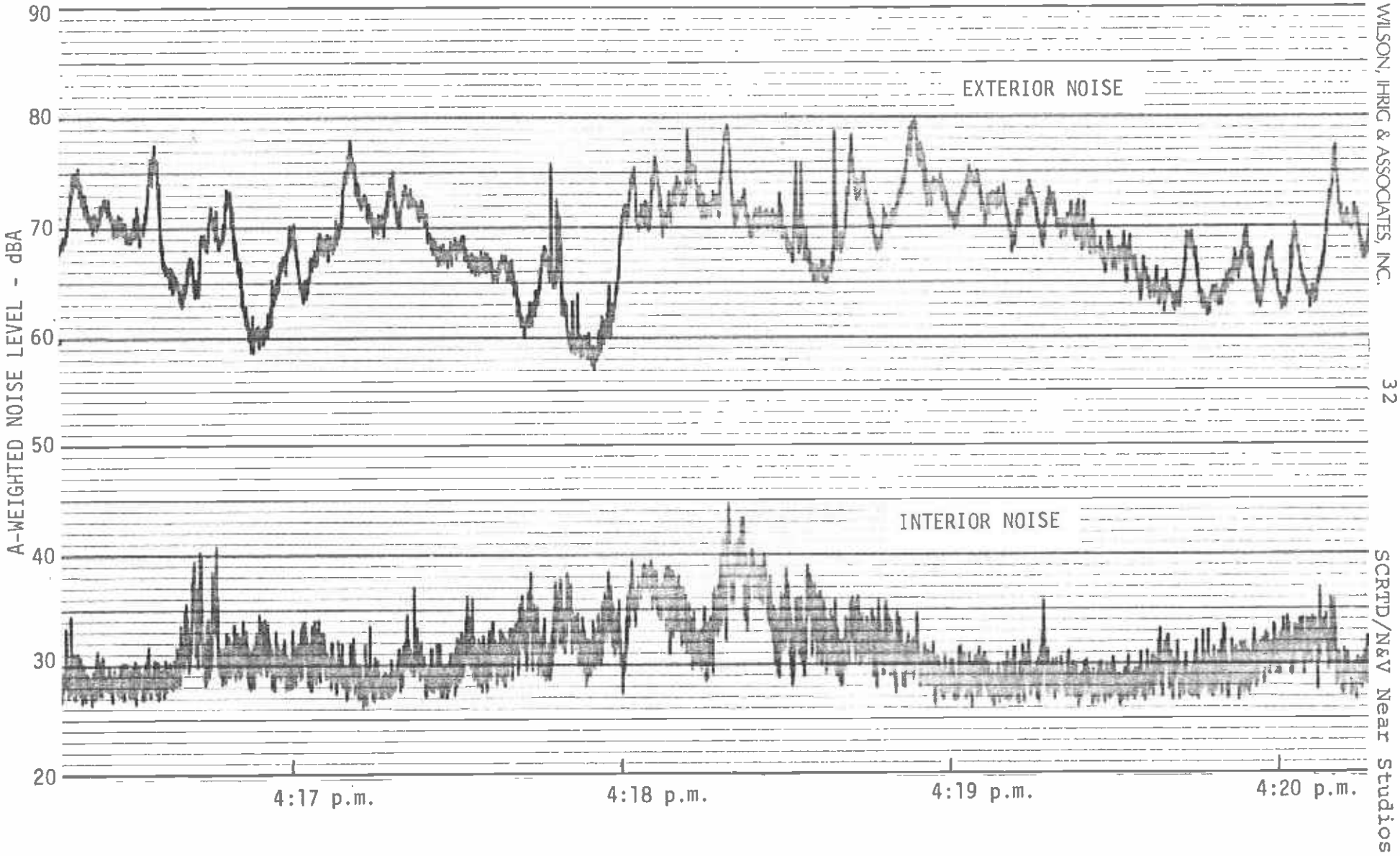


FIGURE 15 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE KWHY CHANNEL 22 STUDIOS (STUDIO B), MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

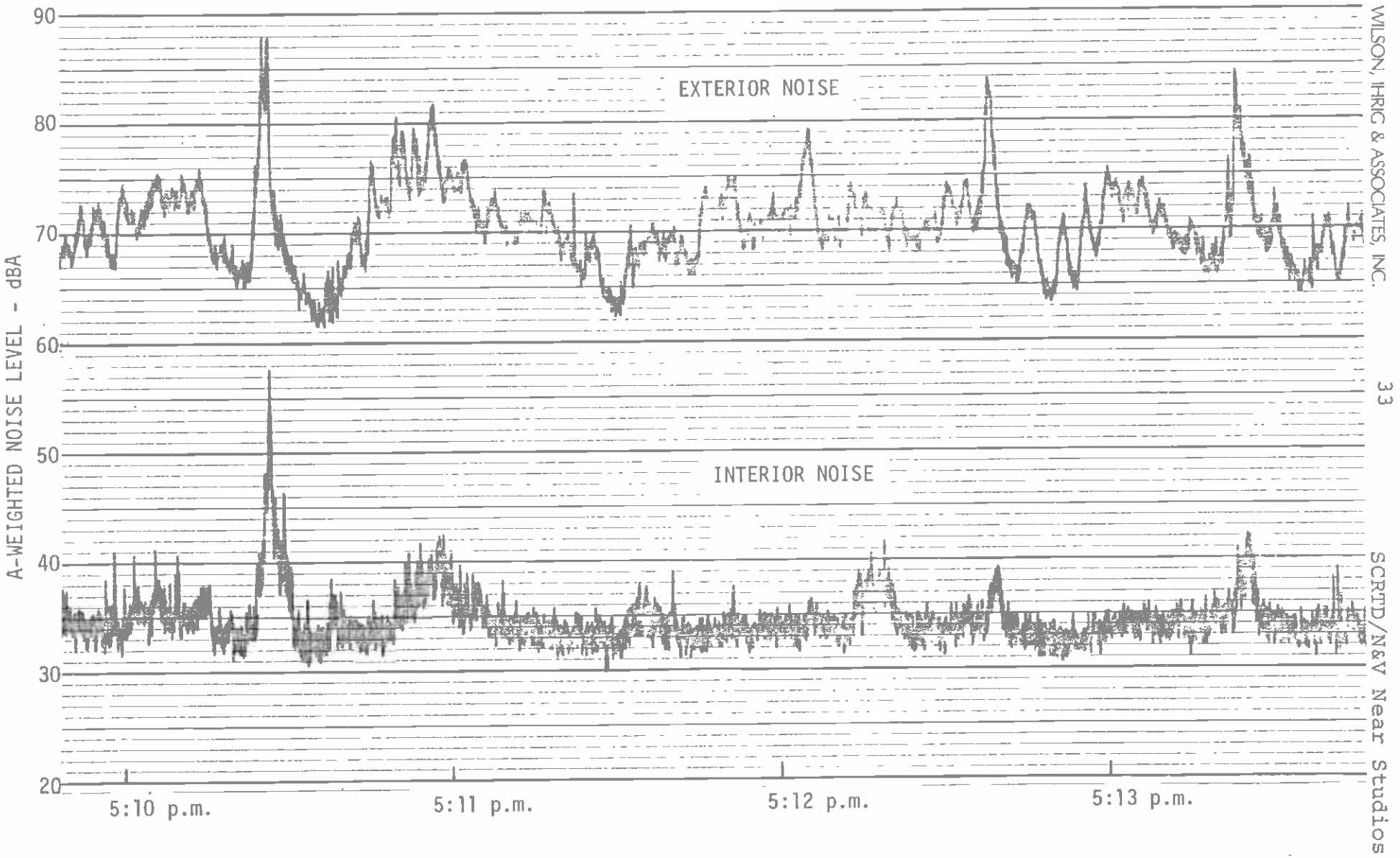


FIGURE 16 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE KWHY CHANNEL 22 STUDIOS (STUDIO A), MEASURED ON TUESDAY, 8 SEPTEMBER 1987.

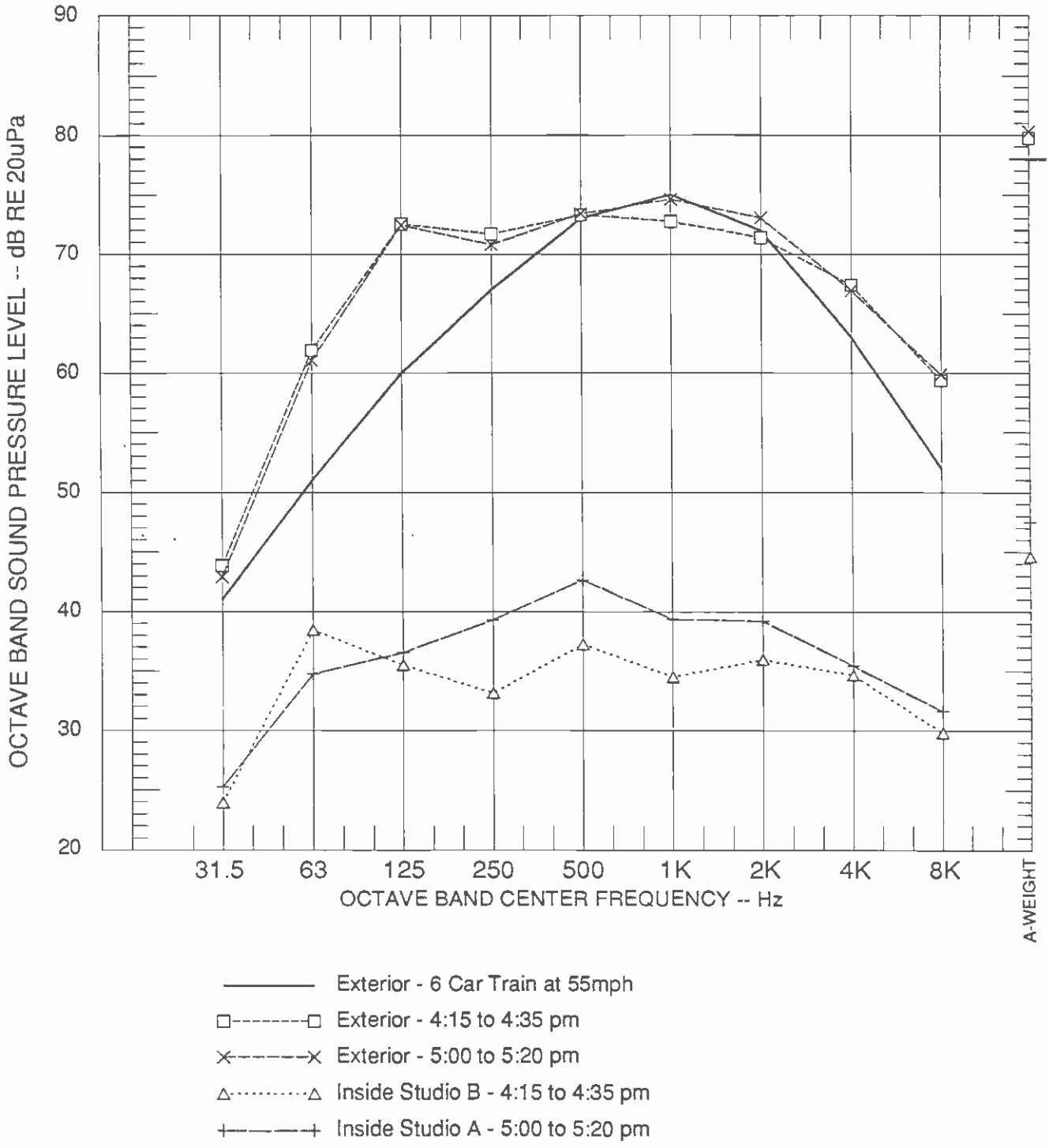


FIGURE 17 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT KWHY CHANNEL 22 ON TUESDAY, 8 SEPTEMBER, 1987

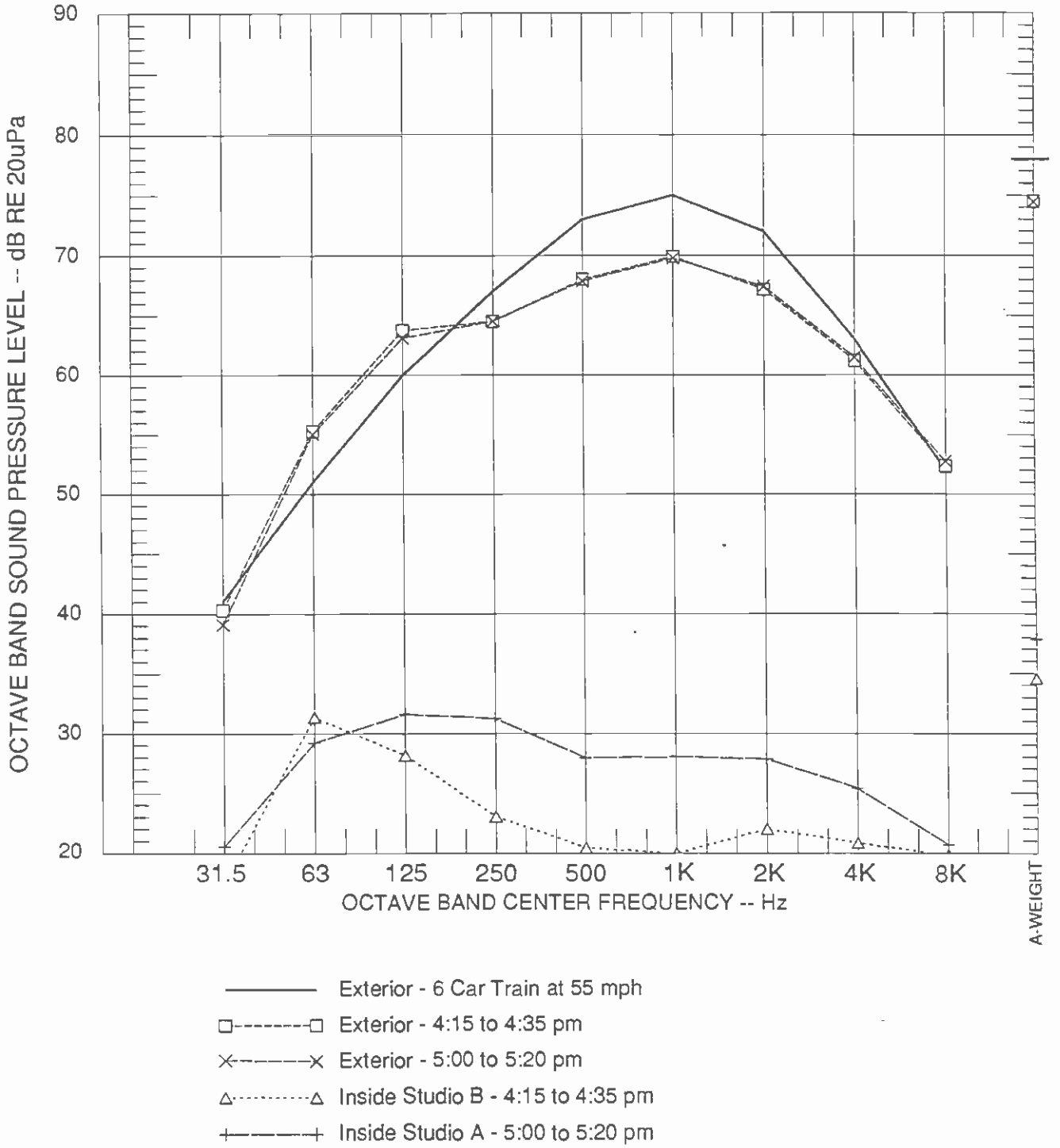


FIGURE 18 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT KWHY CHANNEL 22 ON TUESDAY, 8 SEPTEMBER, 1987

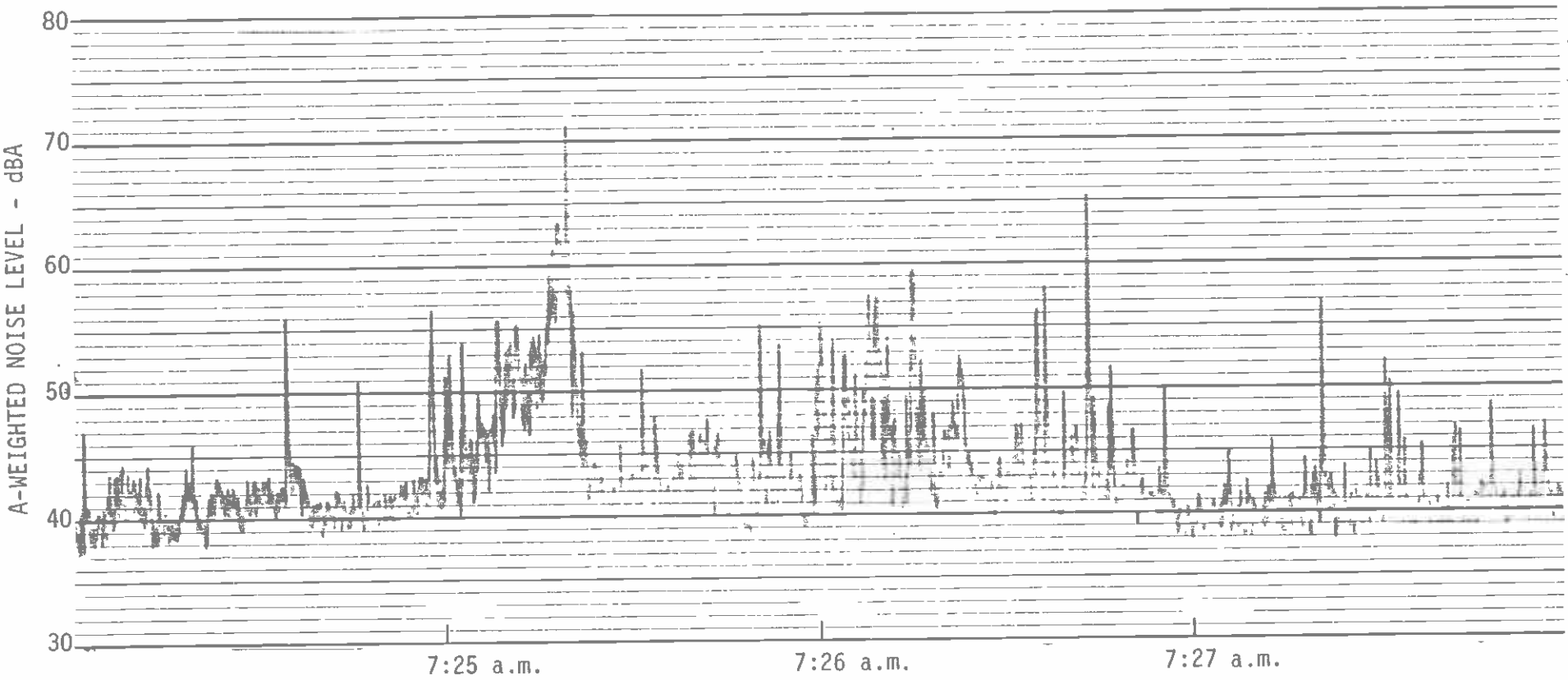


FIGURE 19 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE THE KTLA CHANNEL 5 STUDIOS (STAGE 9), MEASURED ON THURSDAY, 10 SEPTEMBER 1987.

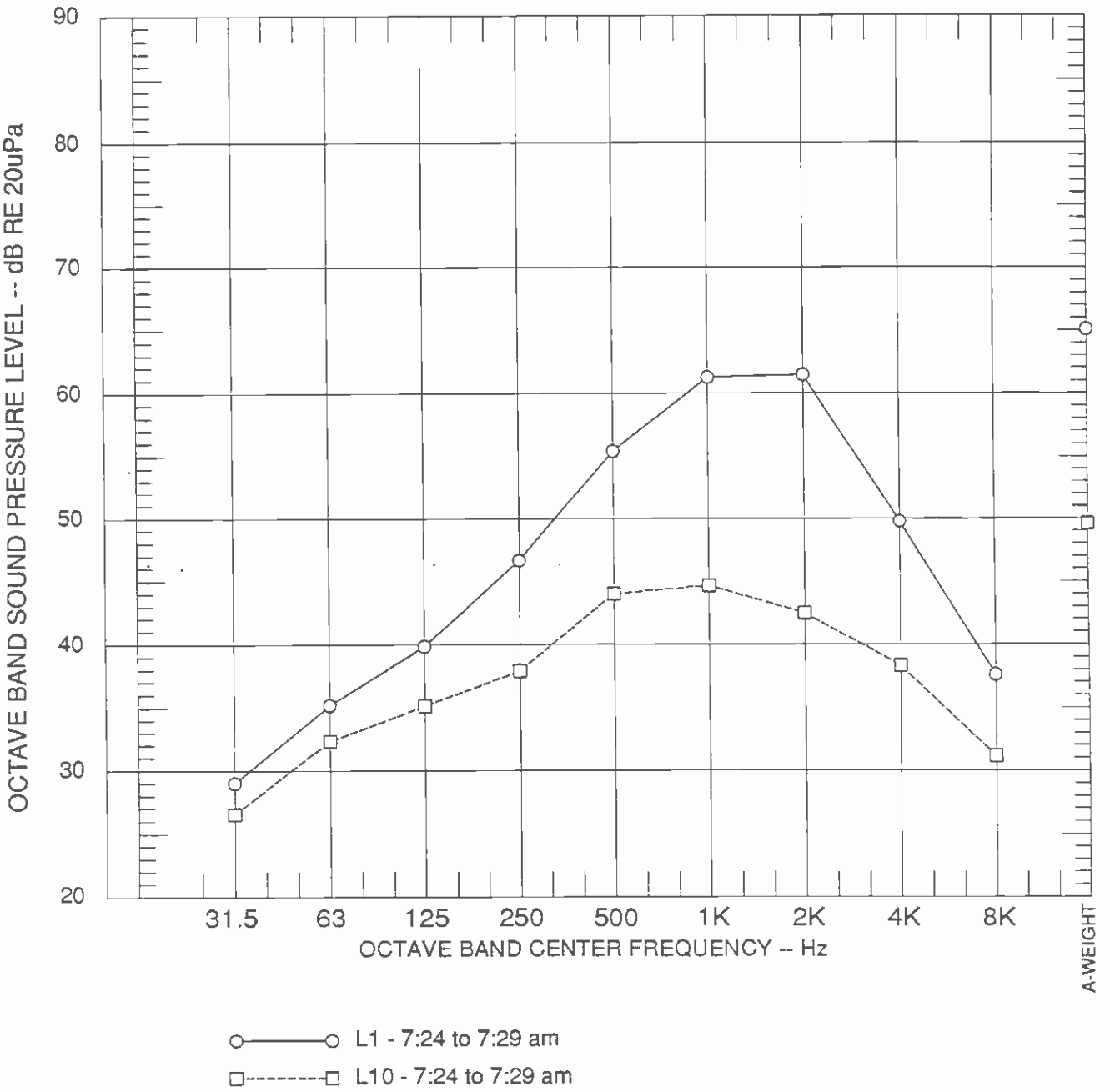


FIGURE 20 A-WEIGHTED INTERIOR NOISE LEVELS MEASURED AT KTLA CHANNEL 5 (STAGE 9) ON THURSDAY, 10 SEPTEMBER, 1987

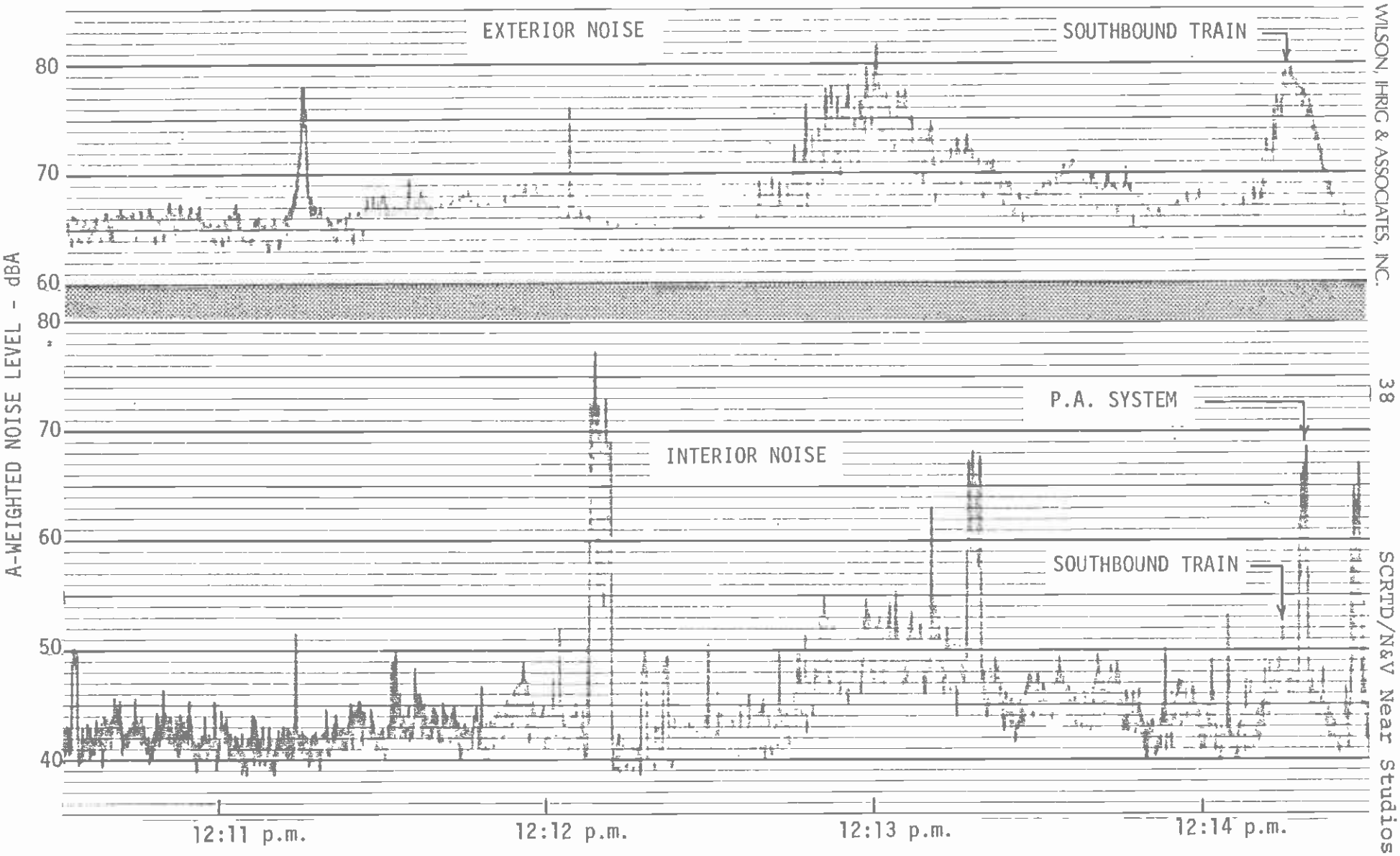


FIGURE 21 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE CEDARS MEDICAL CENTER, MIAMI, MEASURED ON TUESDAY, 15 SEPTEMBER 1987.

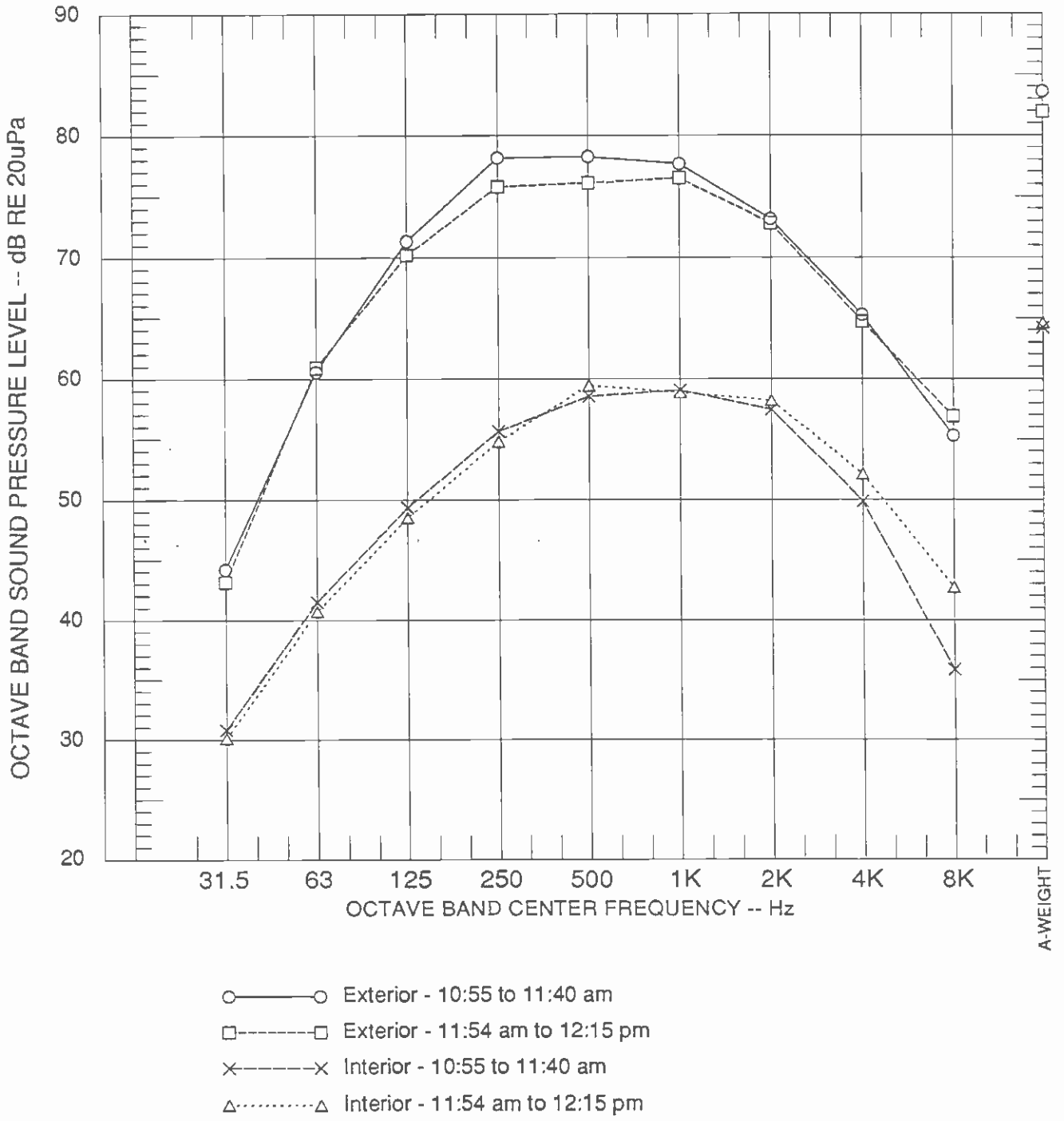


FIGURE 22 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 9/15/87

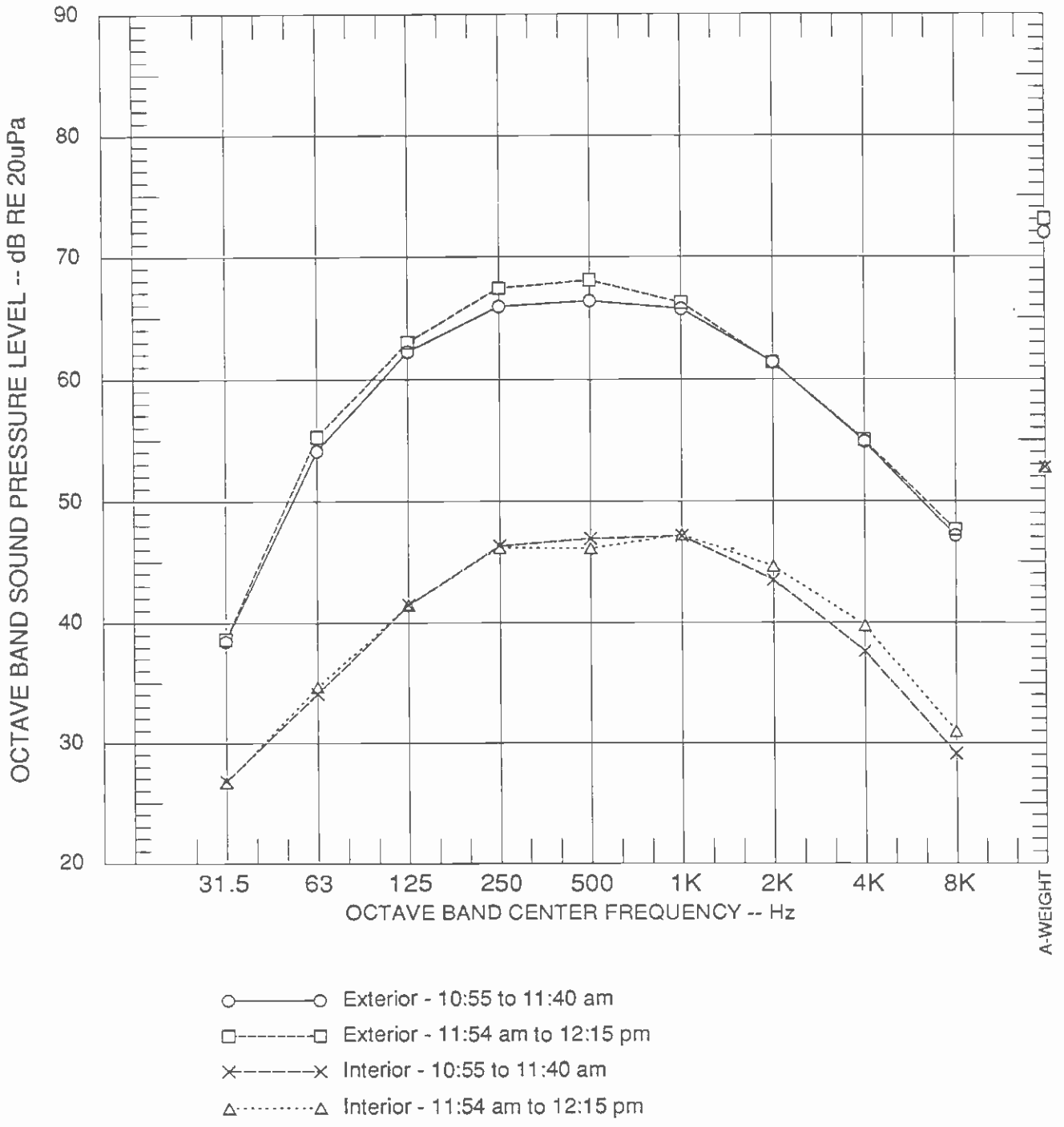


FIGURE 23 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 9/15/87

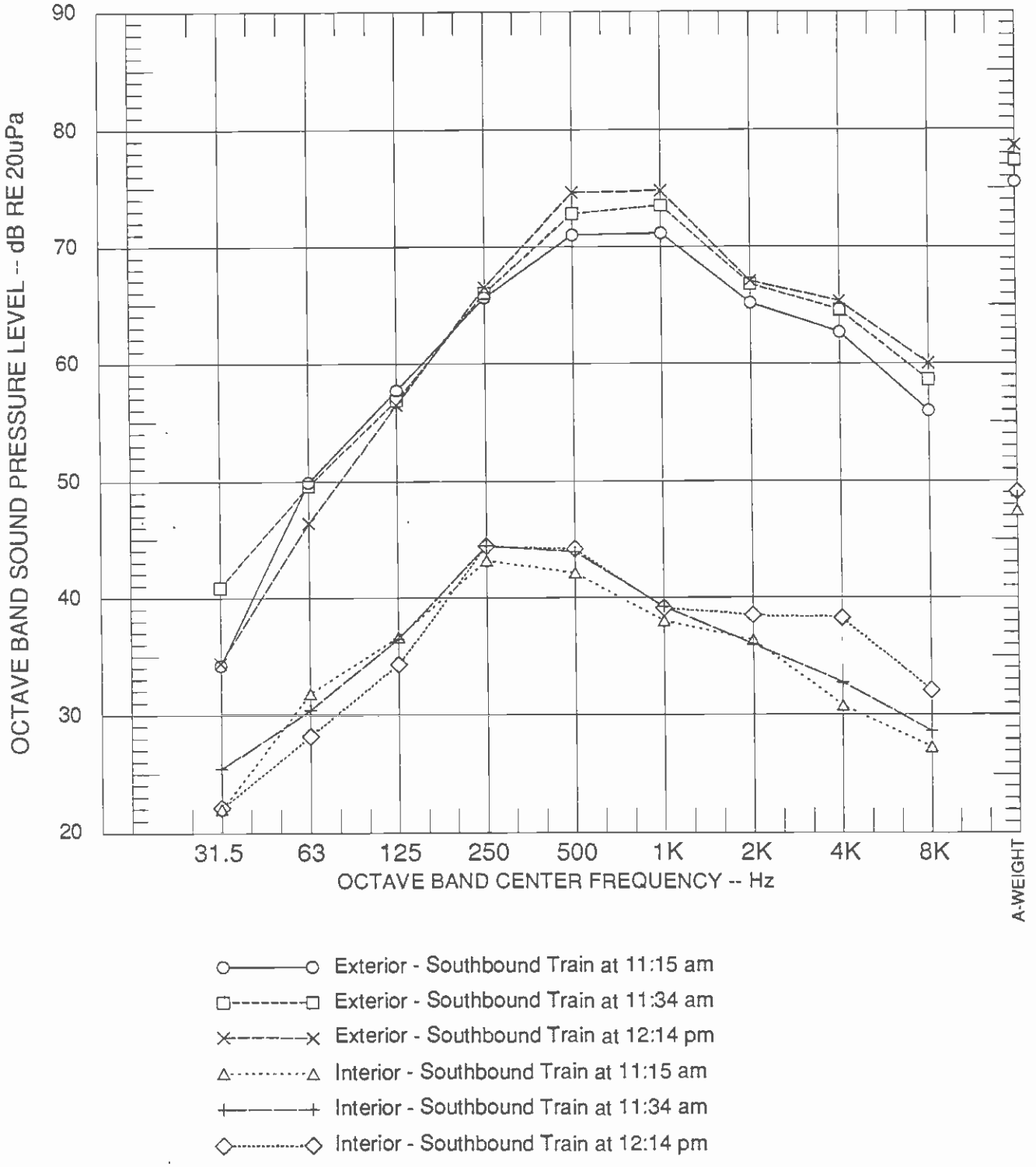


FIGURE 24 TYPICAL A-WEIGHTED EXTERIOR AND INTERIOR TRAIN PASSBY NOISE LEVELS MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 15 SEPTEMBER, 1987

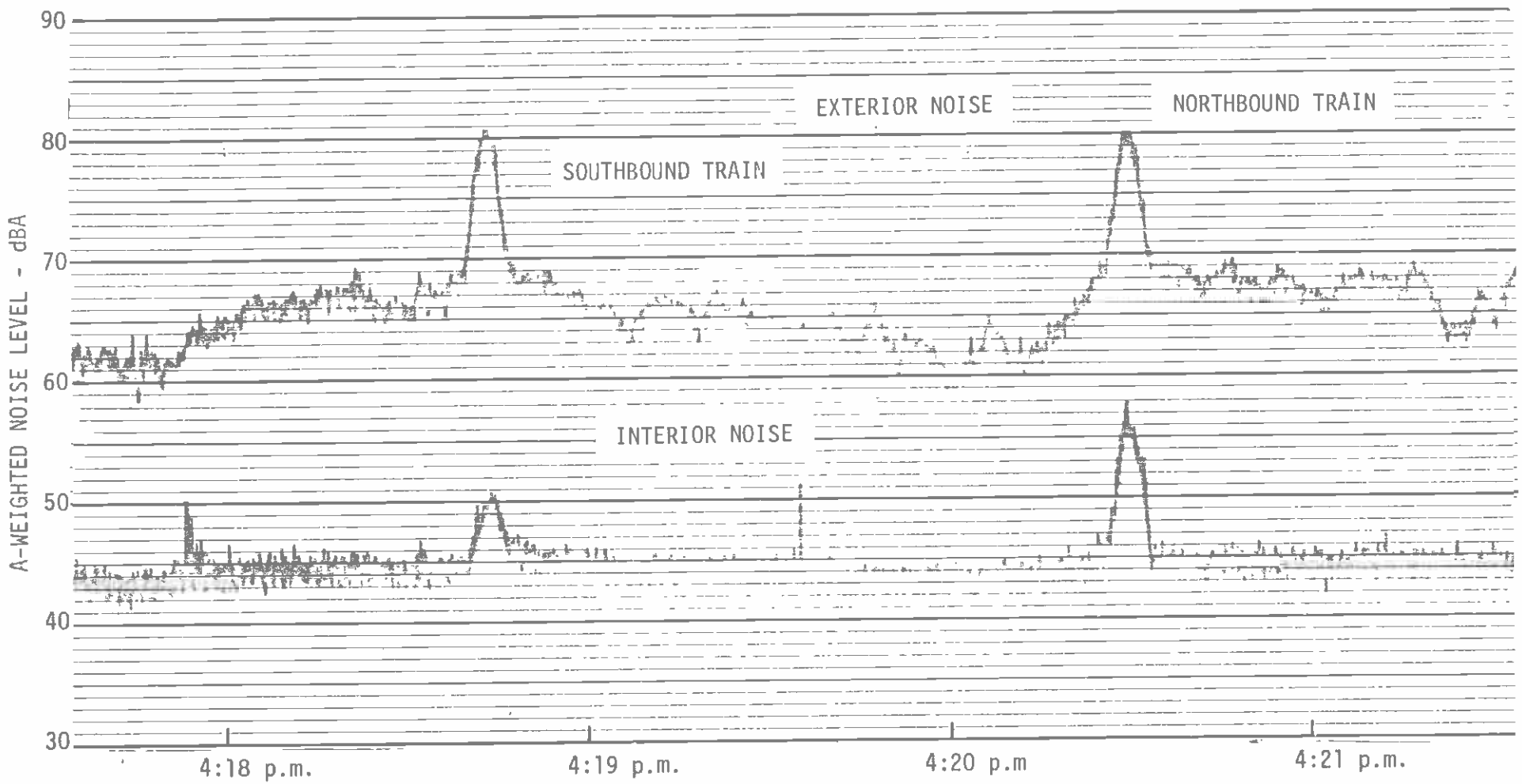


FIGURE 25 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE SOUTH MIAMI HOSPITAL, MEASURED ON TUESDAY, 15 SEPTEMBER 1987.

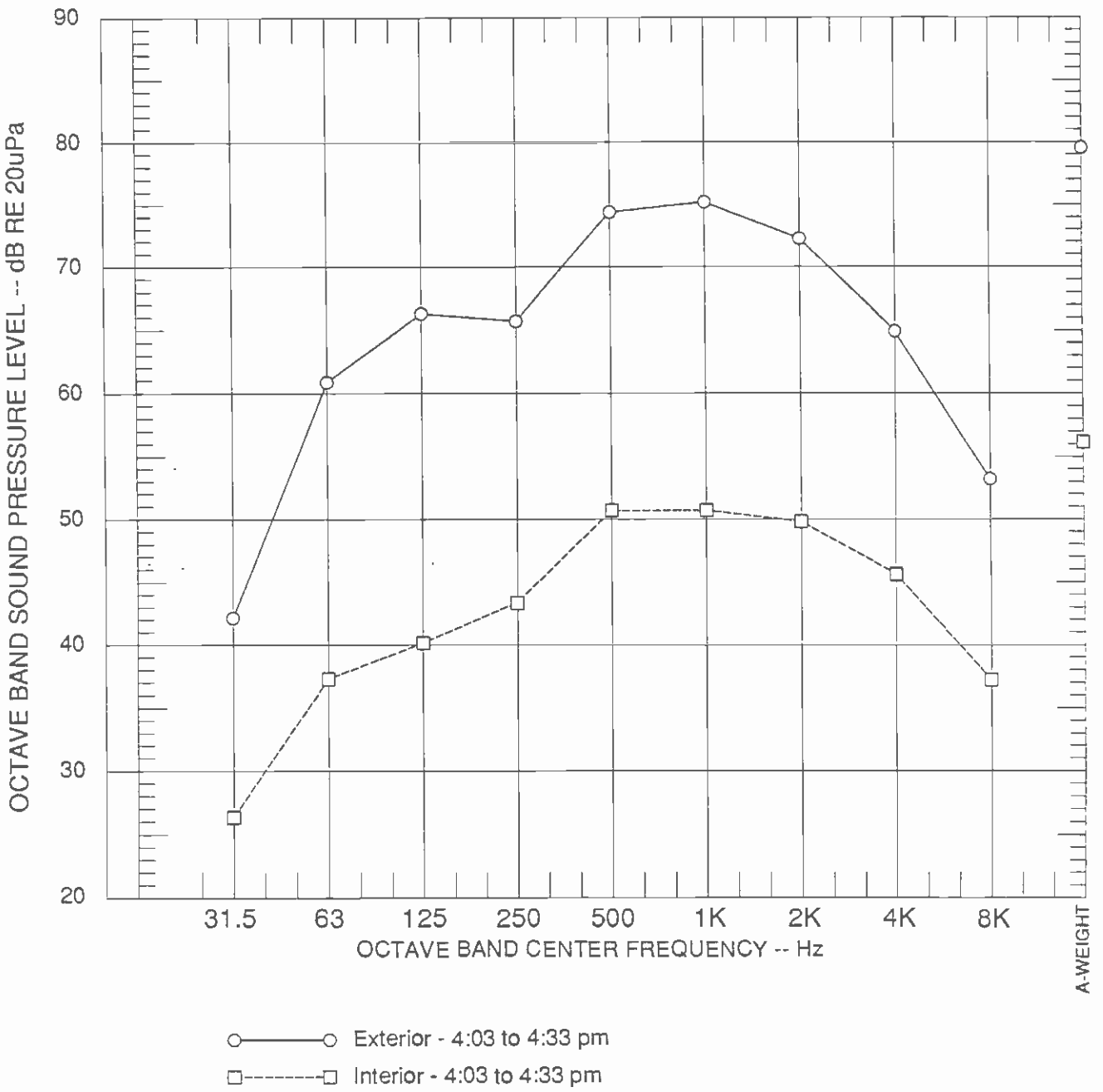


FIGURE 26 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

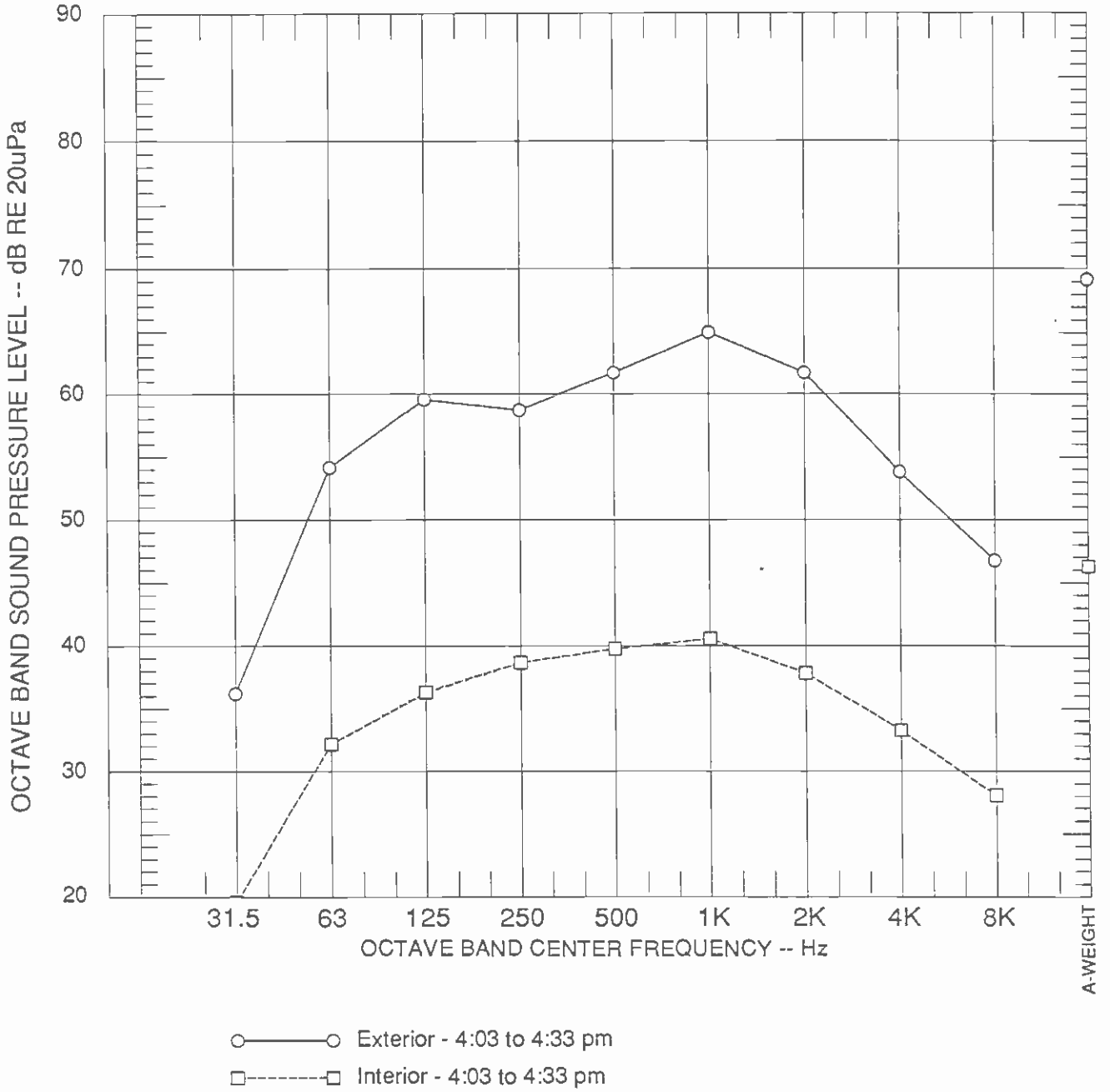


FIGURE 27 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

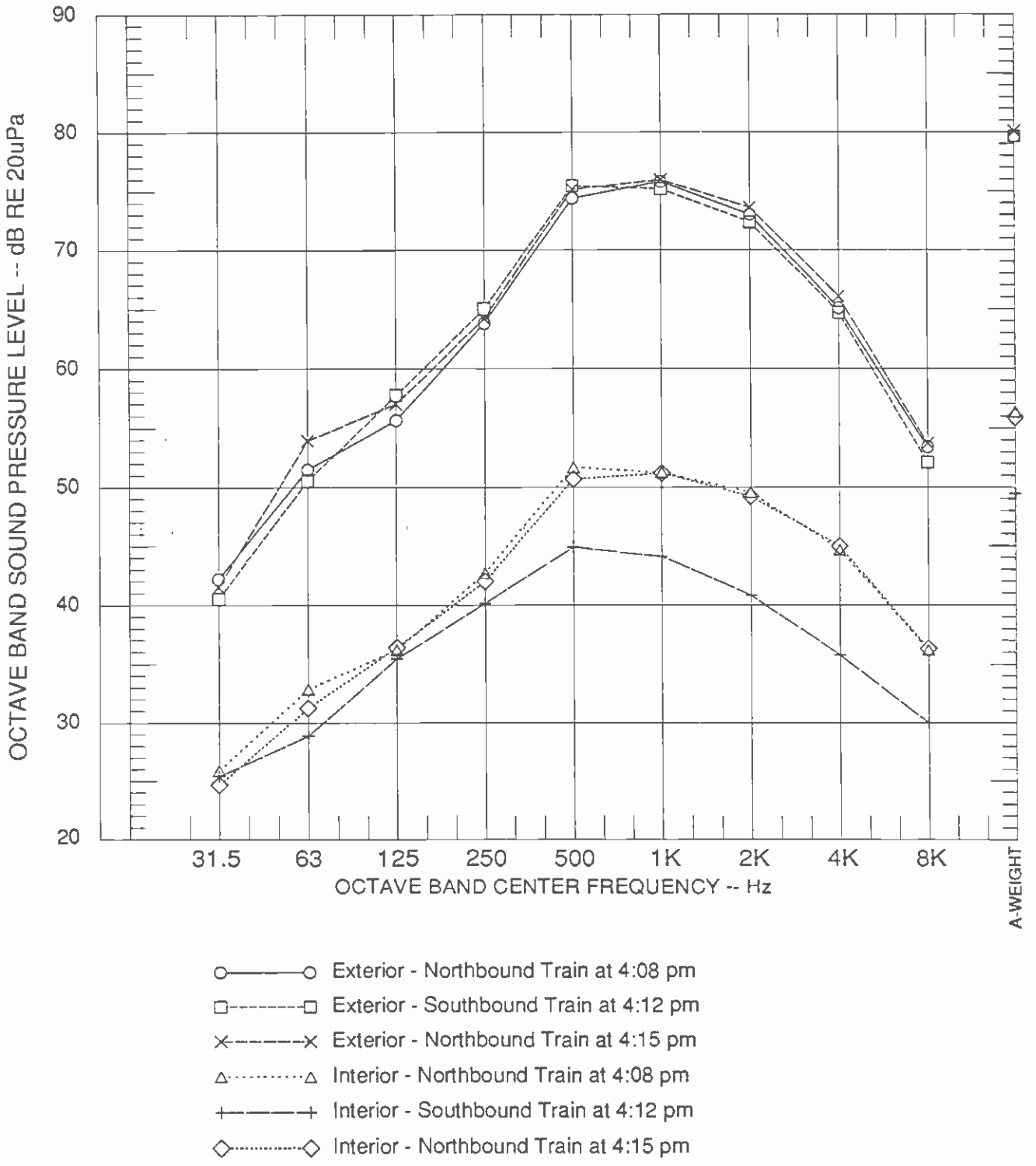


FIGURE 28 TYPICAL A-WEIGHTED EXTERIOR AND INTERIOR TRAIN PASSBY NOISE LEVELS MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

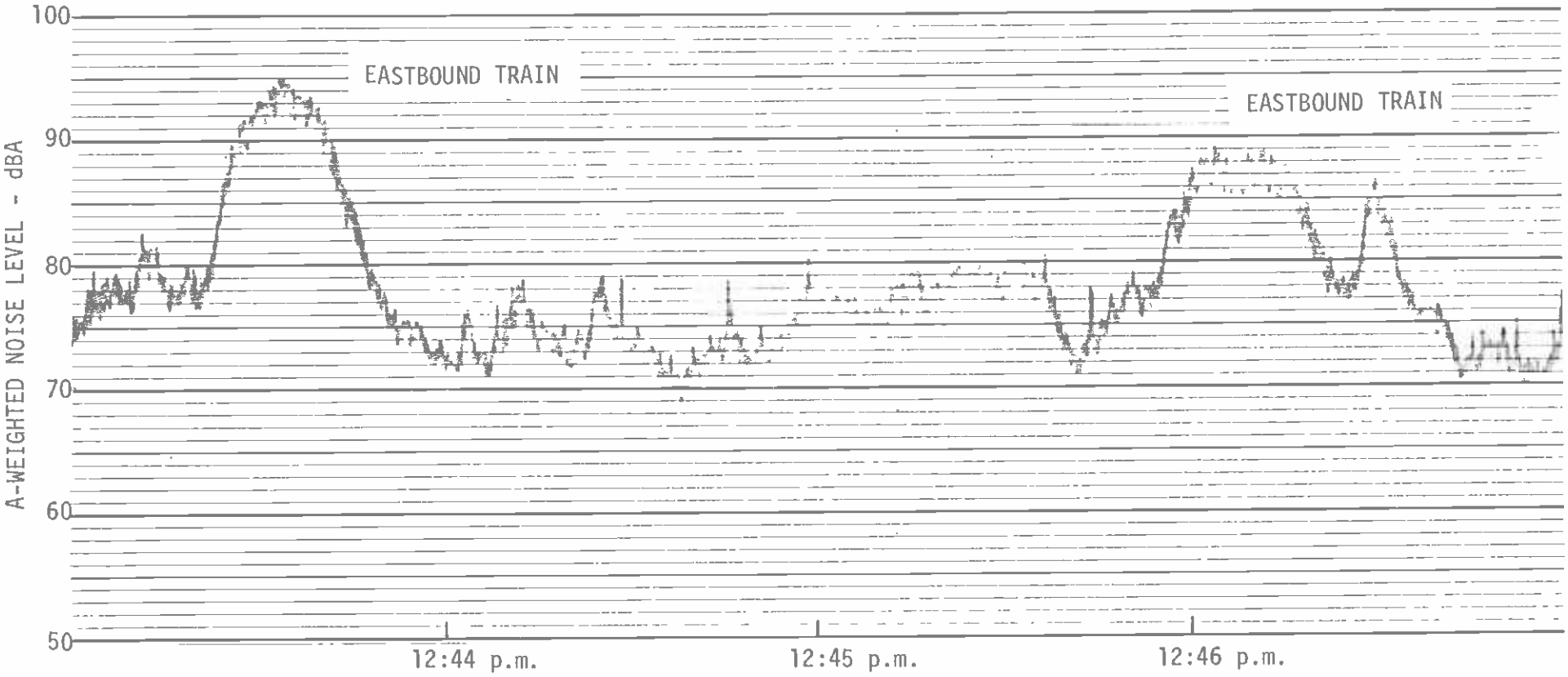


FIGURE 29 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, MEASURED ON WEDNESDAY, 16 SEPTEMBER 1987.

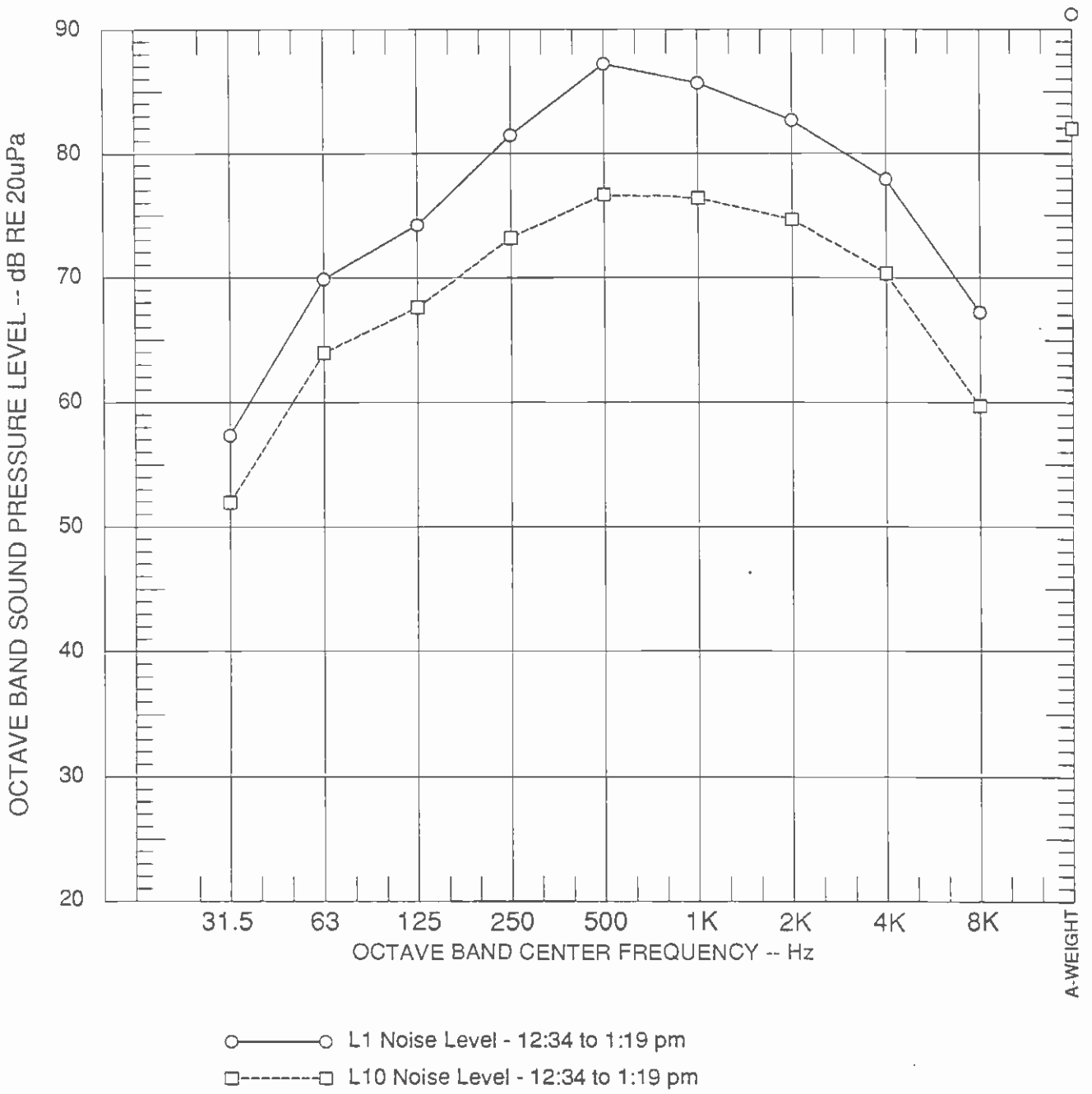


FIGURE 30 A-WEIGHTED NOISE LEVELS MEASURED OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, ON WEDNESDAY, 16 SEPTEMBER, 1987

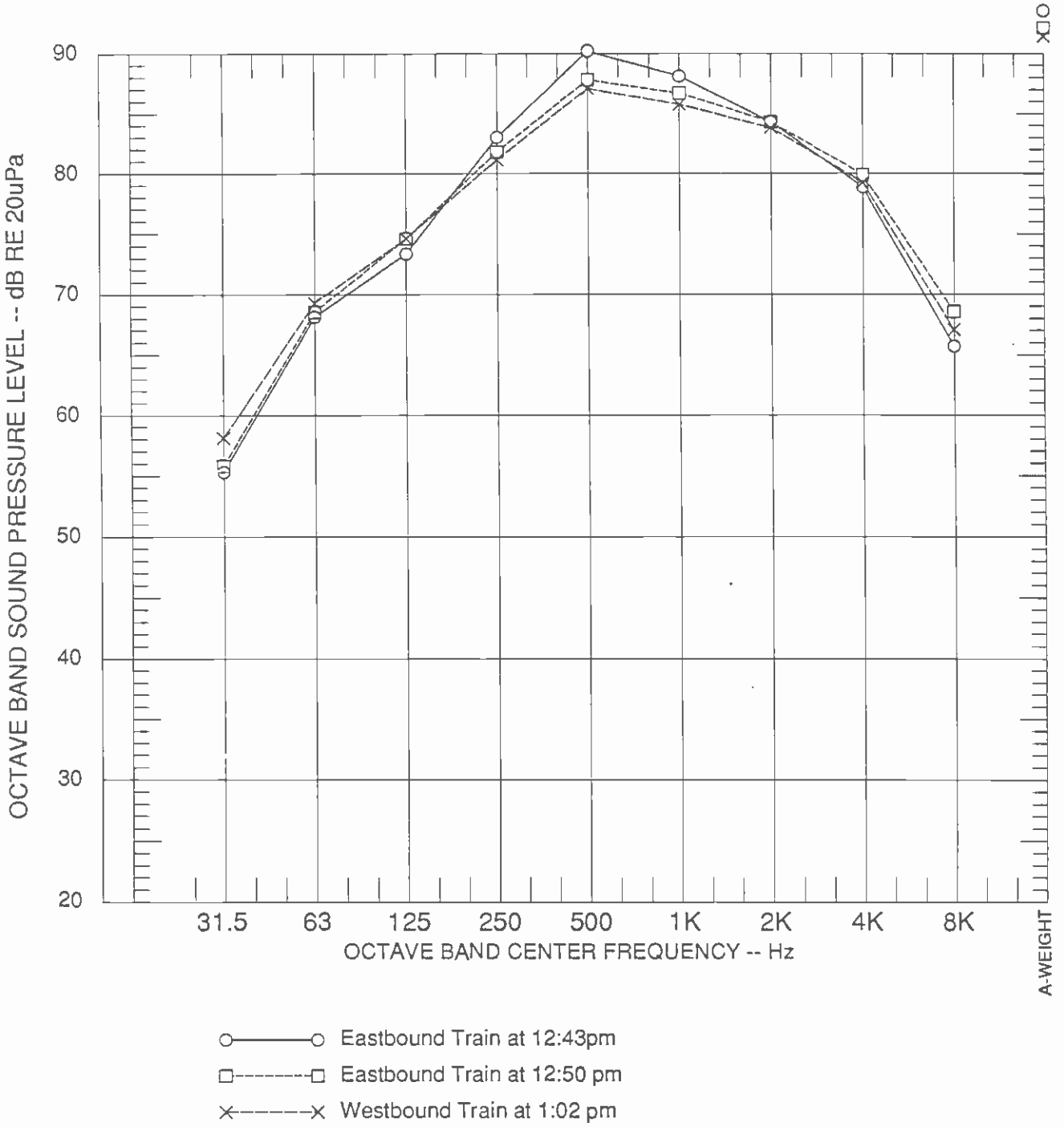


FIGURE 31 TYPICAL A-WEIGHTED TRAIN PASSBY NOISE LEVELS MEASURED OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, ON WEDNESDAY, 16 SEPTEMBER, 1987

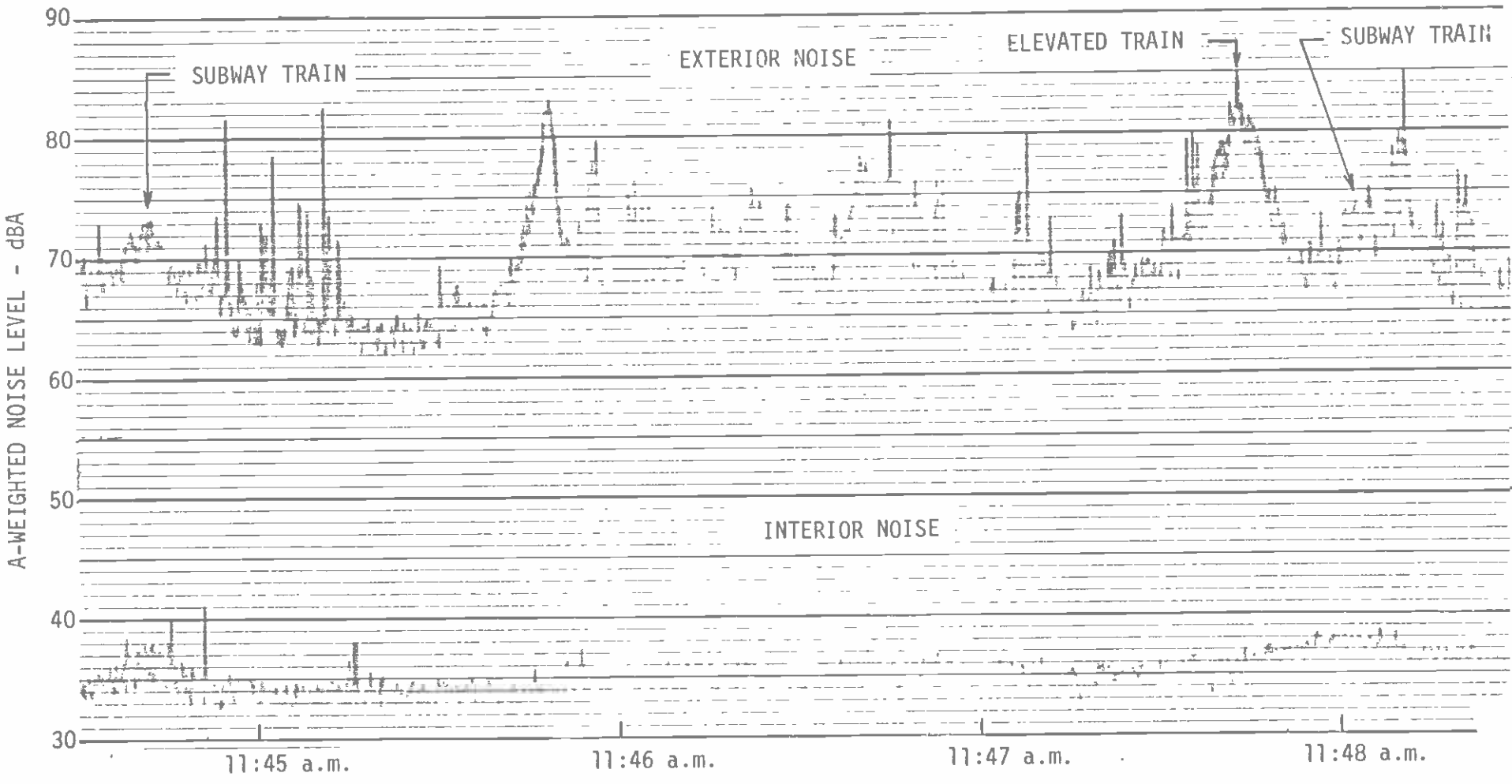


FIGURE 32 SECTION OF THE TIME HISTORY OF THE A-WEIGHTED NOISE LEVEL INSIDE AND OUTSIDE THE ABC (WLS-TV) STUDIOS (STUDIO 2), CHICAGO, MEASURED ON THURSDAY, 17 SEPTEMBER 1987.

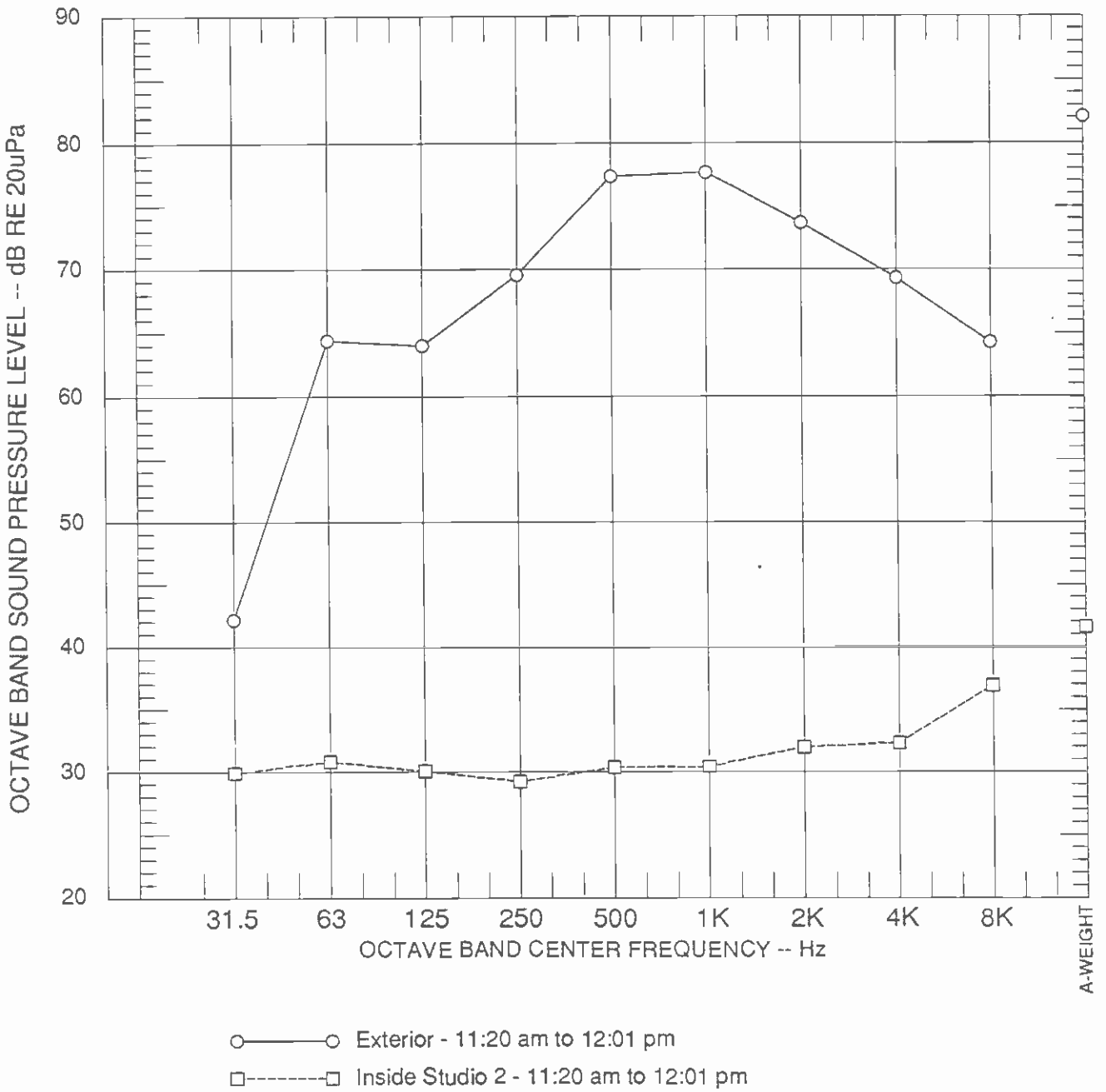


FIGURE 33 A-WEIGHTED EXTERIOR AND INTERIOR L1 NOISE LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

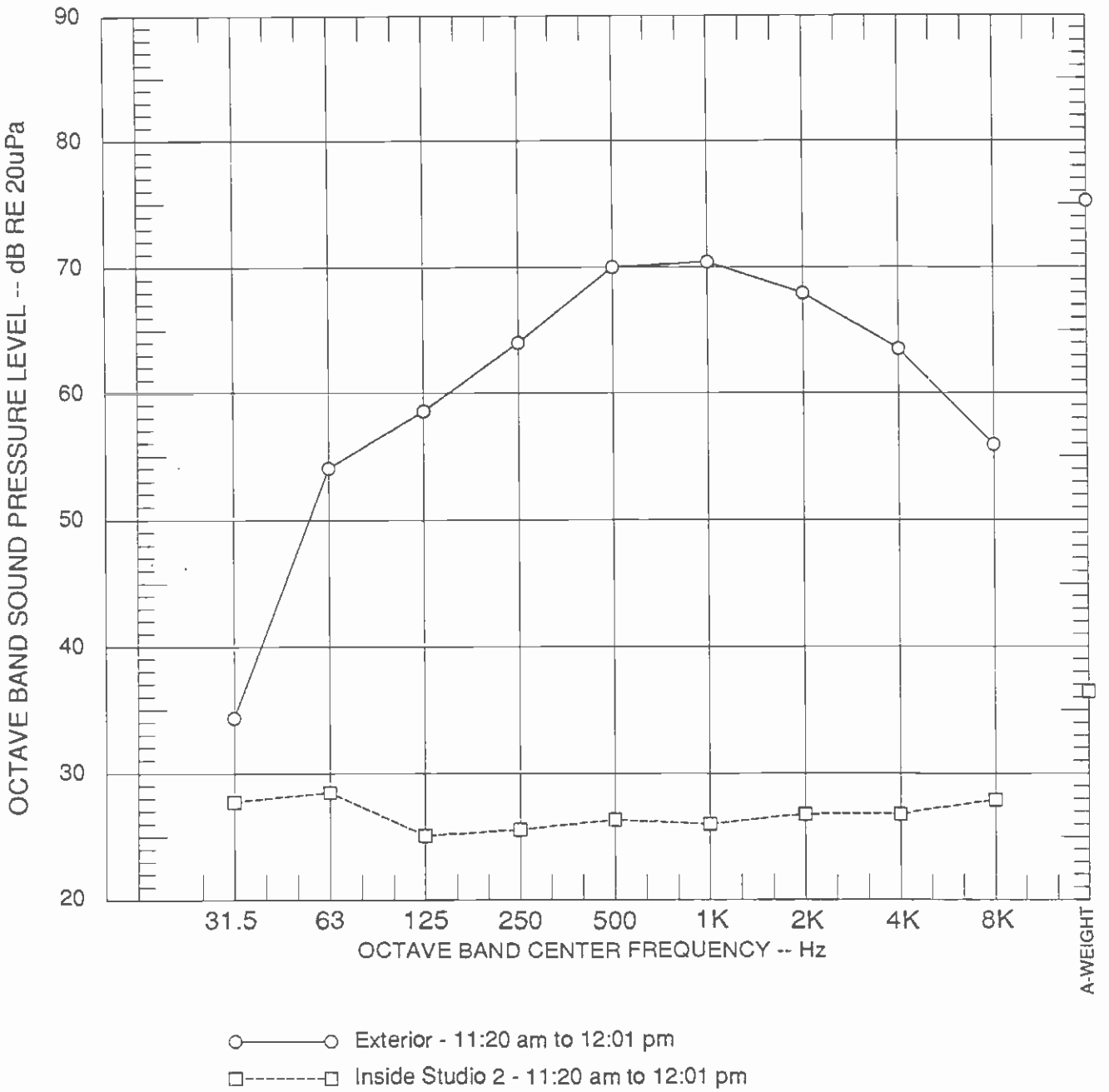


FIGURE 34 A-WEIGHTED EXTERIOR AND INTERIOR L10 NOISE LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

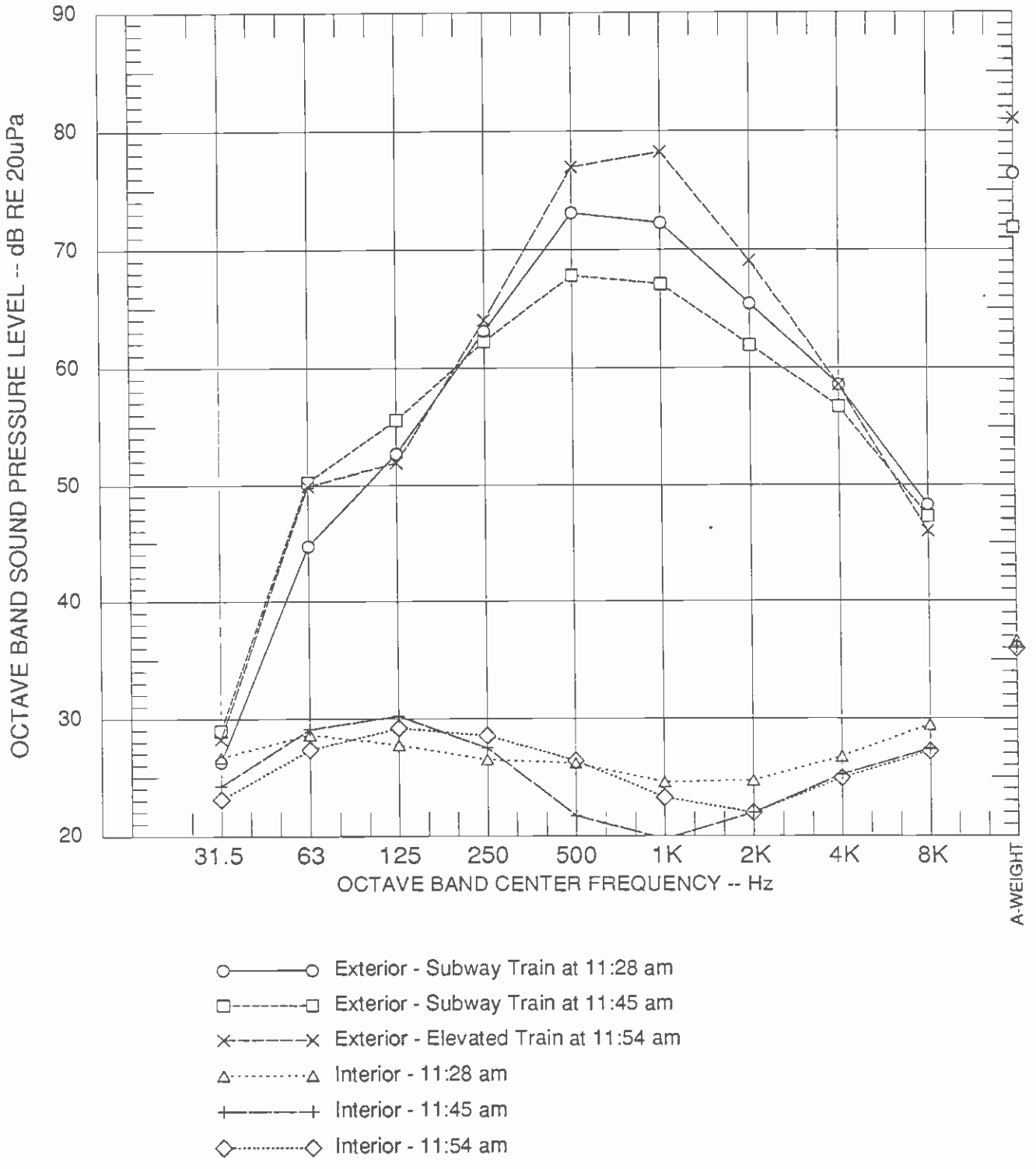


FIGURE 35 TYPICAL A-WEIGHTED EXTERIOR AND INTERIOR NOISE LEVELS MEASURED DURING TRAIN PASSBYS AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, SEPTEMBER 17, 1987

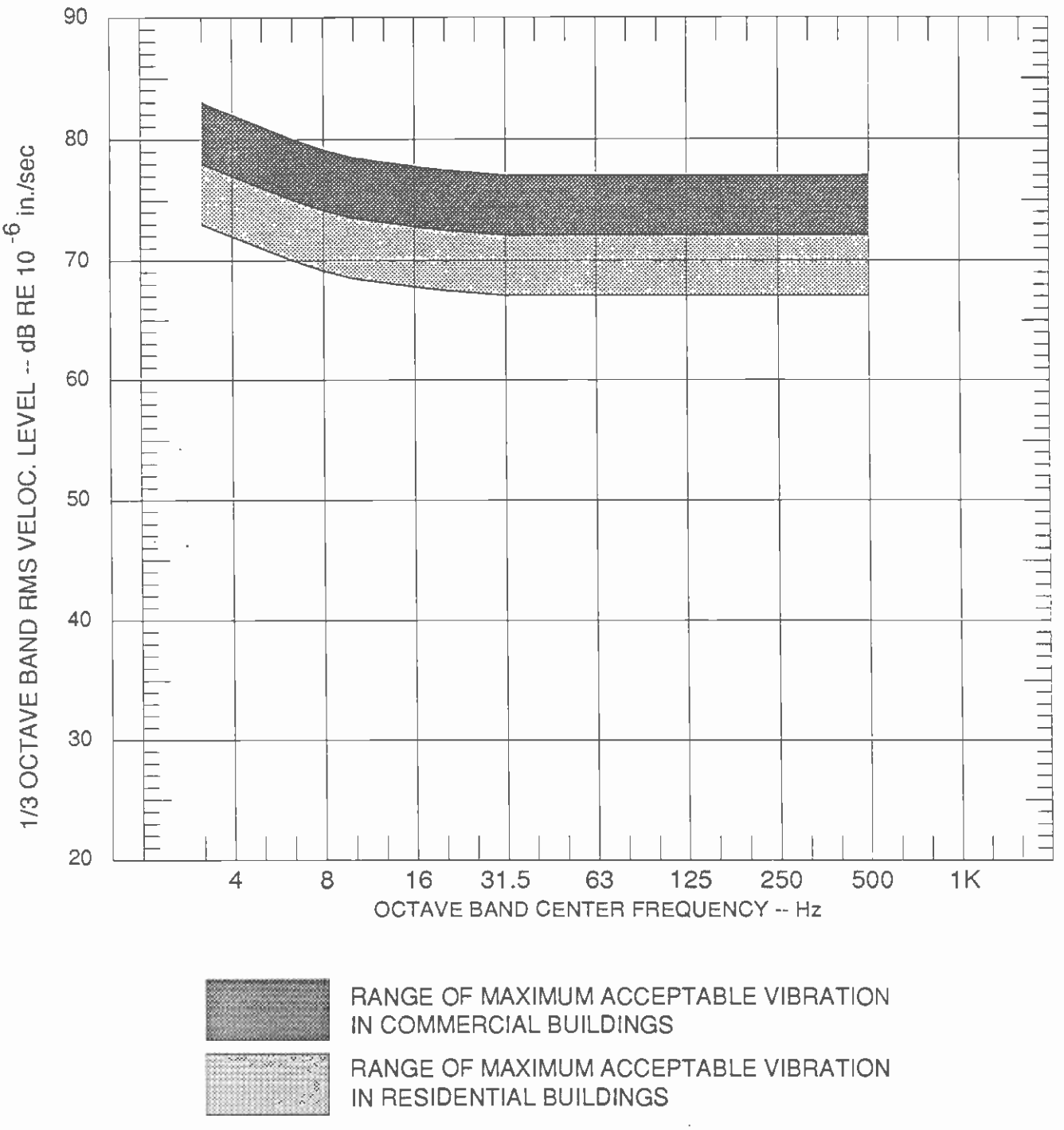


FIGURE 36 CRITERIA FOR ACCEPTABLE LEVELS OF TRANSIENT GROUND-BORNE VIBRATION IN COMMERCIAL AND RESIDENTIAL STRUCTURES

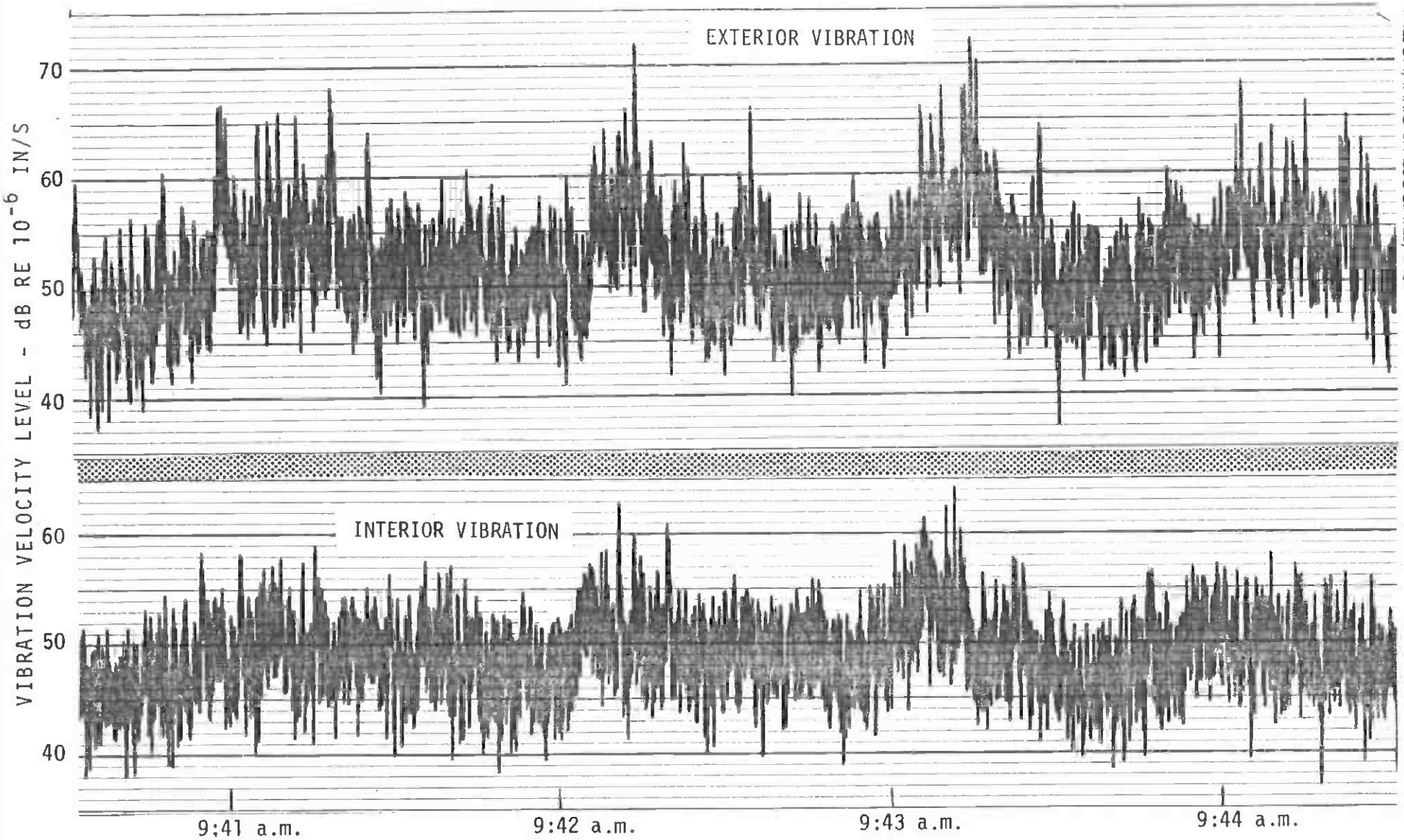


FIGURE 37 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE KTTV CHANNEL 11 (STAGE 7), MEASURED ON TUESDAY, 8 SEPTEMBER 1987

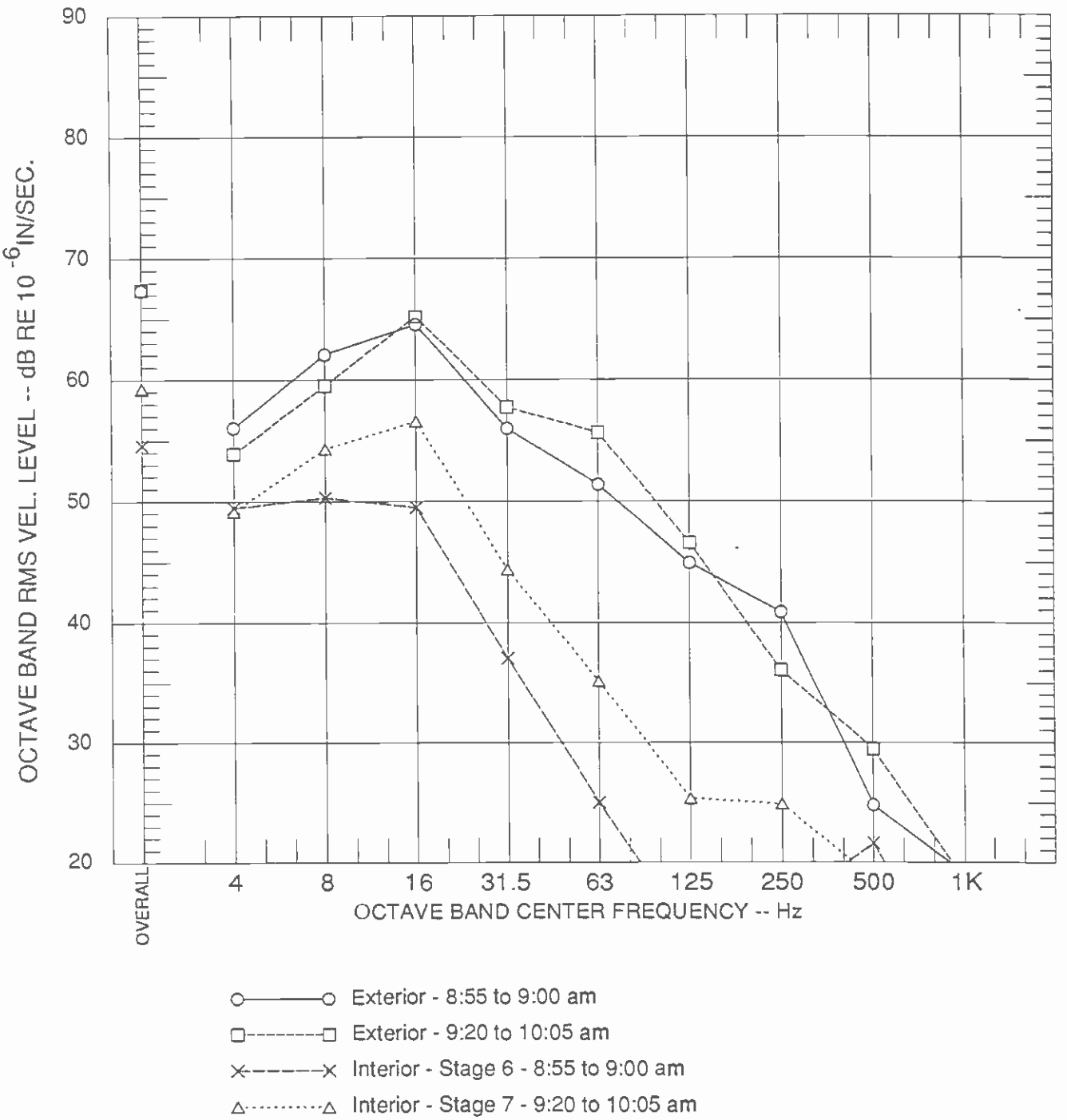


FIGURE 38 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT KTTV CHANNEL 11 ON TUESDAY, 8 SEPTEMBER, 1987

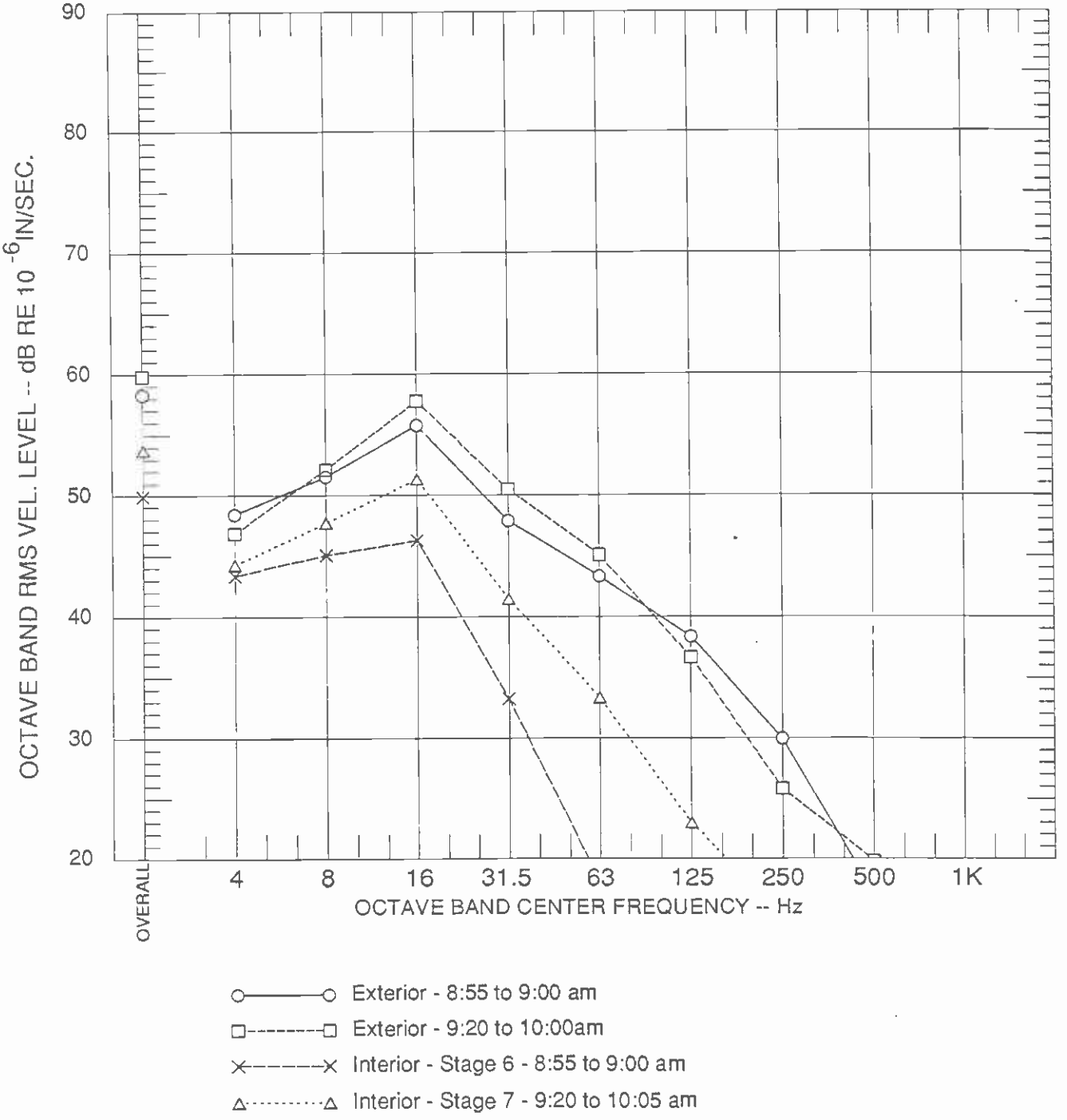


FIGURE 39 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT KTTV CHANNEL 11 ON TUESDAY, 8 SEPTEMBER, 1987

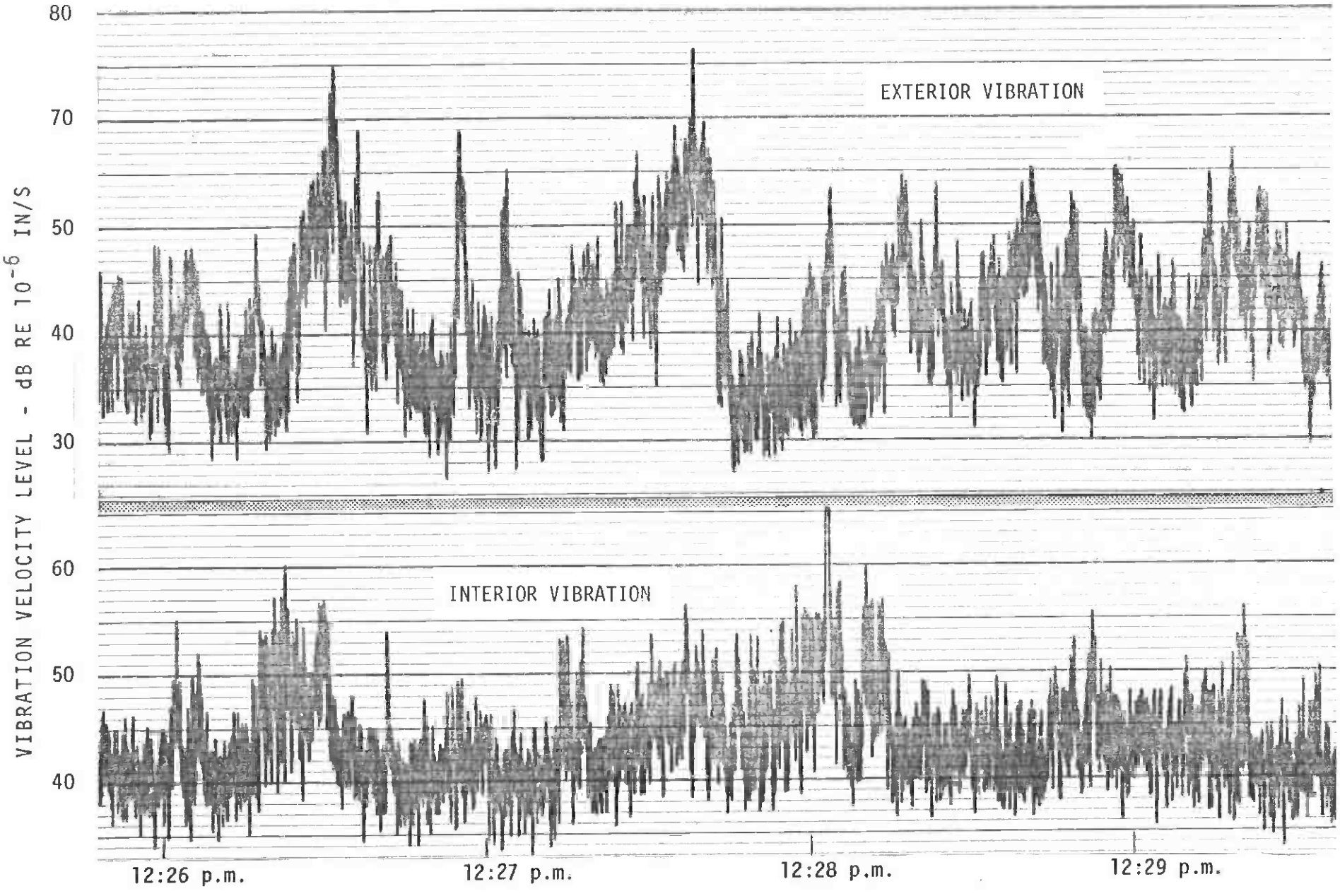


FIGURE 40 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE SELF REALIZATION FELLOWSHIP MEETING AREA, MEASURED ON TUESDAY, 8 SEPTEMBER 1987

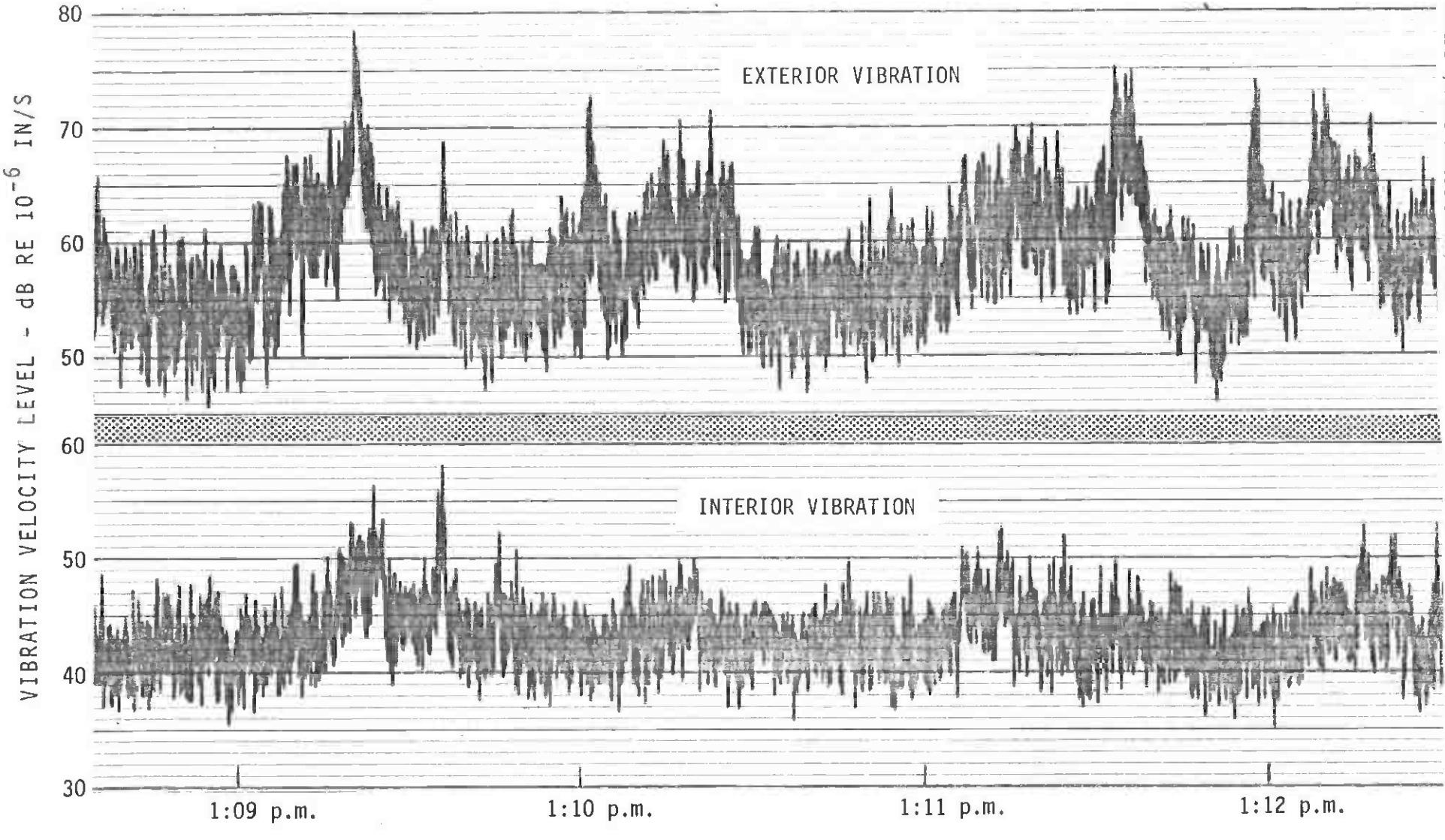


FIGURE 41 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE SELF REALIZATION FELLOWSHIP TEMPLE, MEASURED ON TUESDAY, 8 SEPTEMBER 1987

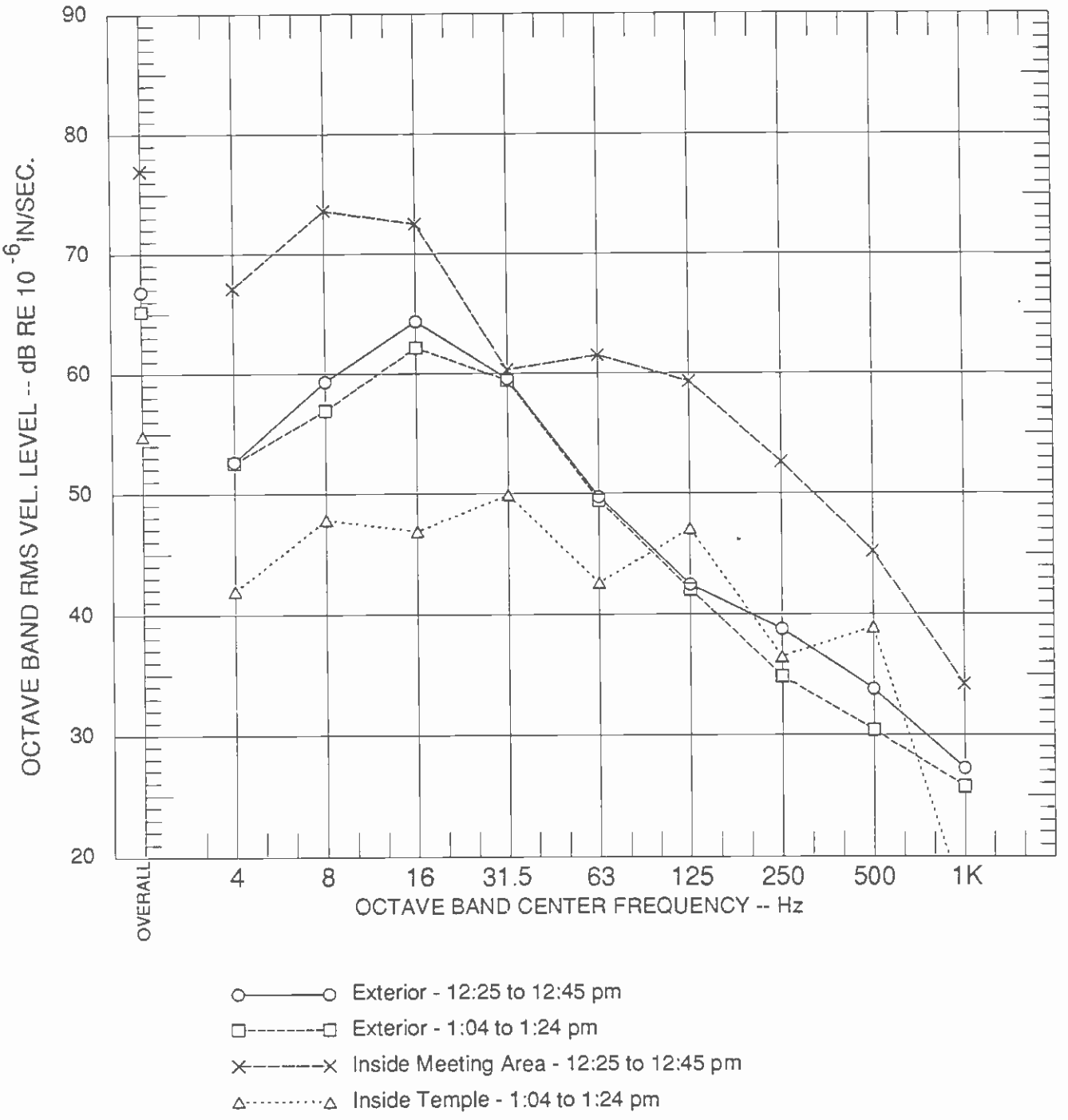


FIGURE 42 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE SELF REALIZATION FELLOWSHIP PREMISES ON TUESDAY, 9/8/87

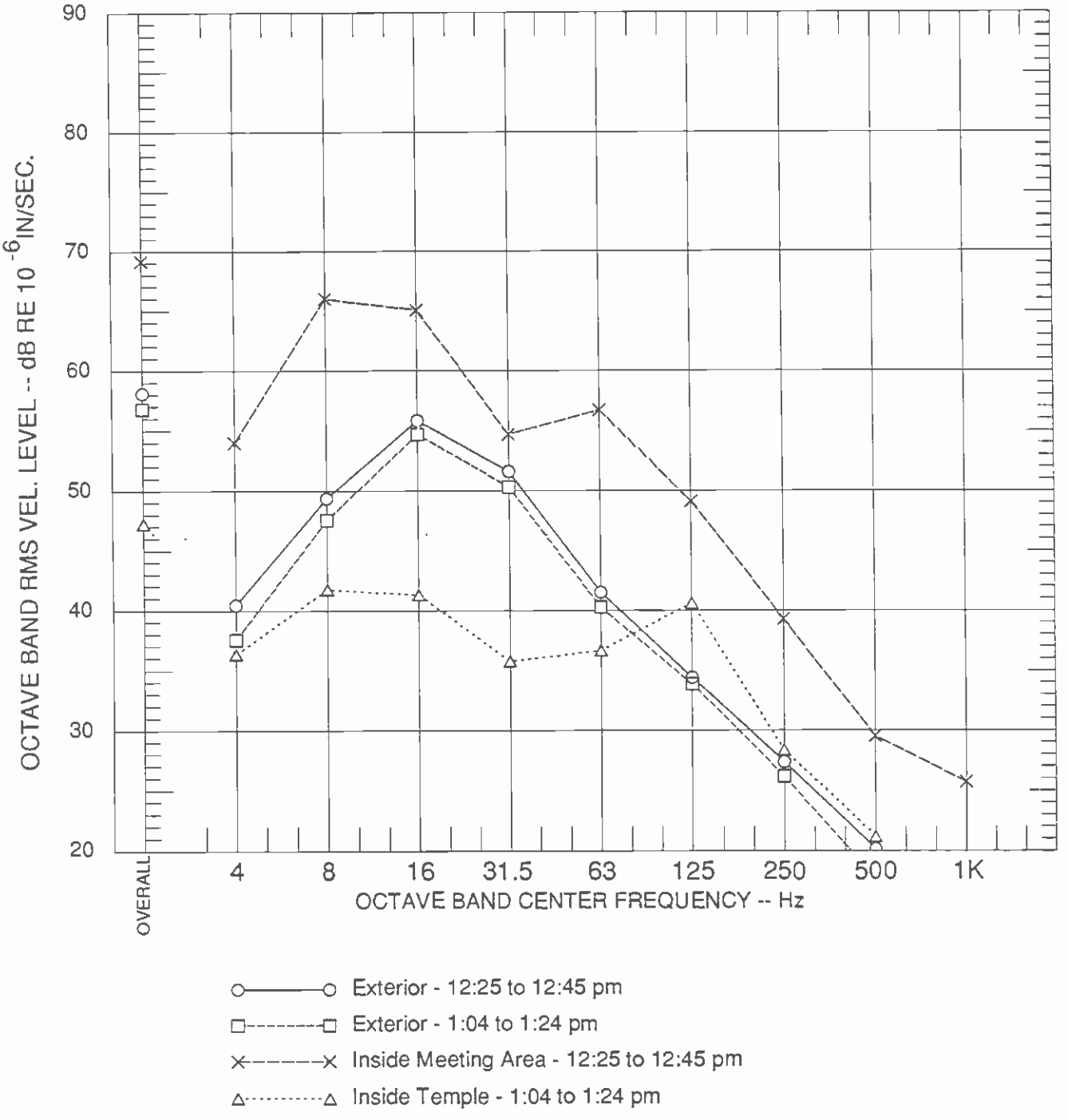


FIGURE 43 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE SELF REALIZATION FELLOWSHIP PREMISES ON 9/8/87

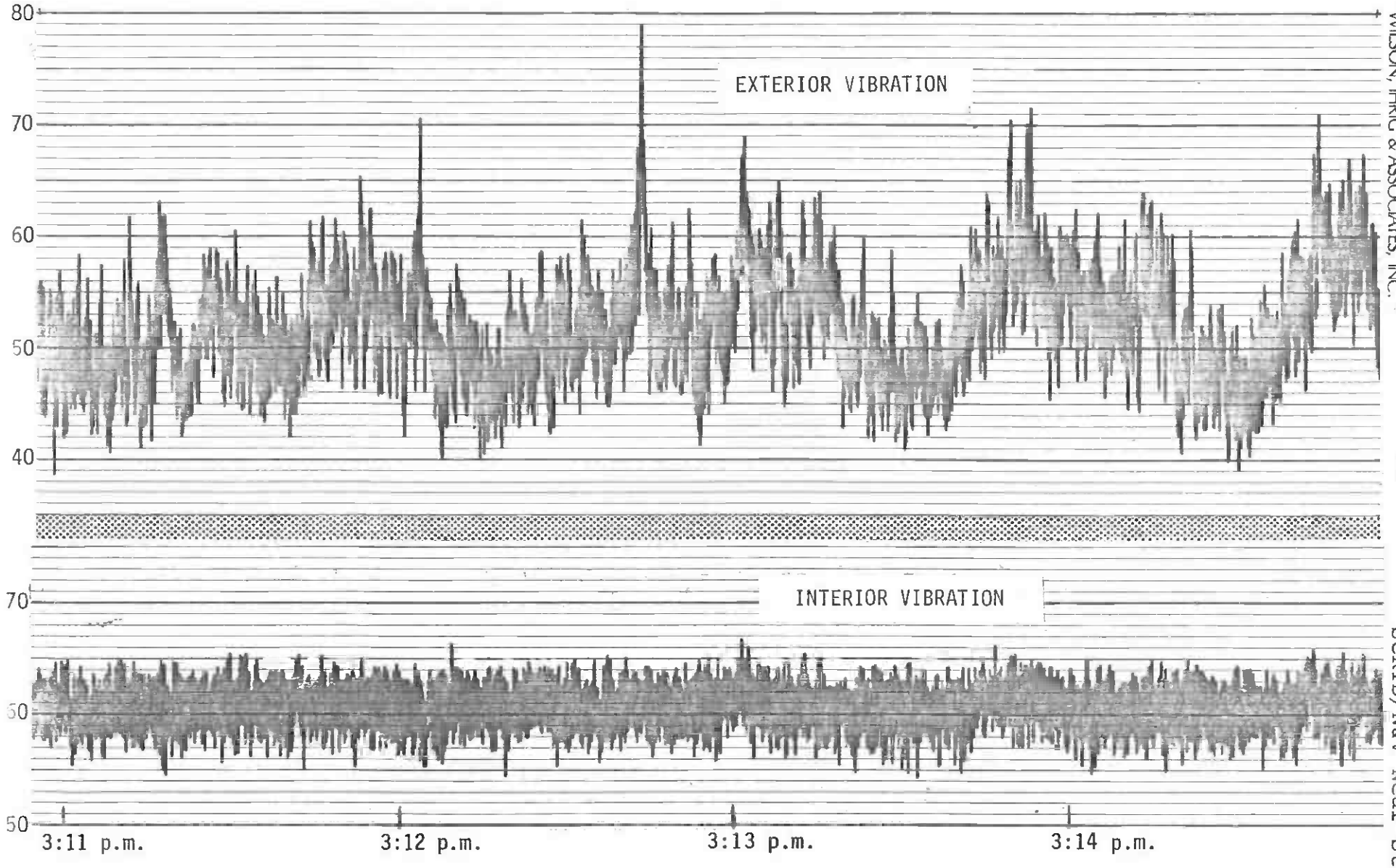


FIGURE 44 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE KMPC AM STUDIOS (CONTROL ROOM B), MEASURED ON TUESDAY, 8 SEPTEMBER 1987

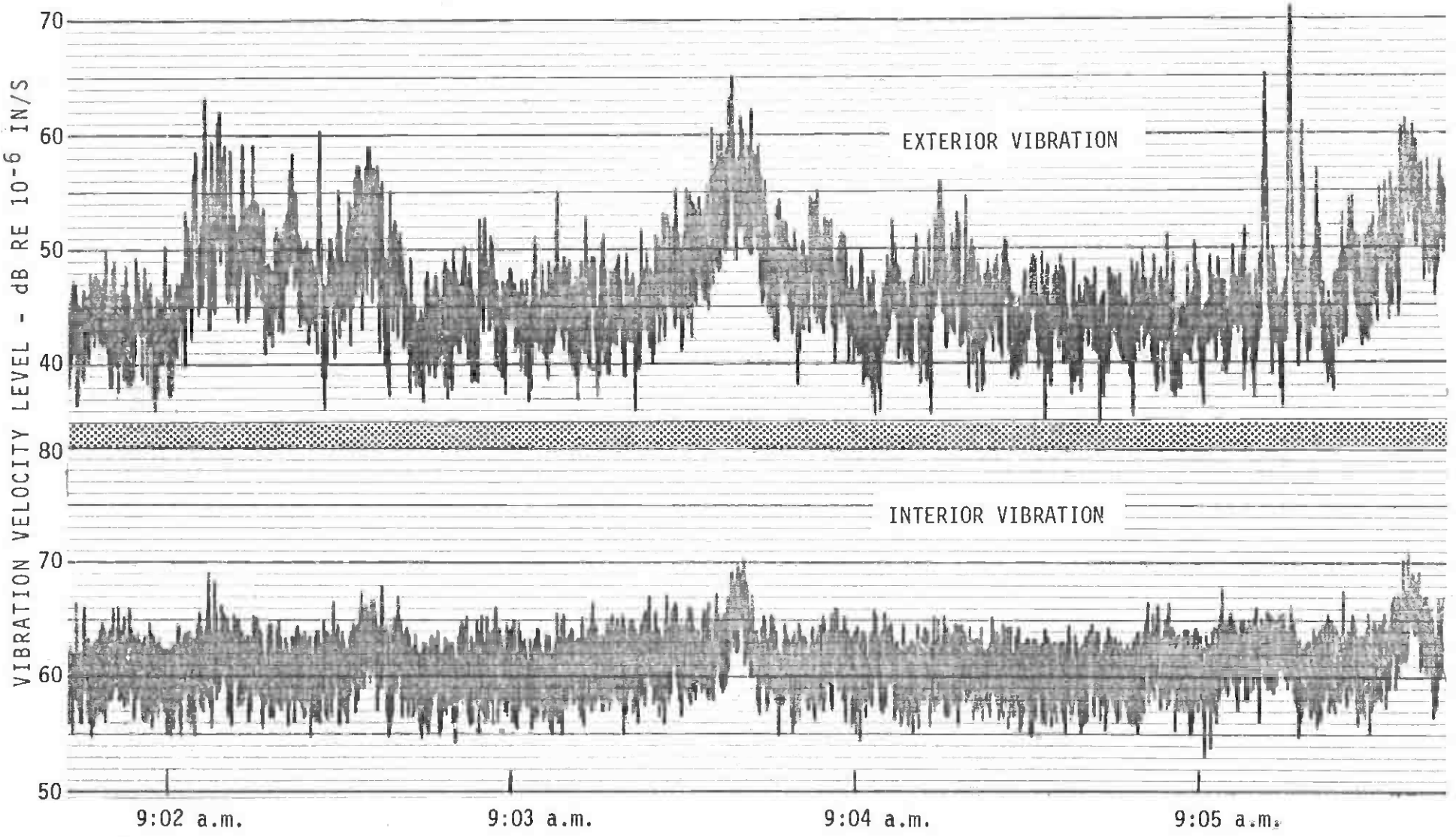


FIGURE 45 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE KMPC AM STUDIOS (PRODUCTION STUDIO), MEASURED ON THURSDAY, 10 SEPTEMBER 1987

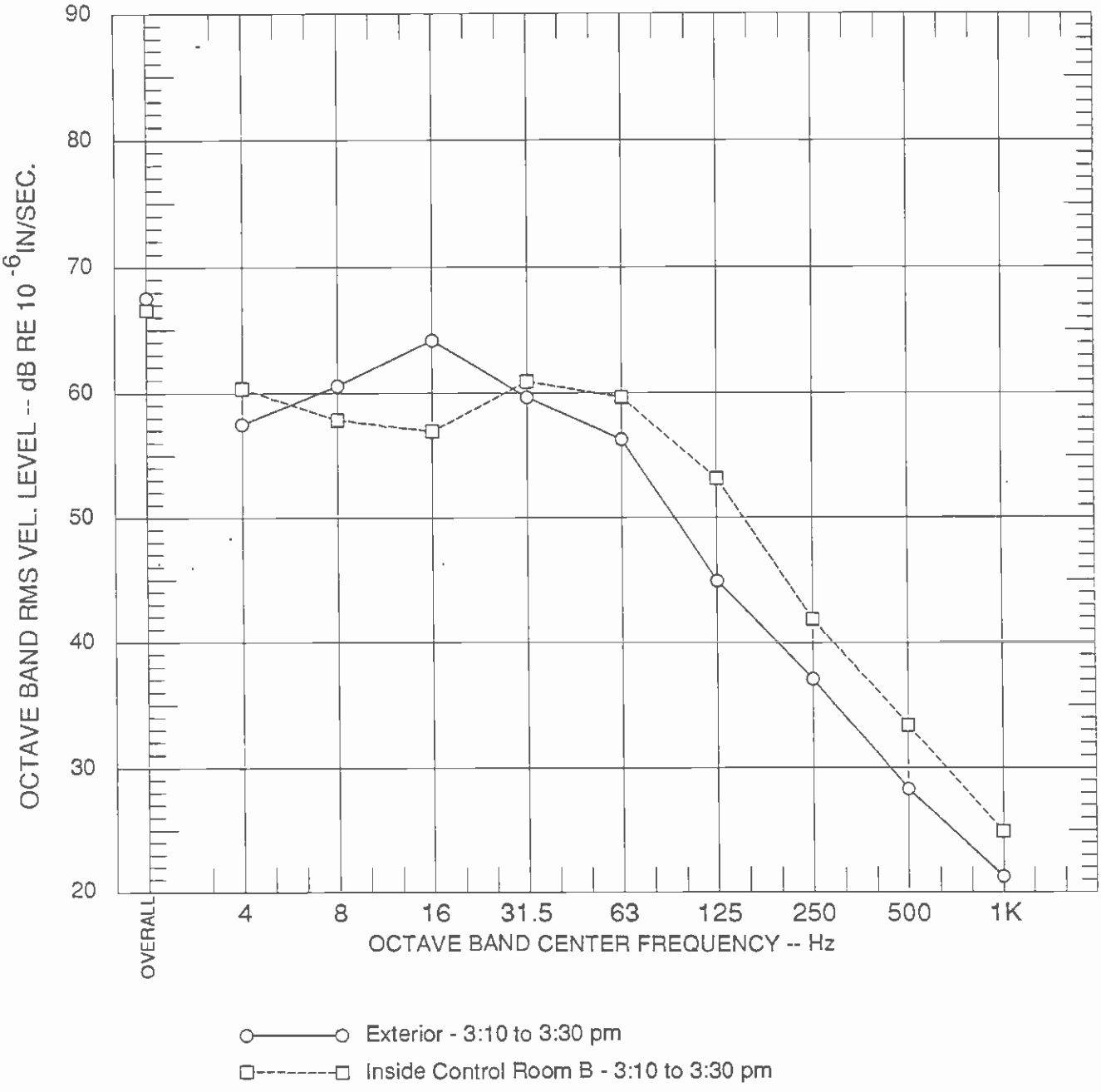


FIGURE 46 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON TUESDAY, 8 SEPTEMBER, 1987

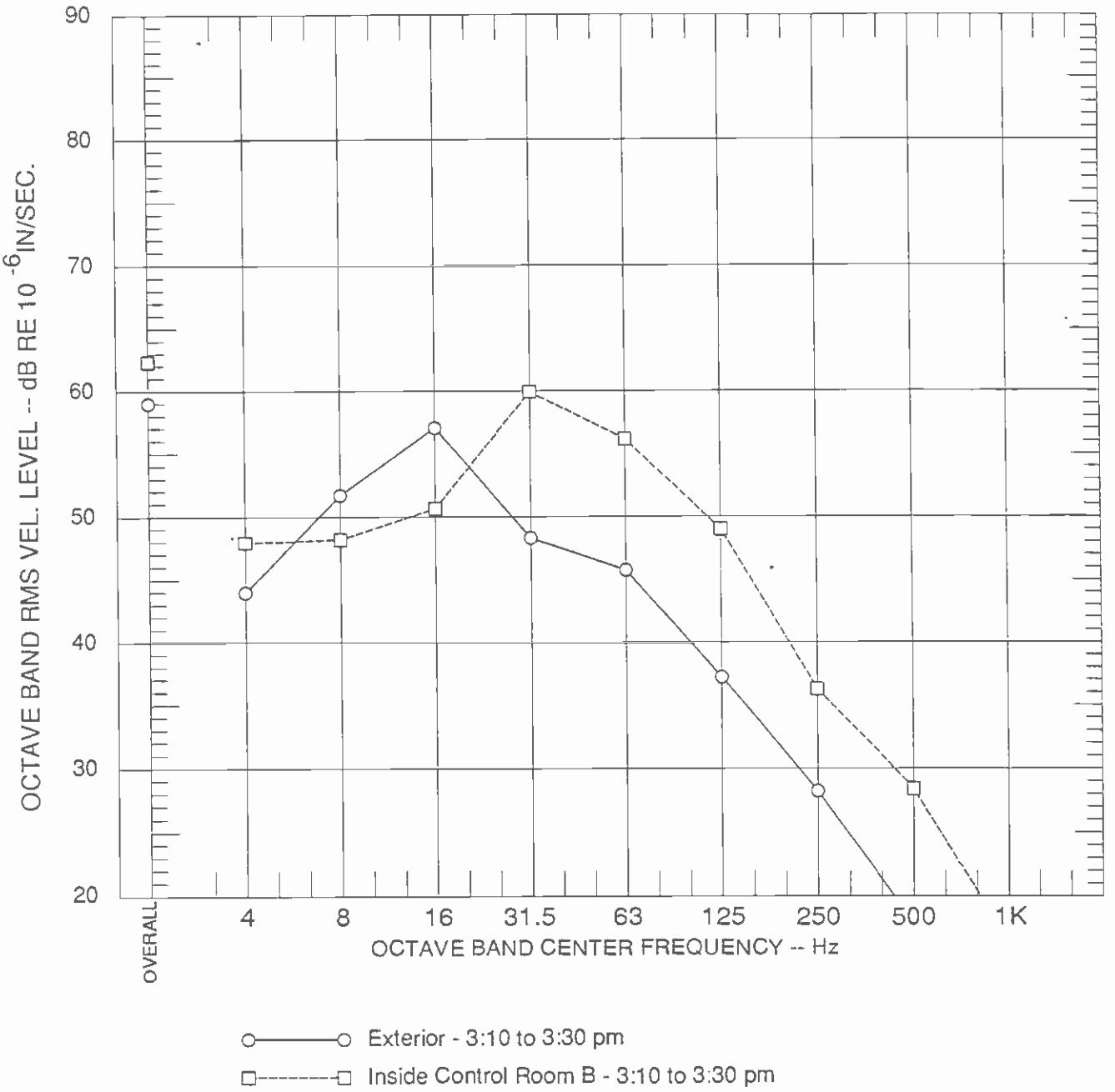


FIGURE 47 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON TUESDAY, 8 SEPTEMBER, 1987

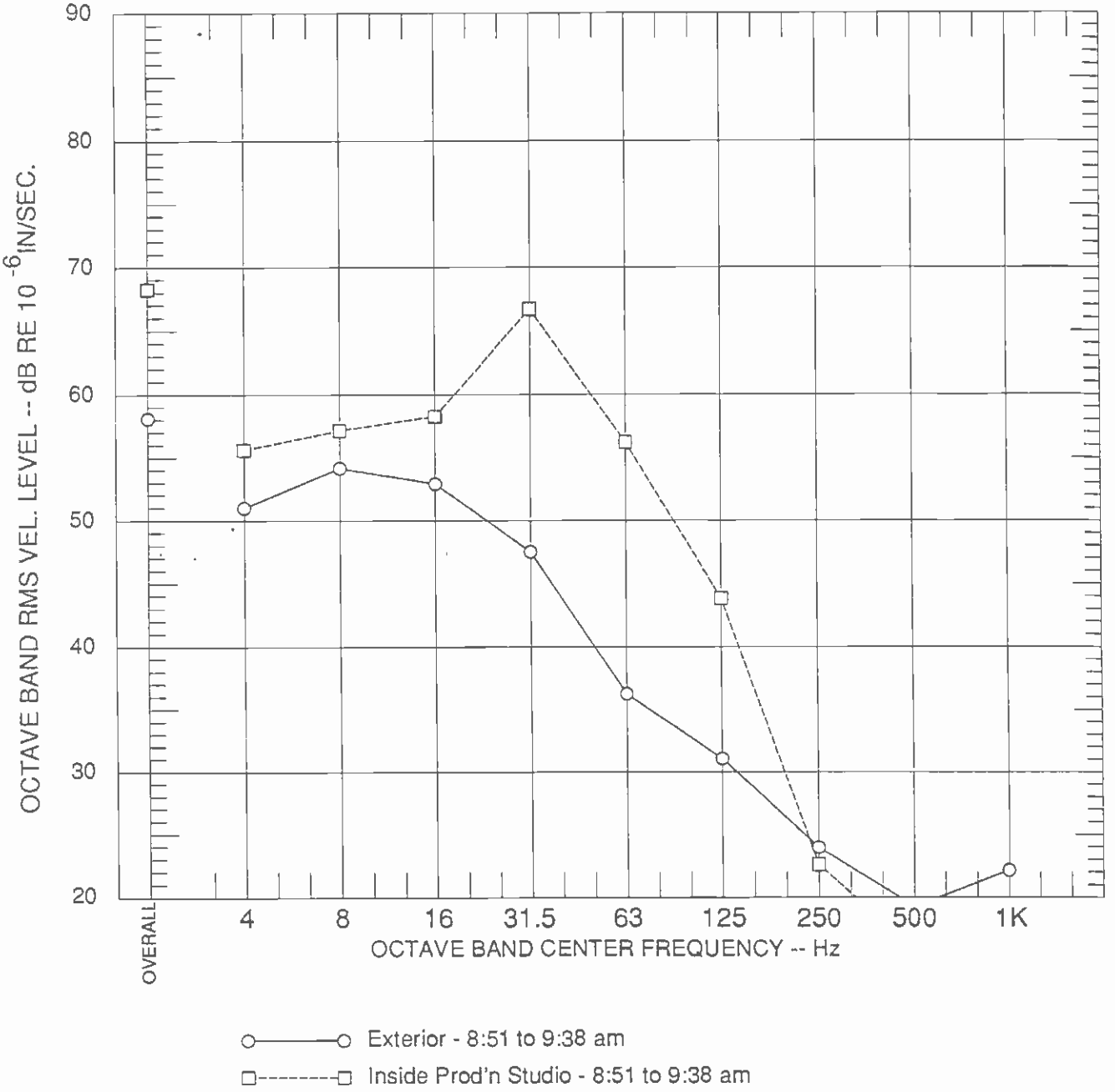


FIGURE 48 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON THURSDAY, 10 SEPTEMBER, 1987

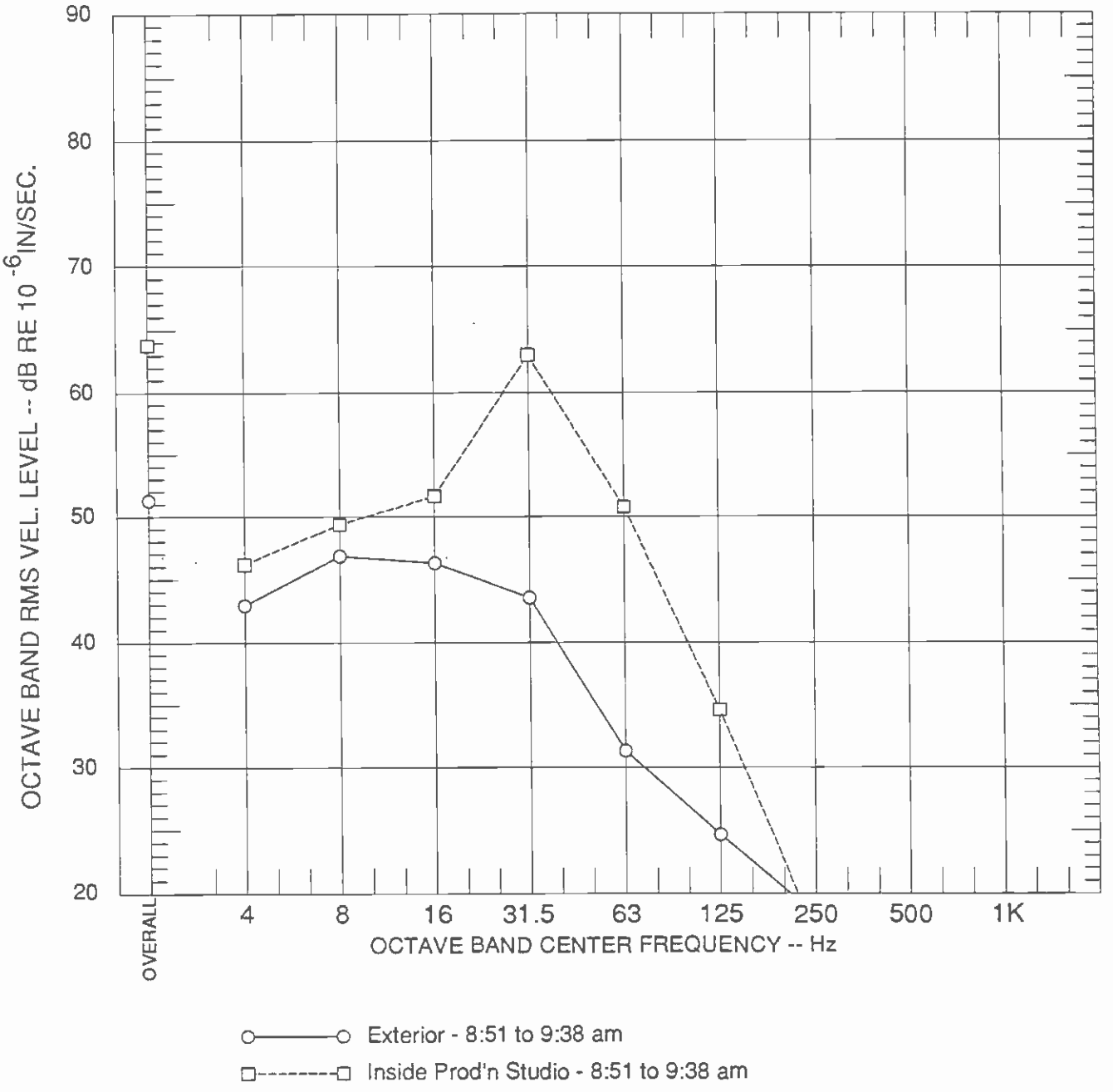


FIGURE 49 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE KMPC AM STUDIOS ON THURSDAY, 10 SEPTEMBER, 1987

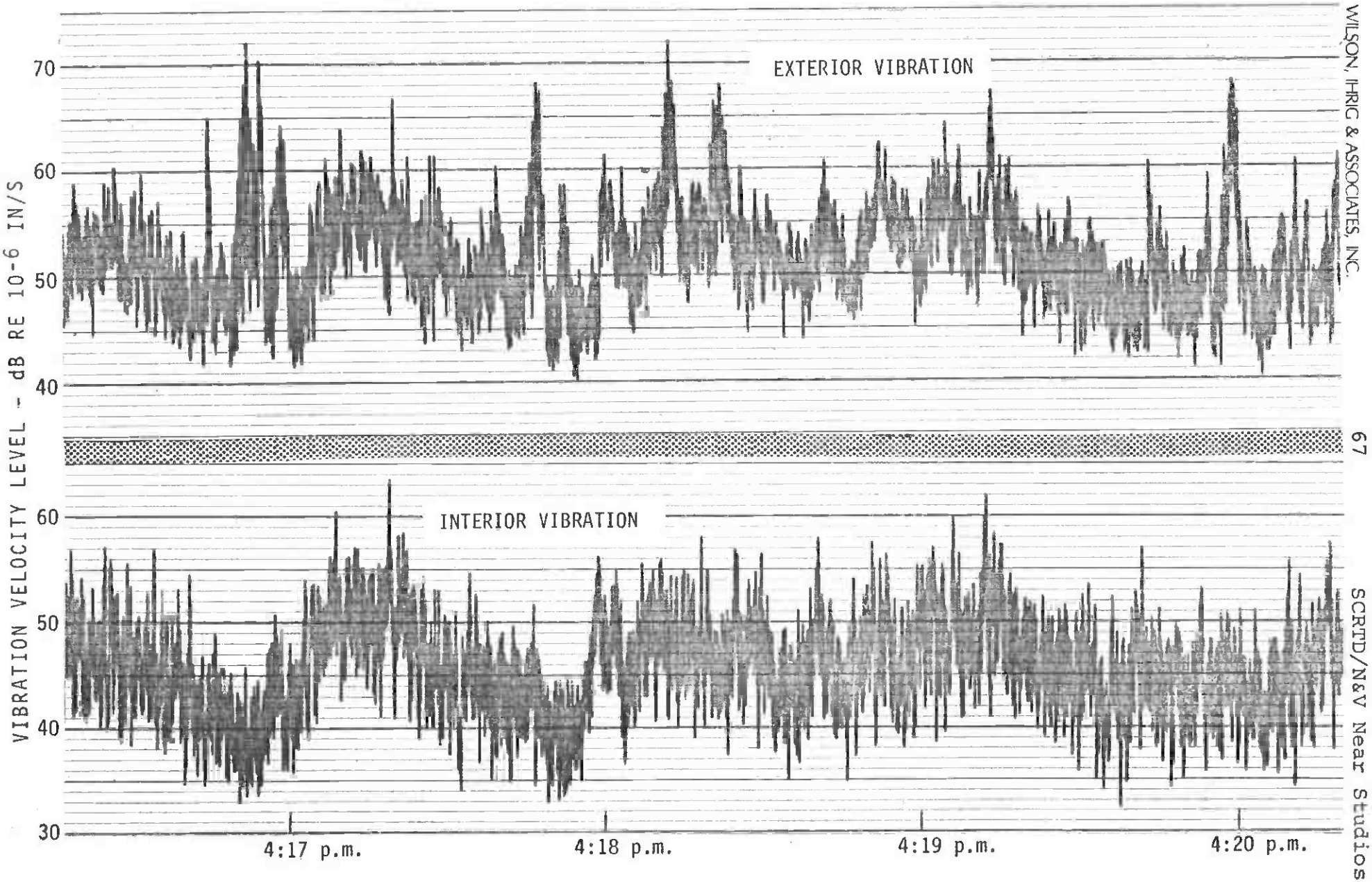


FIGURE 50 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE KWHY CHANNEL 22 STUDIOS (STUDIO B), MEASURED ON UTESDAY, 8 SEPTEMBER 1987

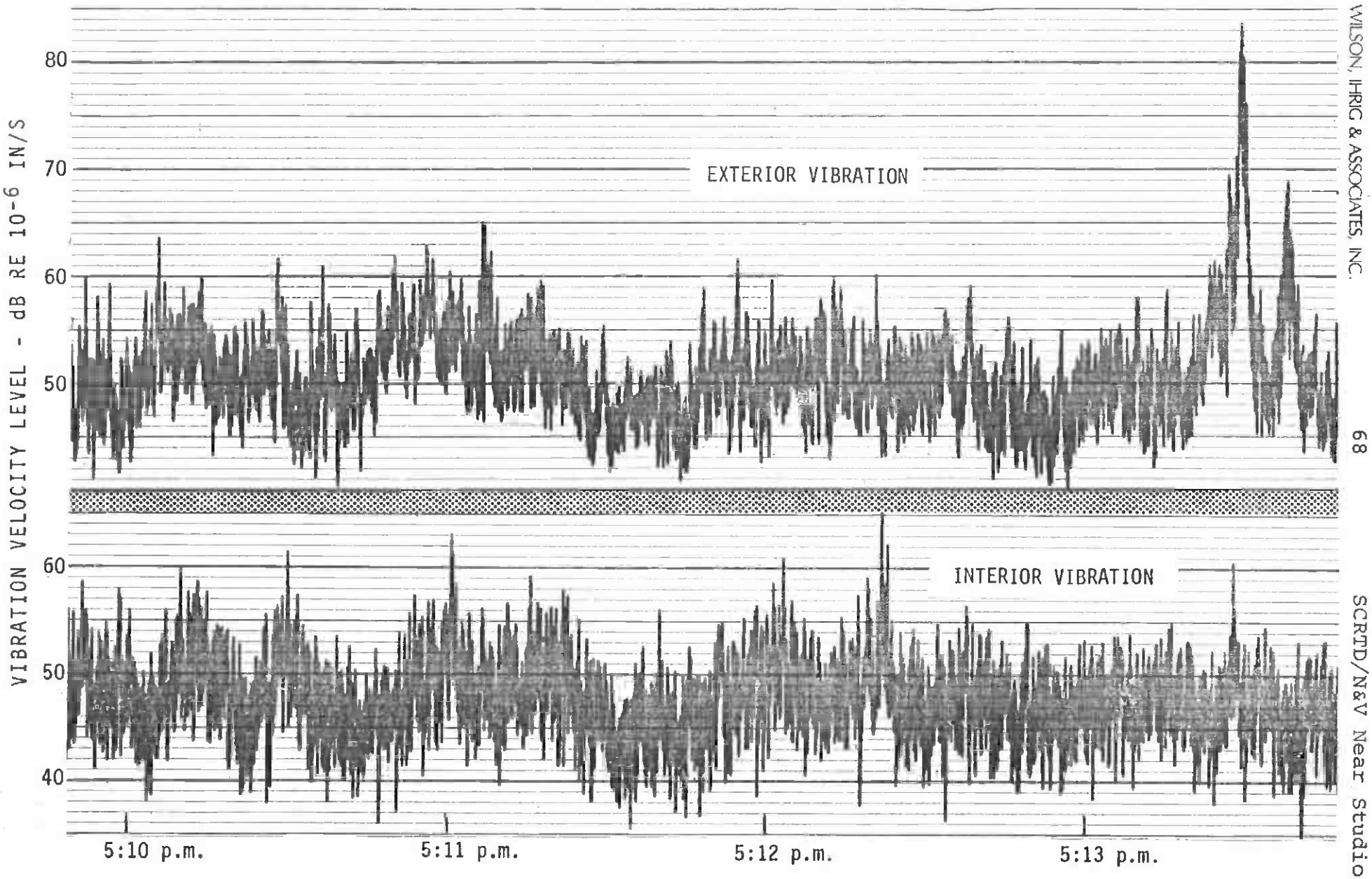


FIGURE 51 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE KWHY CHANNEL 22 STUDIOS (STUDIO A), MEASURED ON TUESDAY, 8 SEPTEMBER 1987

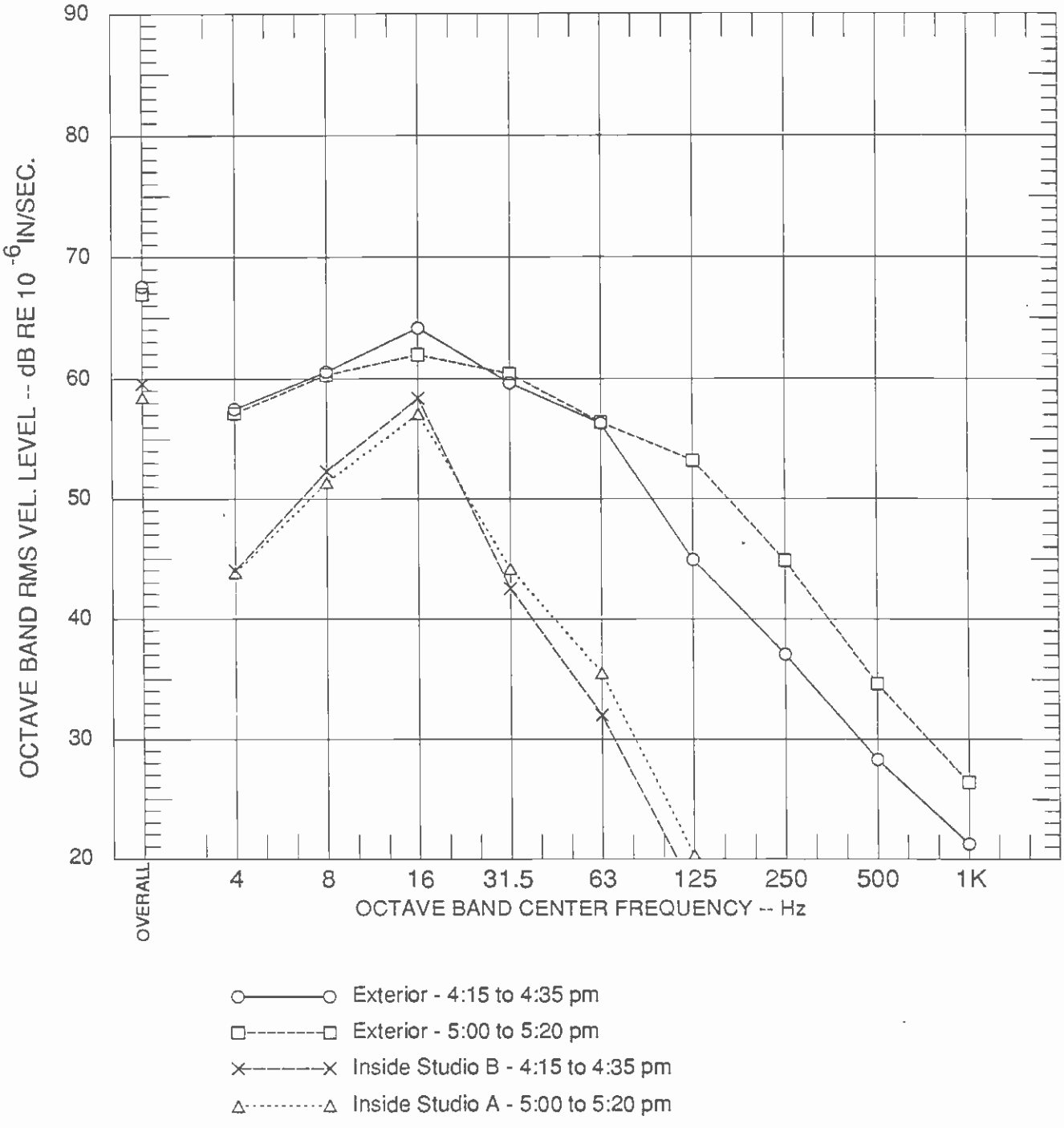


FIGURE 52 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT KWHY CHANNEL 22 ON TUESDAY, 8 SEPTEMBER, 1987

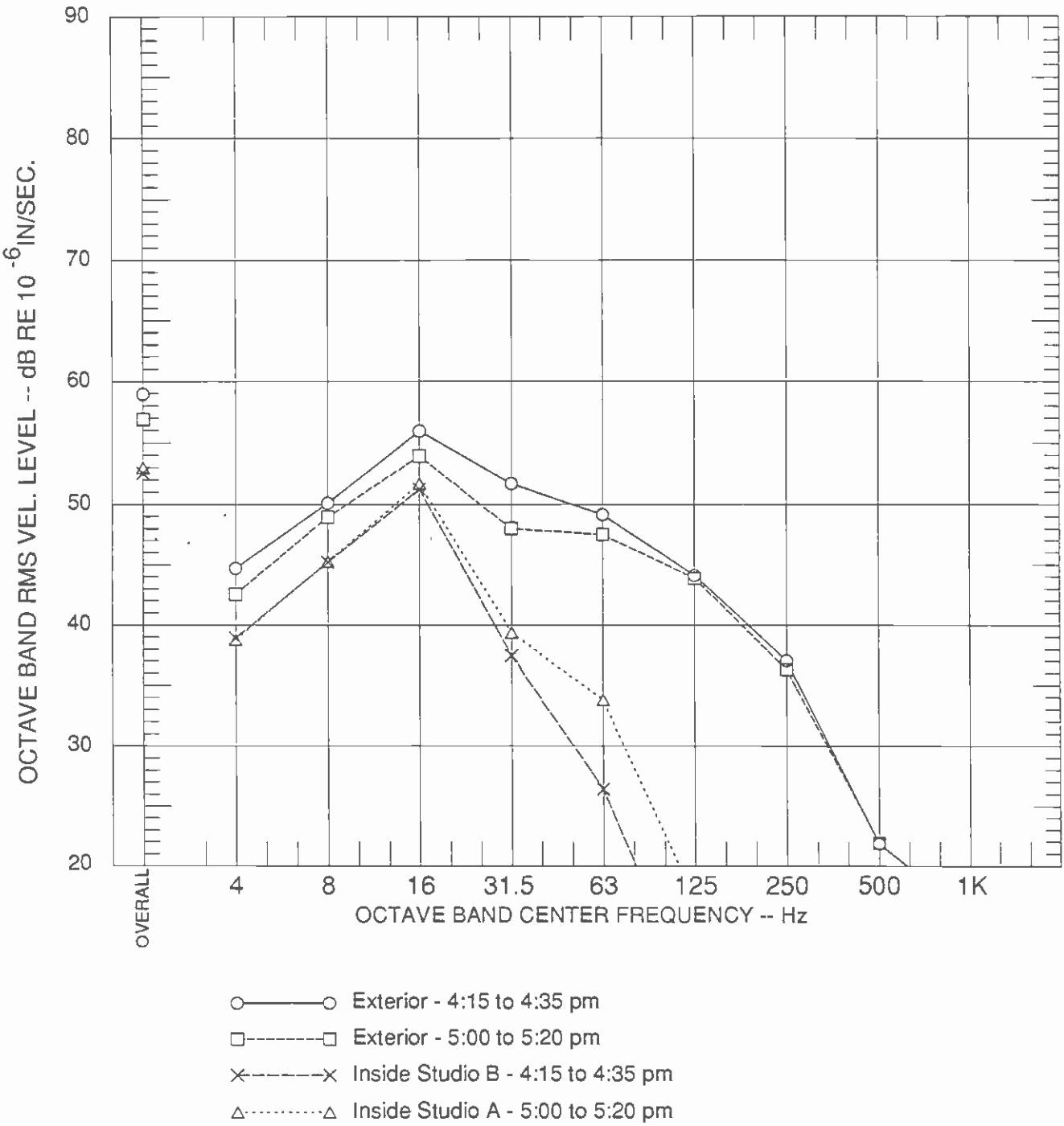


FIGURE 53 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT KWHY CHANNEL 22 ON TUESDAY, 8 SEPTEMBER, 1987

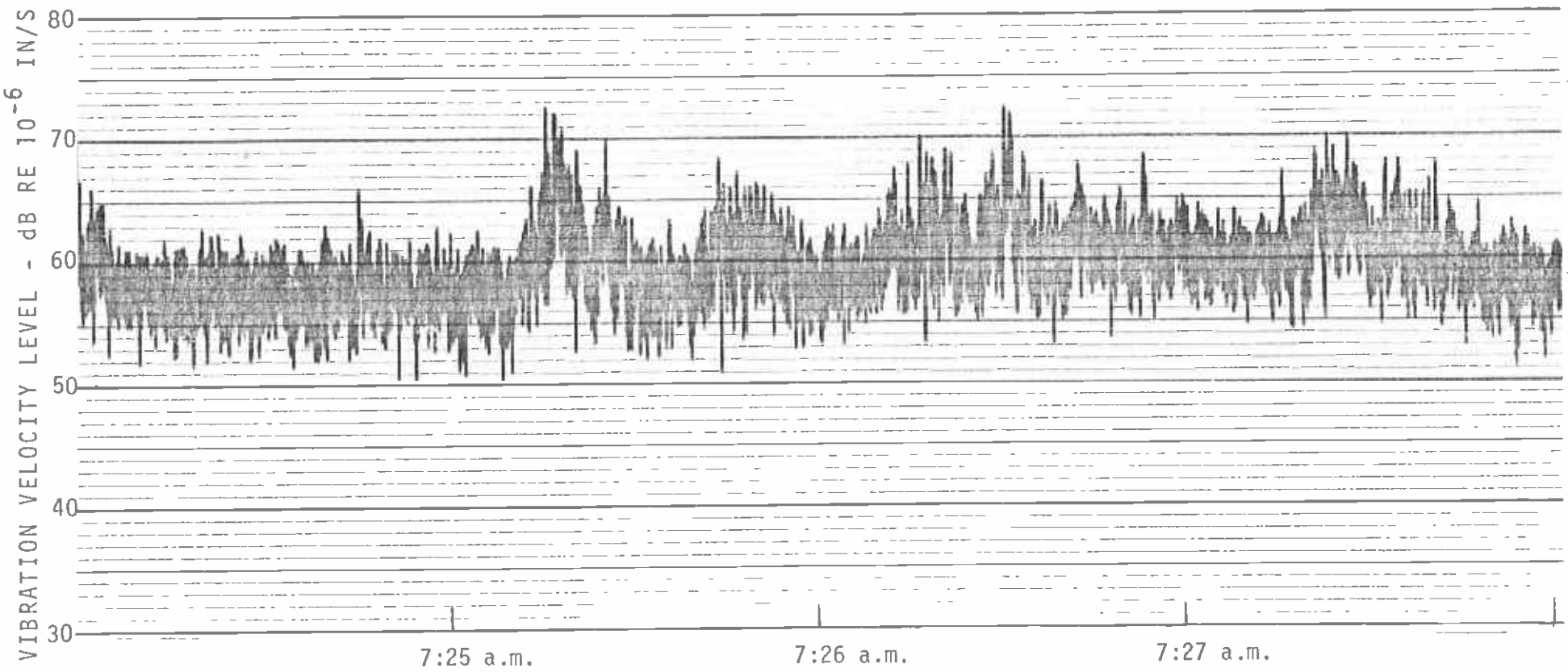


FIGURE 54 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE THE KTLA CHANNEL 5 STUDIOS (STAGE 9), MEASURED ON THURSDAY, 10 SEPTEMBER 1987

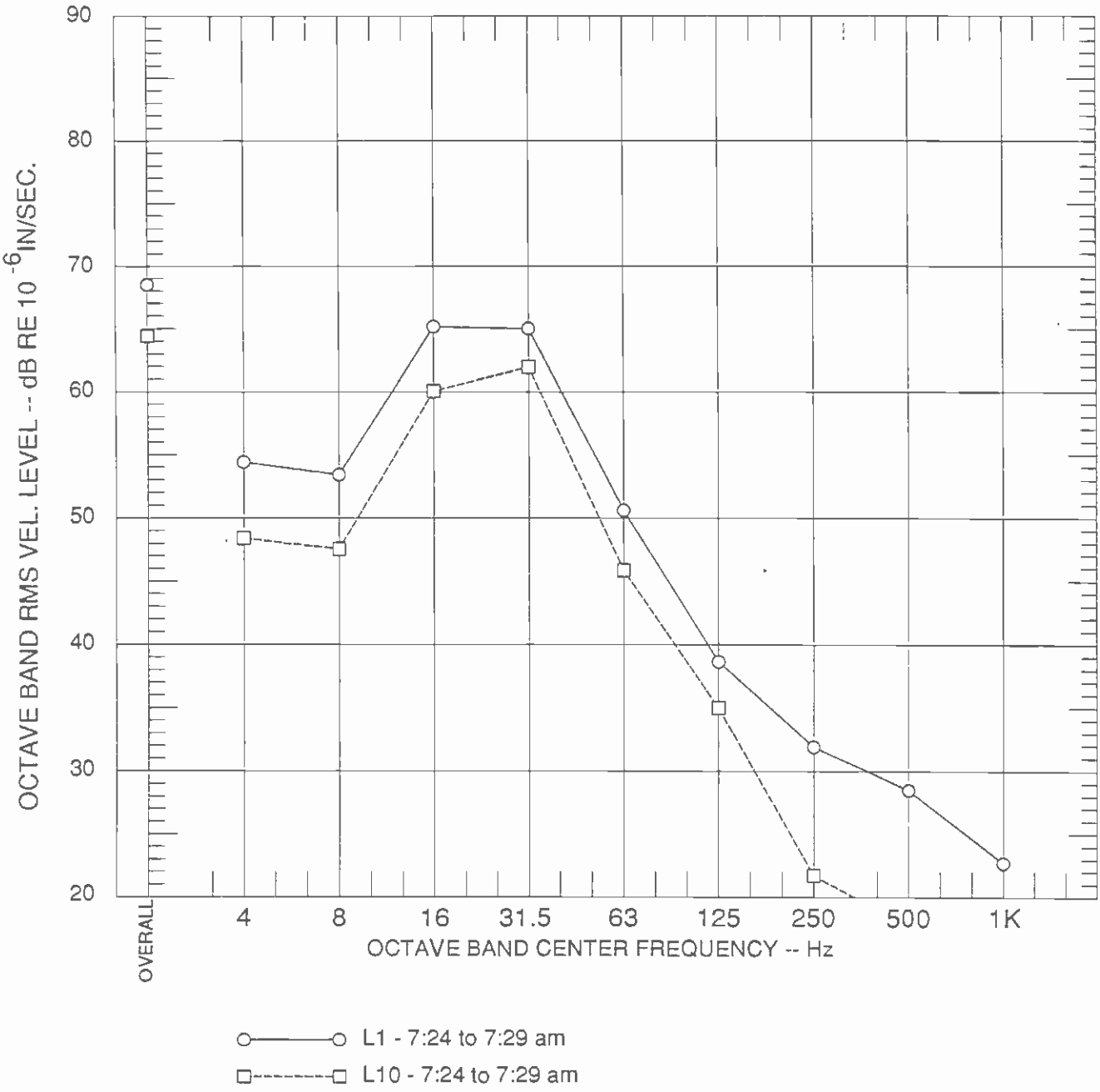


FIGURE 55 INTERIOR VIBRATION VELOCITY LEVELS MEASURED AT KTLA CHANNEL 5 (STAGE 9) ON THURSDAY, 10 SEPTEMBER, 1987

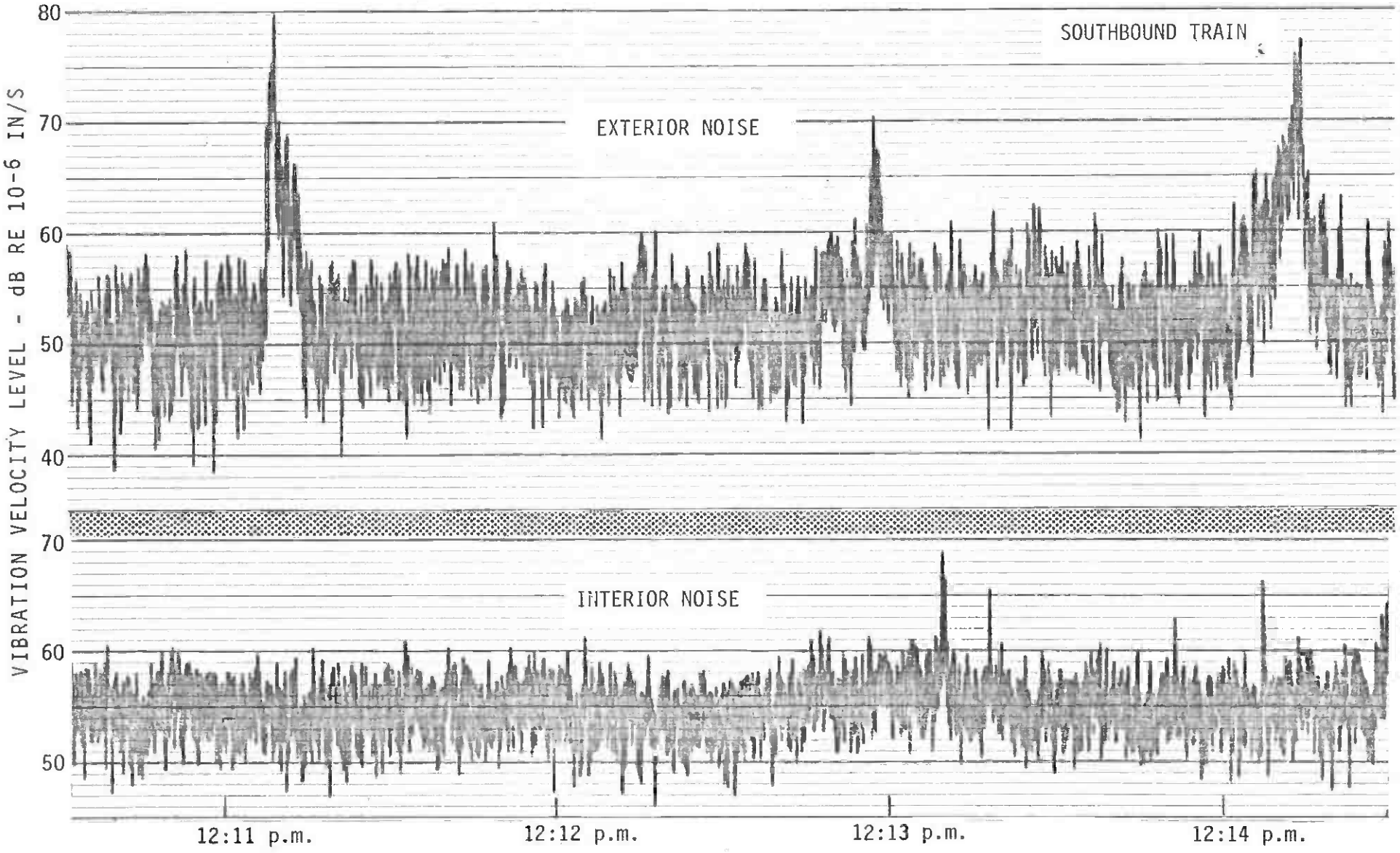


FIGURE 56 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE CEDARS MEDICAL CENTER, MIAMI, MEASURED ON TUESDAY, 15 SEPTEMBER 1987

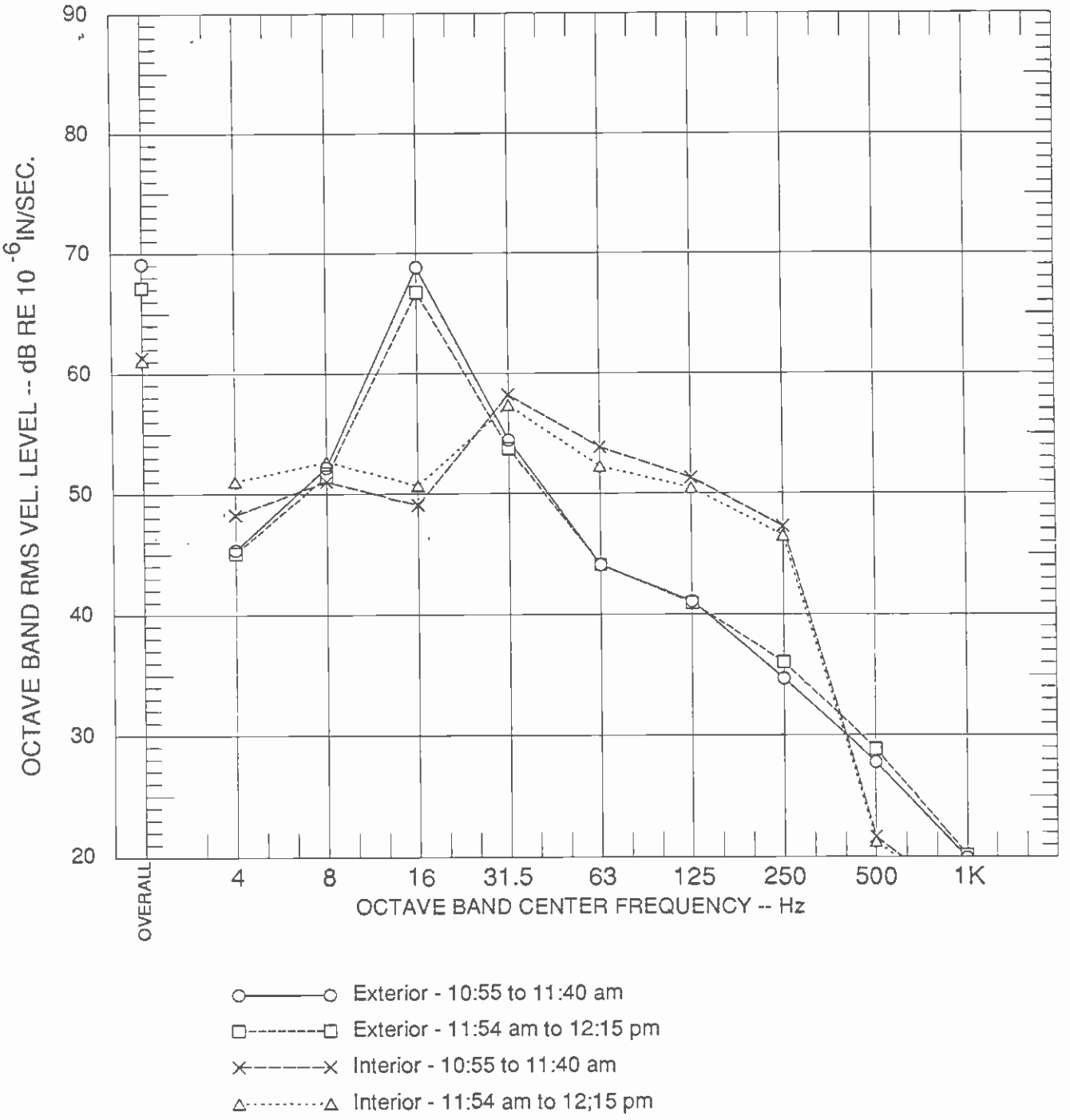


FIGURE 57 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 9/15/87

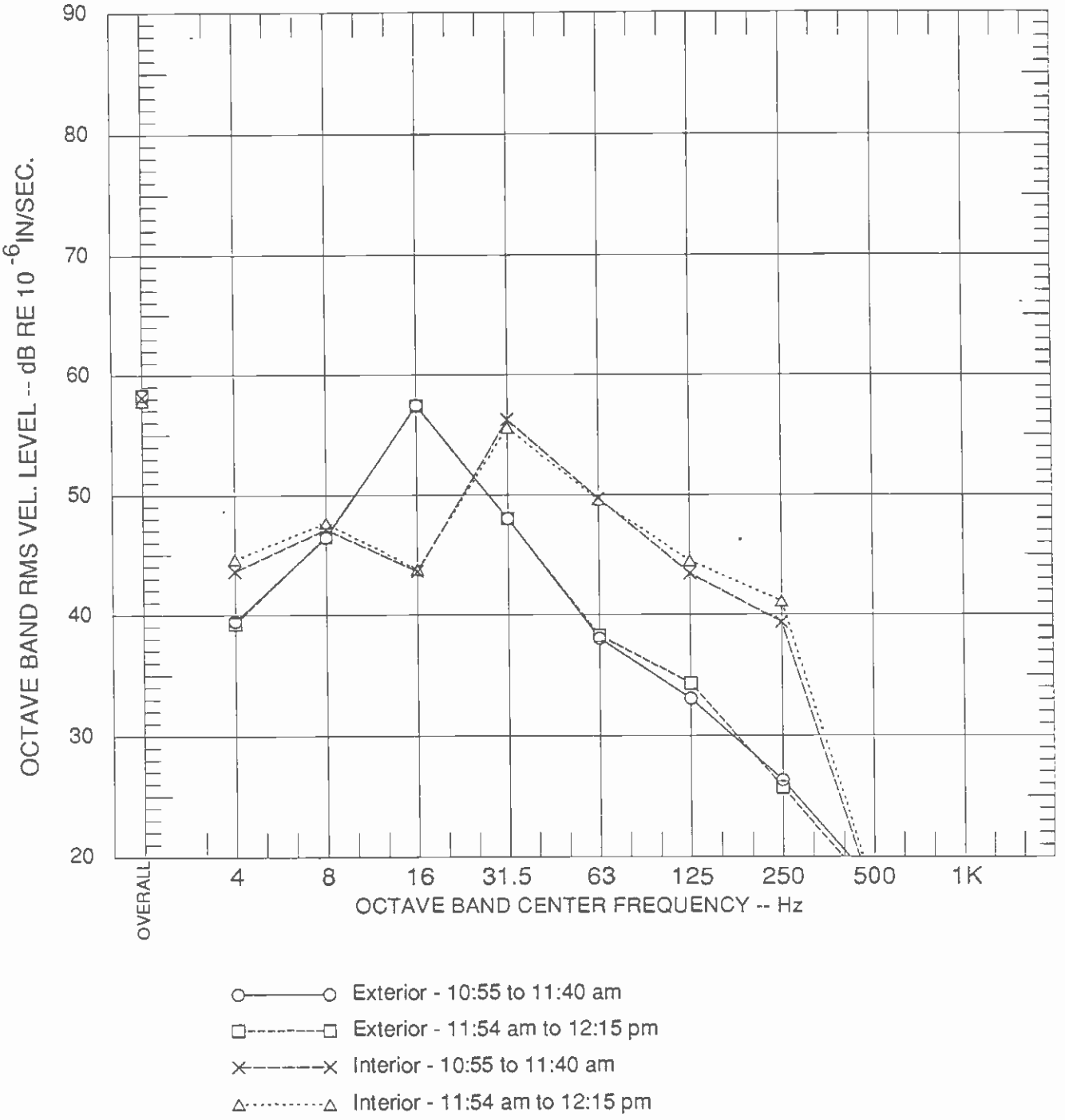


FIGURE 58 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 9/15/87

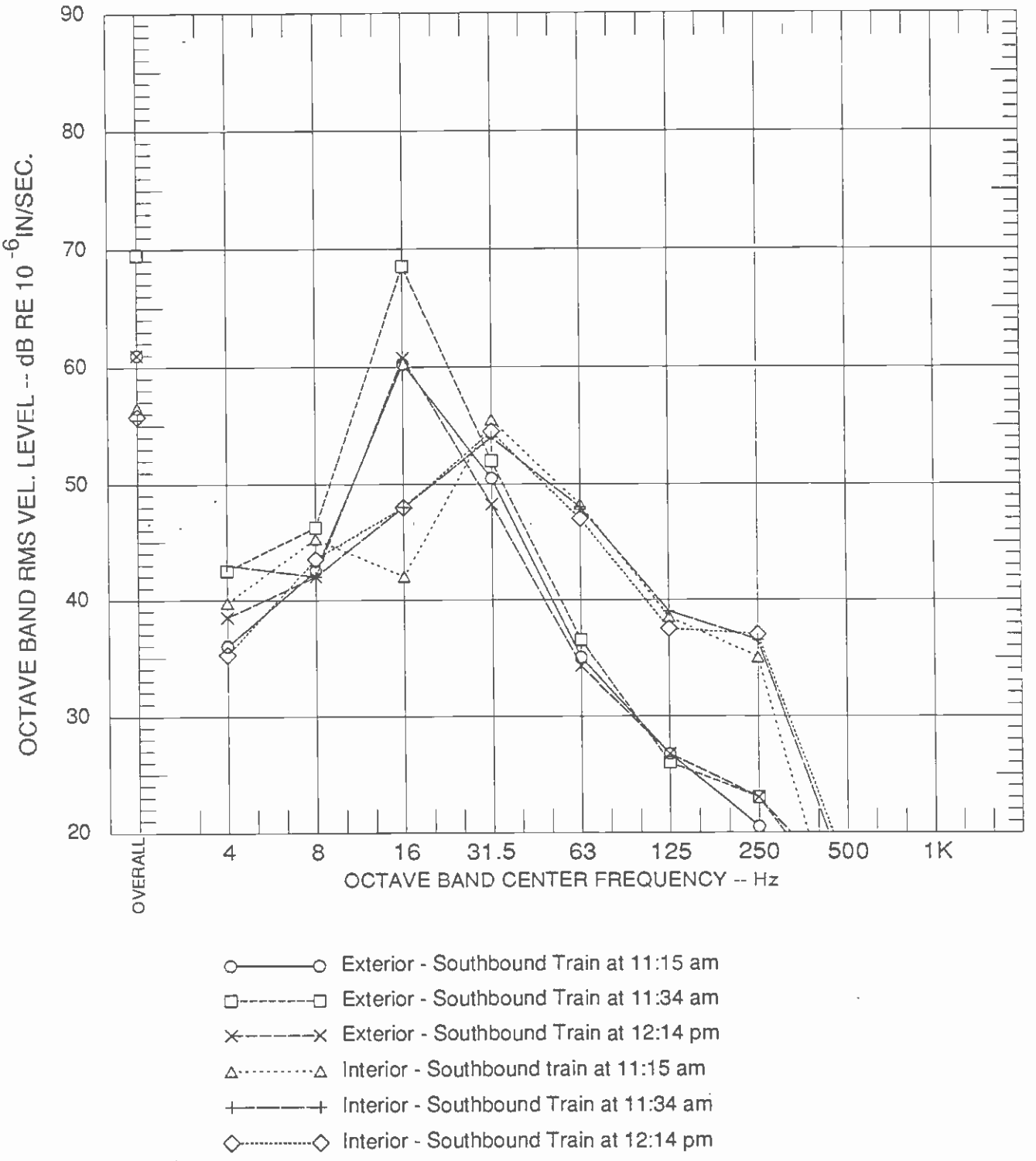


FIGURE 59 TYPICAL EXTERIOR AND INTERIOR TRAIN PASSBY VIBRATION VELOCITY LEVELS MEASURED AT THE CEDARS MEDICAL CENTER, MIAMI, ON TUESDAY, 15 SEPTEMBER, 1987

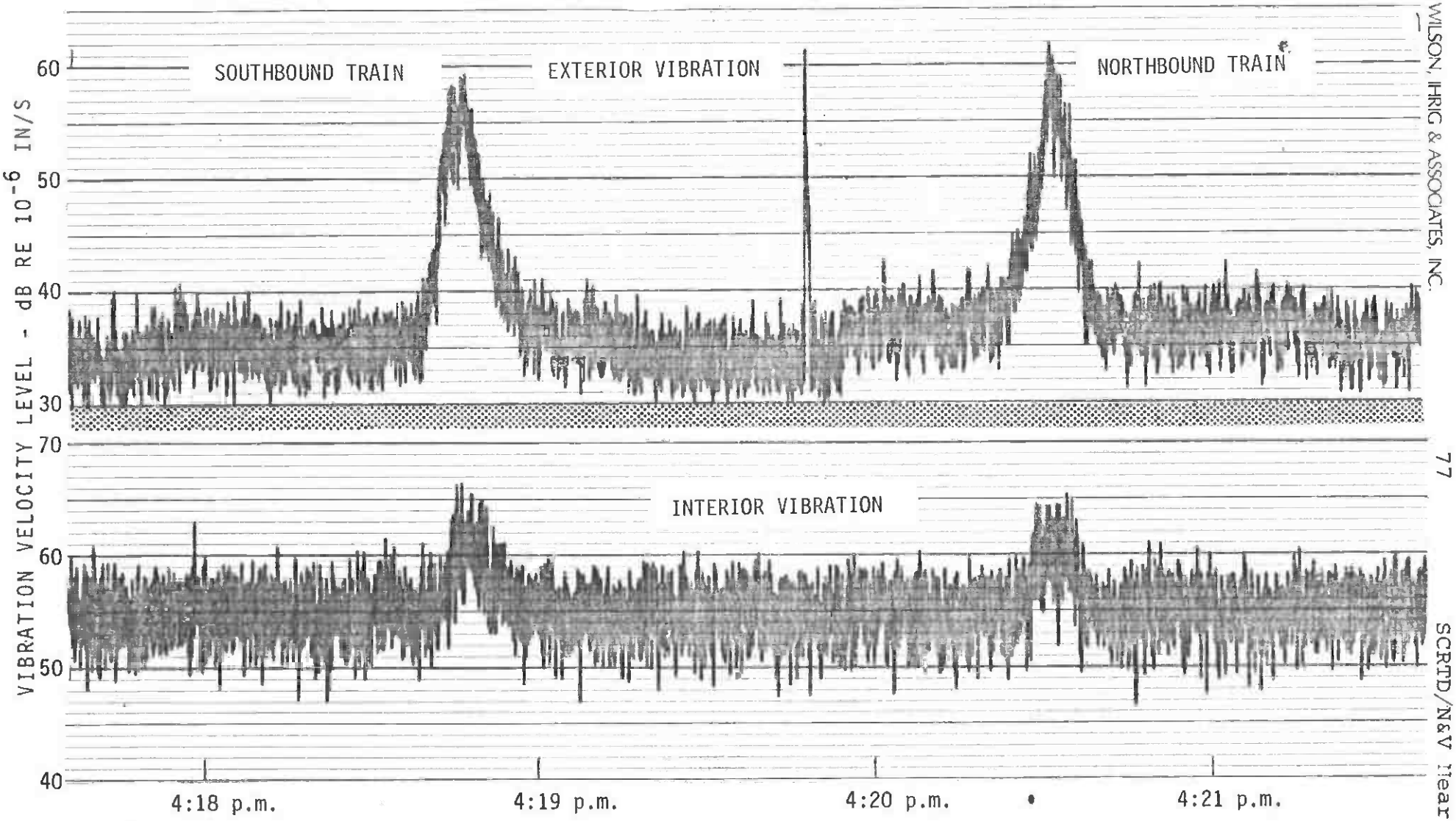


FIGURE 60 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE SOUTH MIAMI HOSPITAL, MEASURED ON TUESDAY, 15 SEPTEMBER 1987

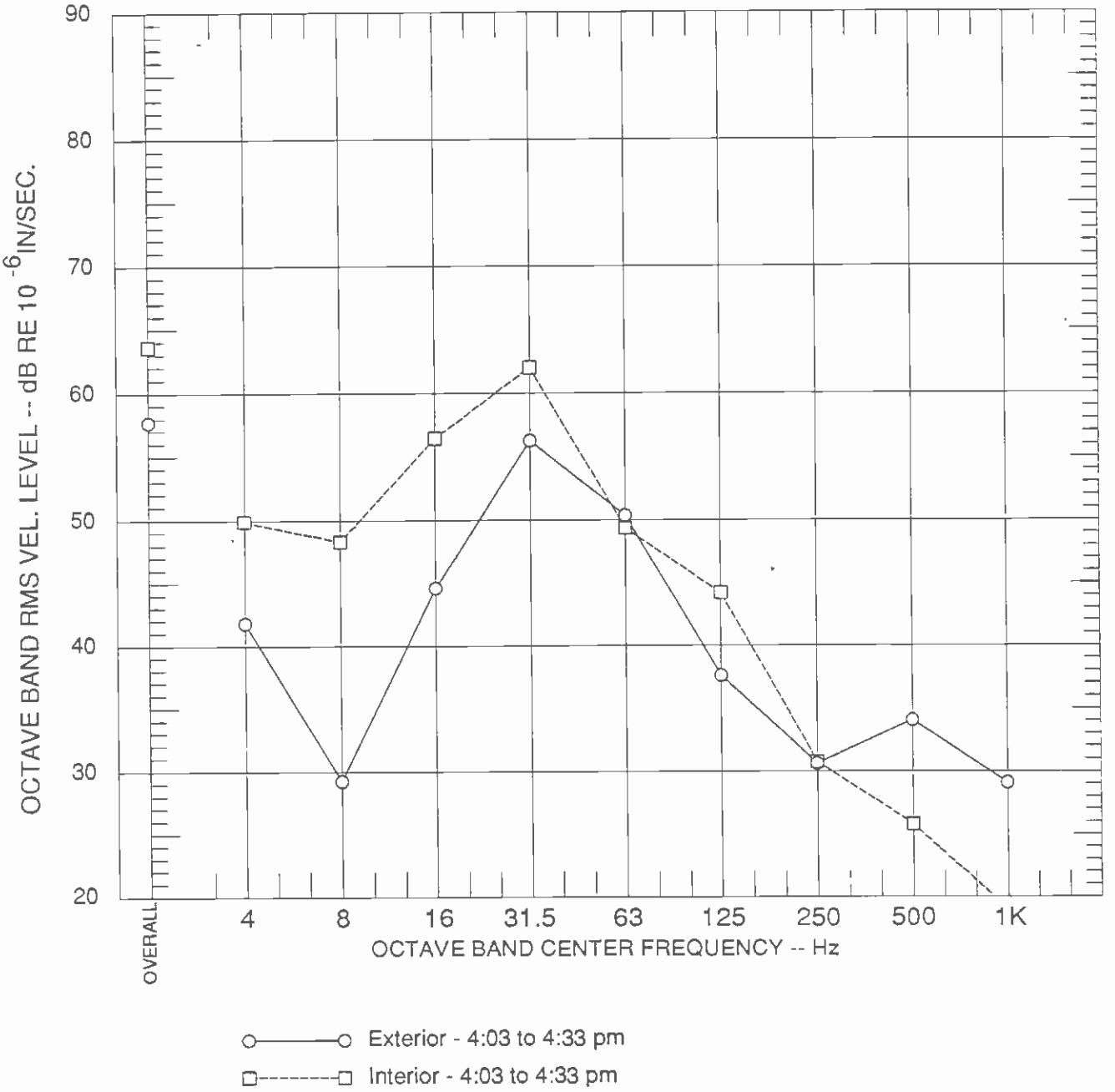


FIGURE 61 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

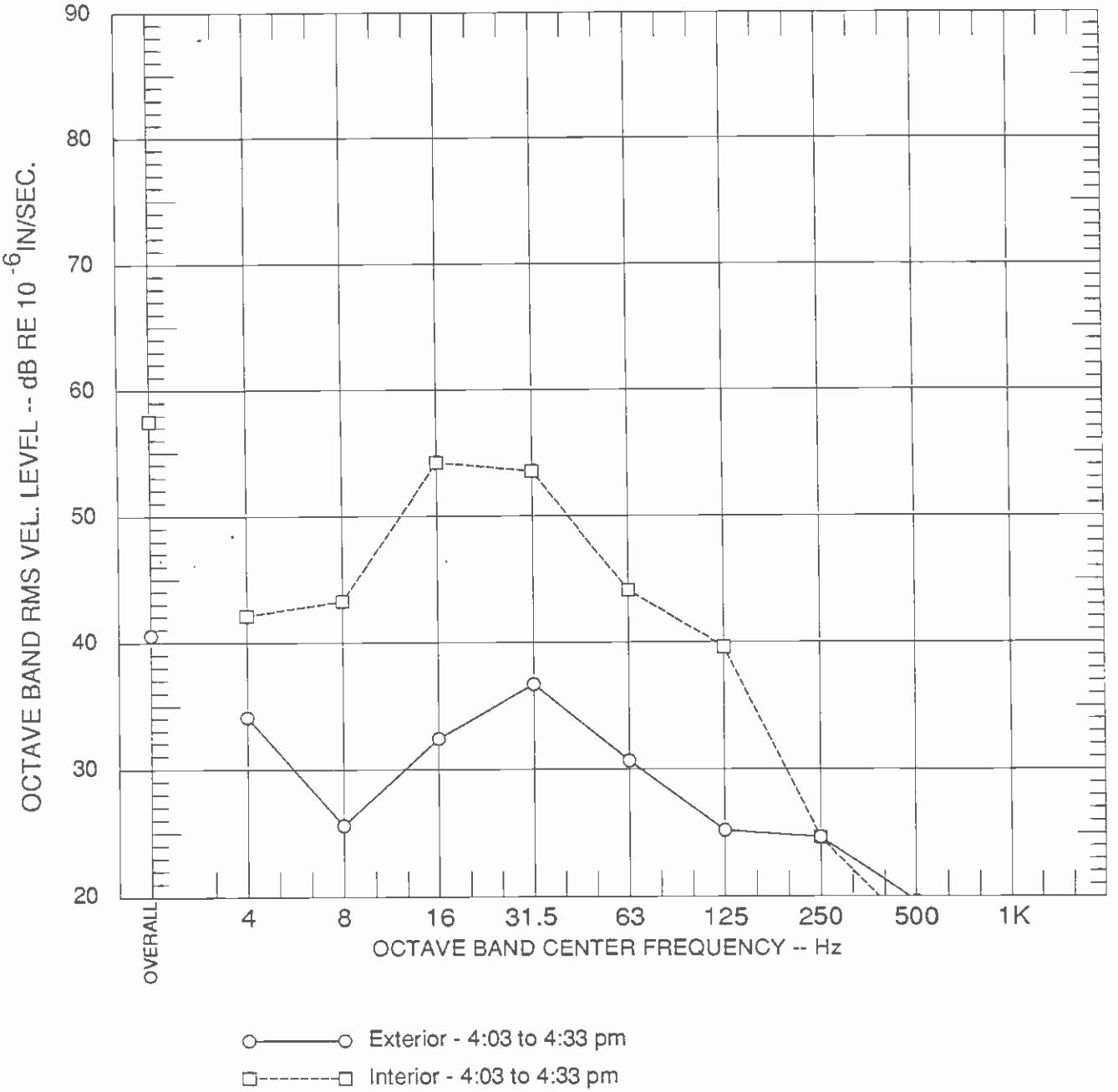


FIGURE 62 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

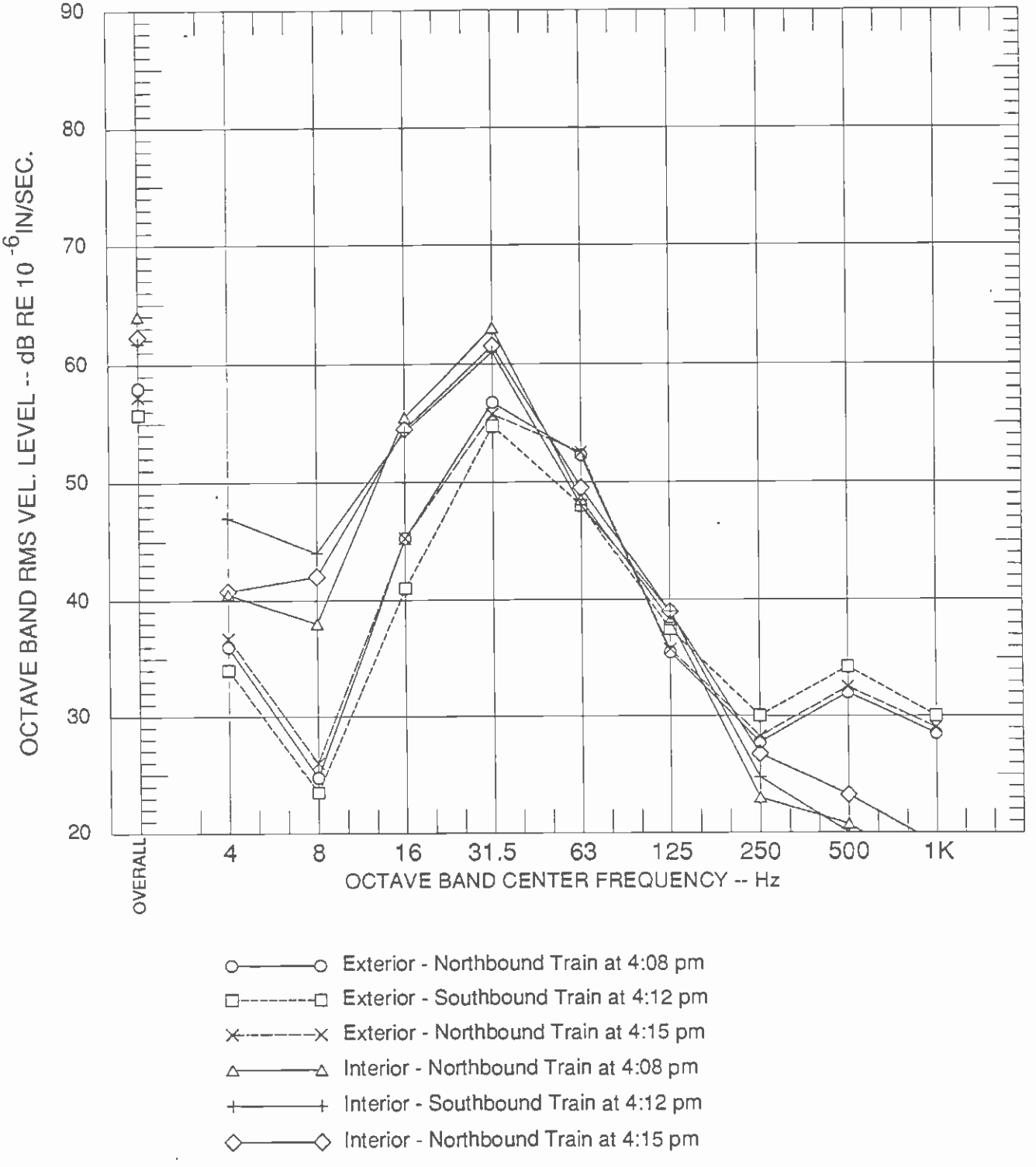


FIGURE 63 TYPICAL EXTERIOR AND INTERIOR TRAIN PASSBY VIBRATION VELOCITY LEVELS MEASURED AT THE SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER, 1987

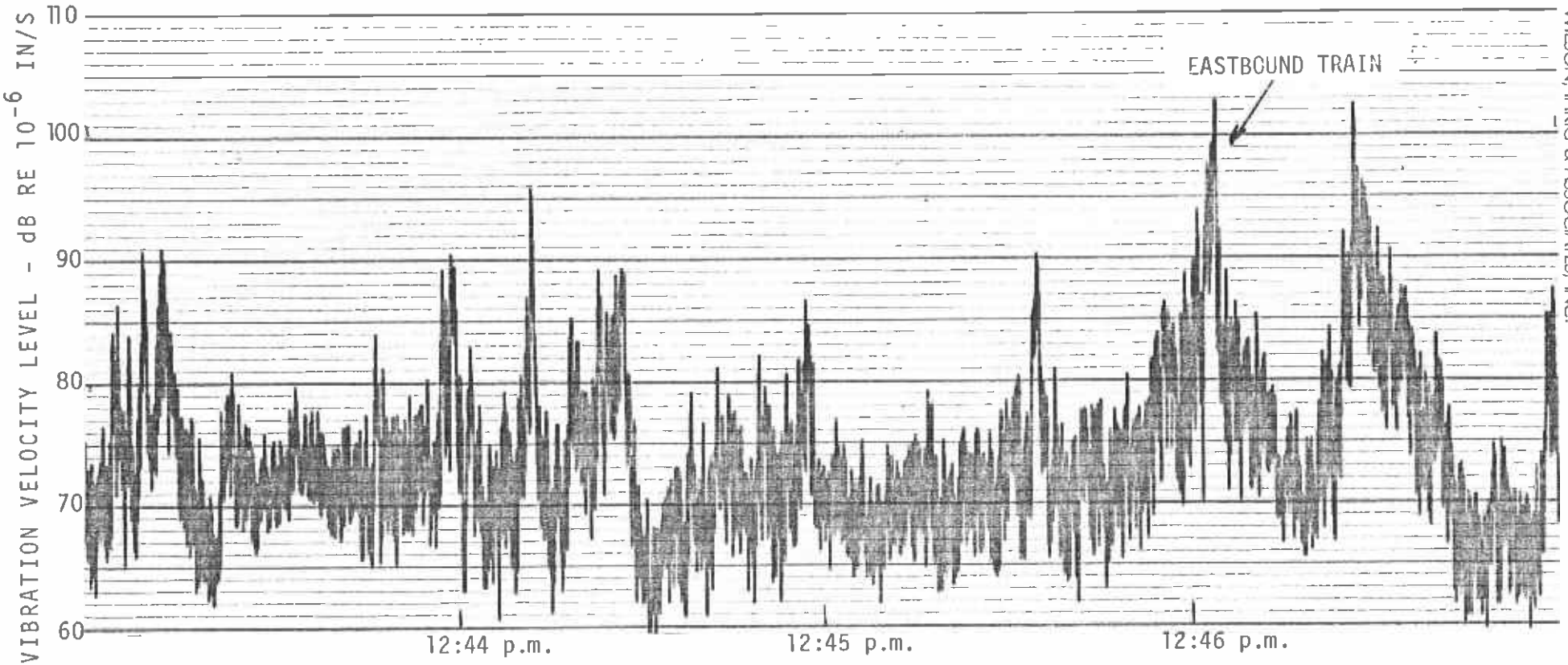


FIGURE 64 SECTION OF TIME HISTORY OF THE VIBRATION VELOCITY LEVEL OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, MEASURED ON WEDNESDAY, 16 SEPTEMBER 1987

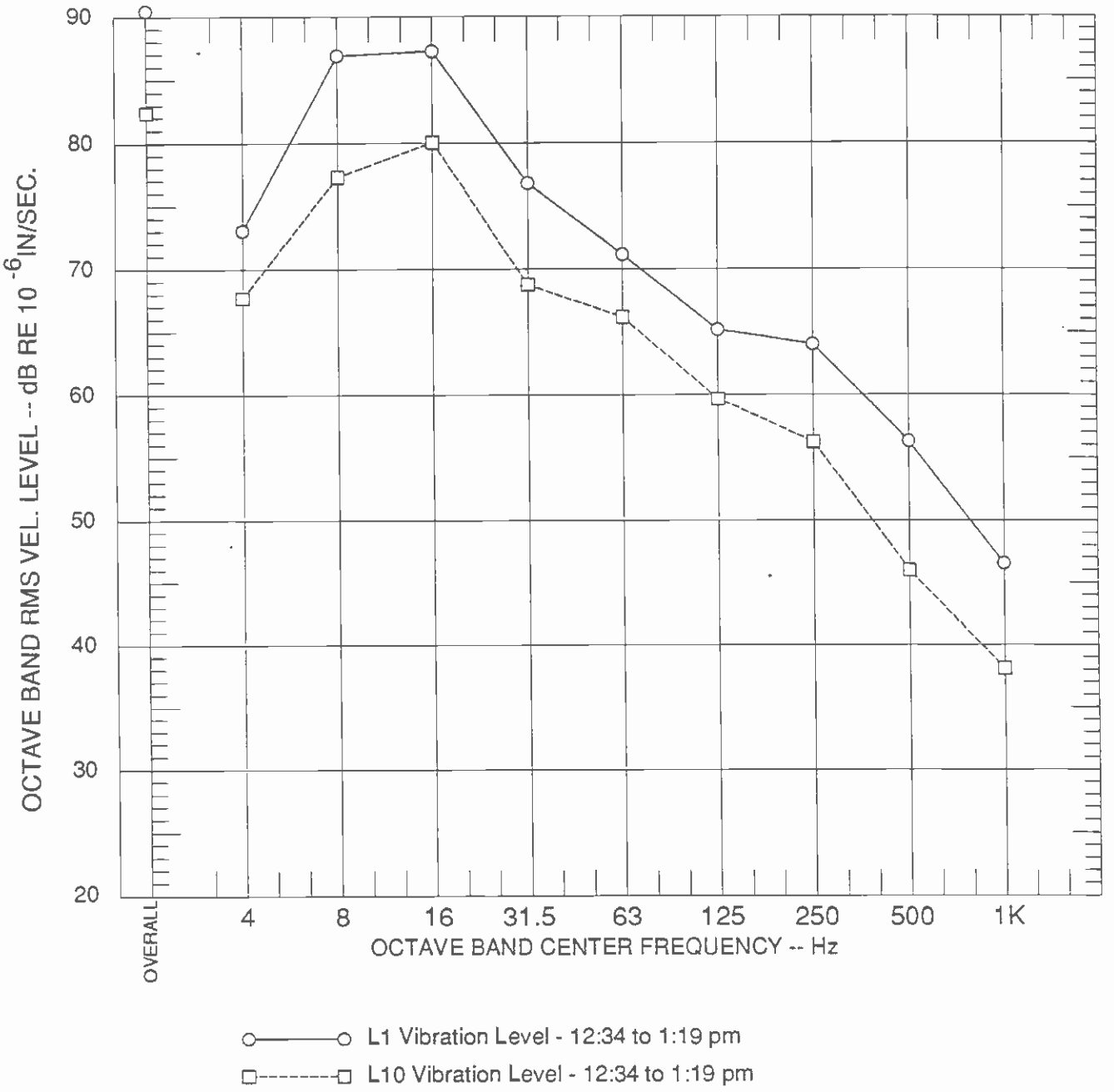


FIGURE 65 VIBRATION VELOCITY LEVELS MEASURED OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, ON . WEDNESDAY, 16 SEPTEMBER, 1987

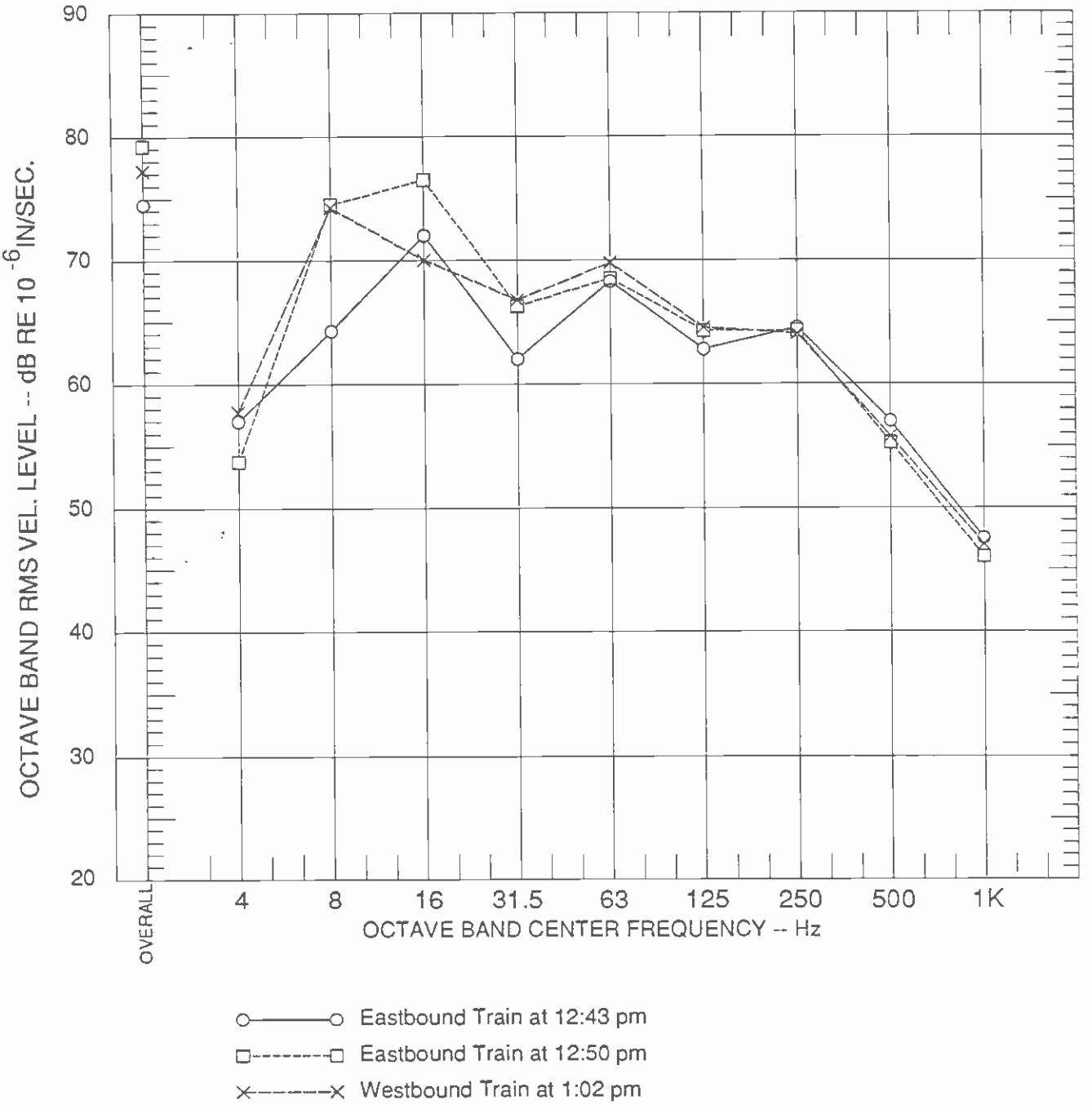


FIGURE 66 TYPICAL TRAIN PASSBY VIBRATION VELOCITY LEVELS MEASURED OUTSIDE THE SILVERCUP RECORDING STUDIOS, NEW YORK CITY, ON WEDNESDAY, 16 SEPTEMBER, 1987

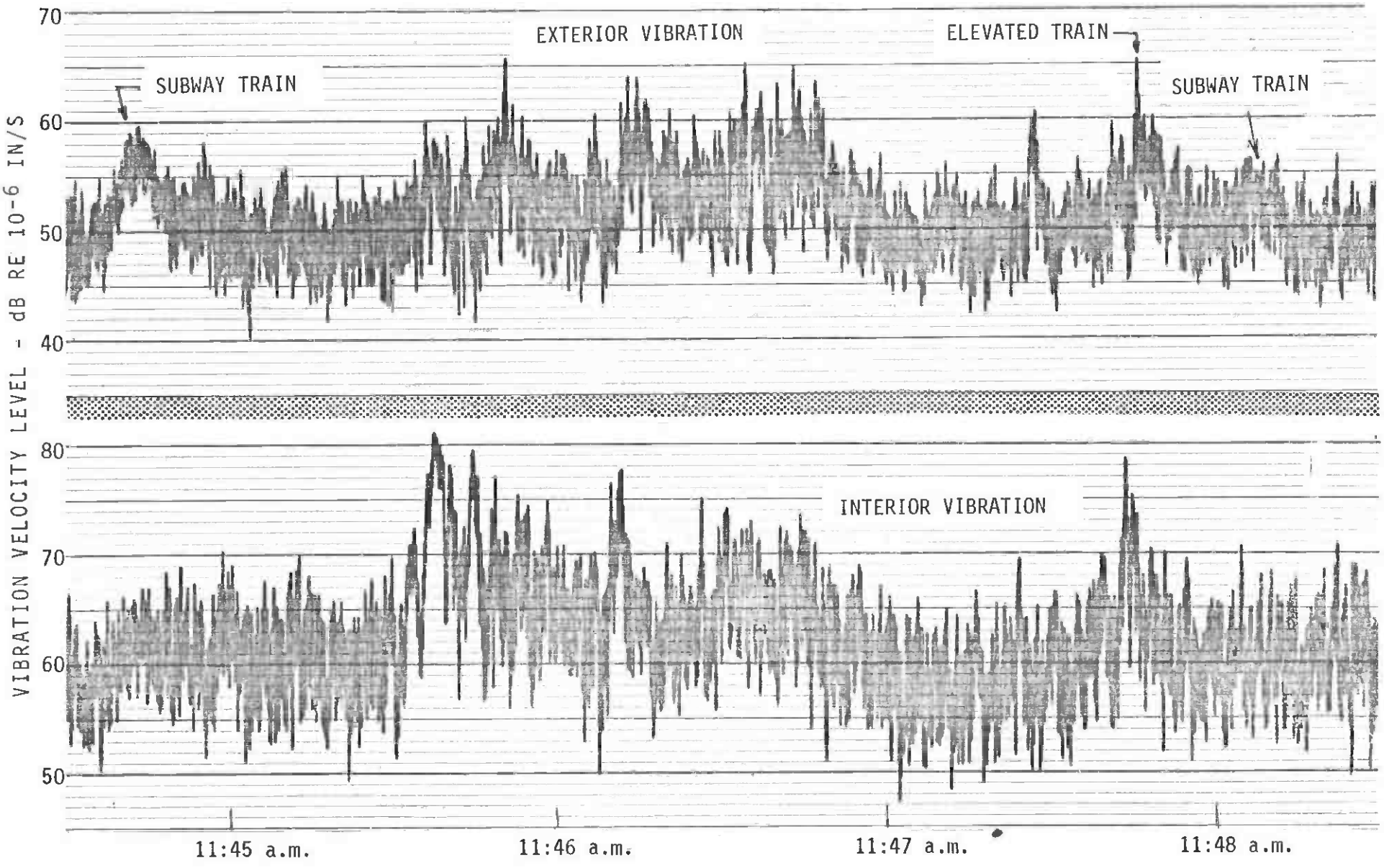


FIGURE 67 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE ABC (WLS-TV) STUDIOS (STUDIO 2), CHICAGO, MEASURED ON THURSDAY, 17 SEPTEMBER 1987

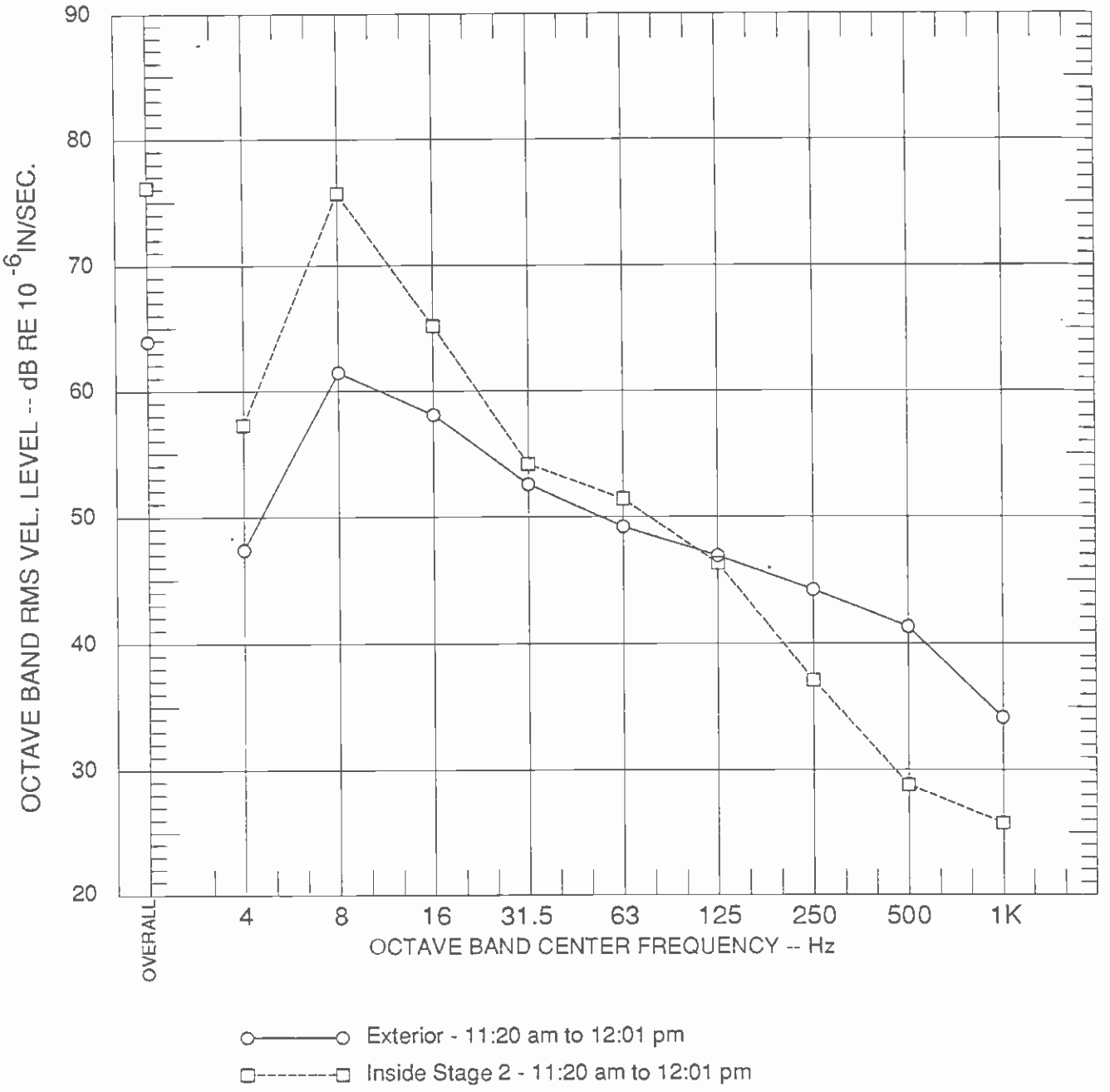


FIGURE 68 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

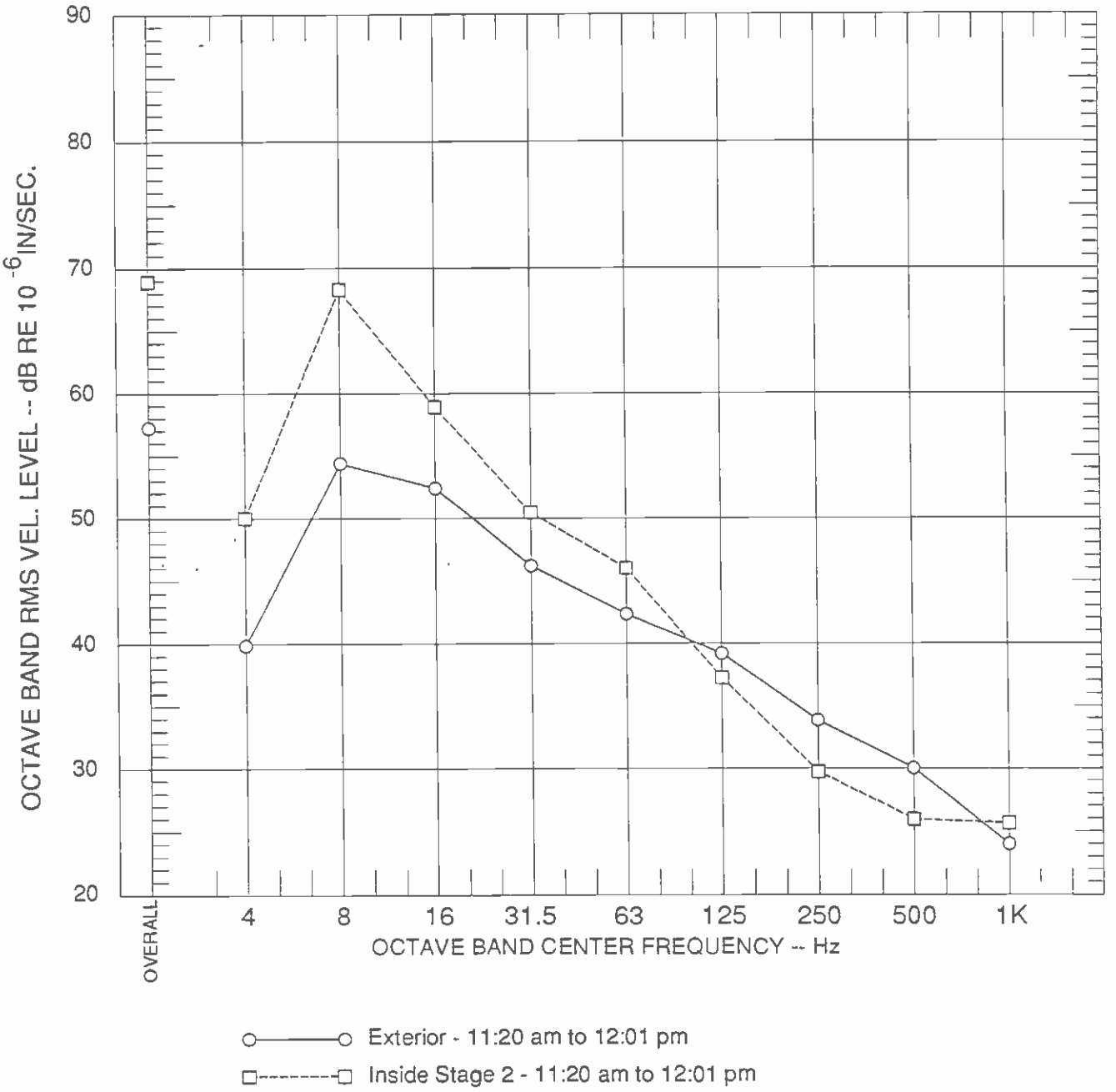


FIGURE 69 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

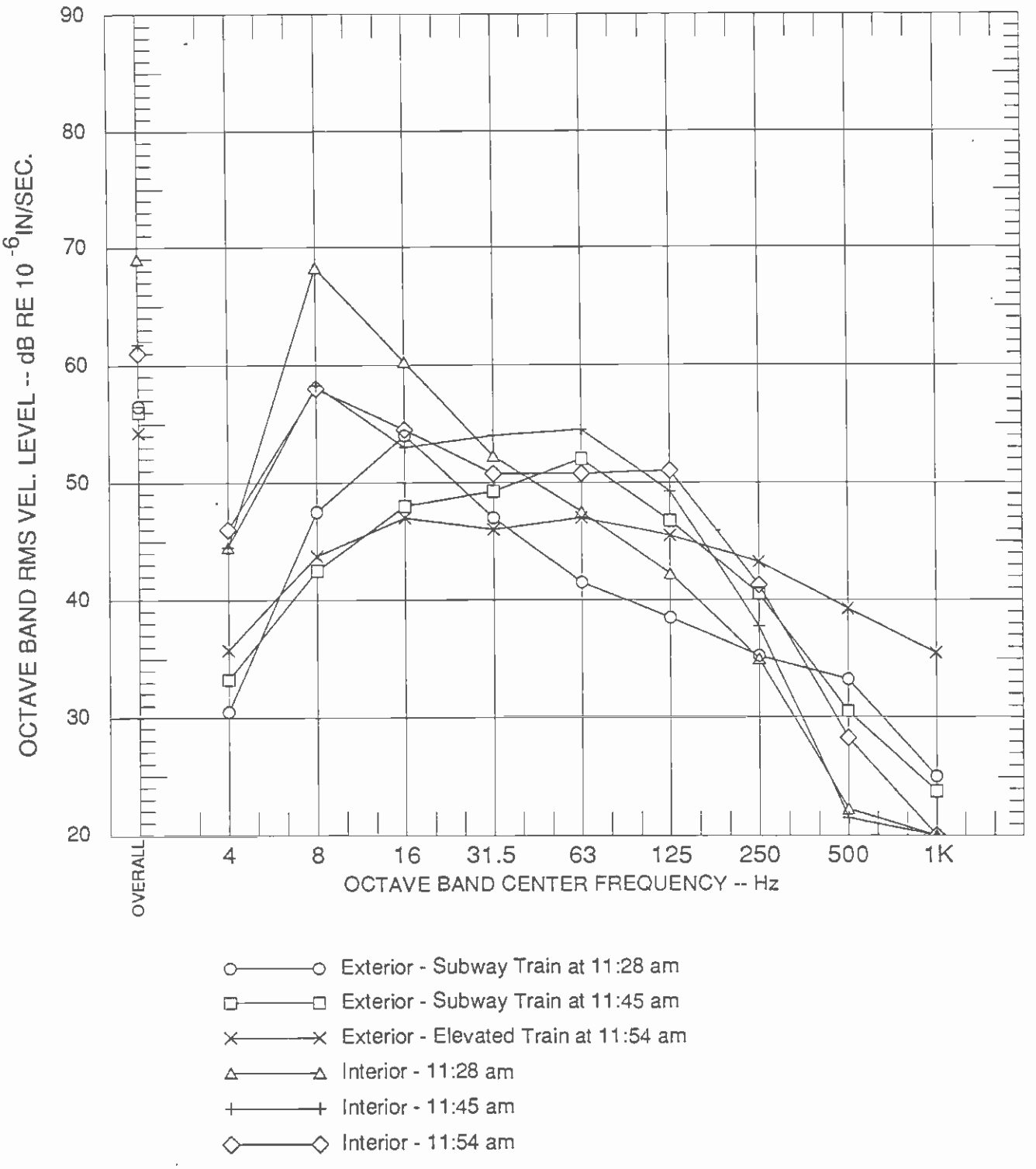


FIGURE 70 TYPICAL EXTERIOR AND INTERIOR VIBRATION VELOCITY LEVELS MEASURED DURING TRAIN PASSBYS AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON 9/17/87

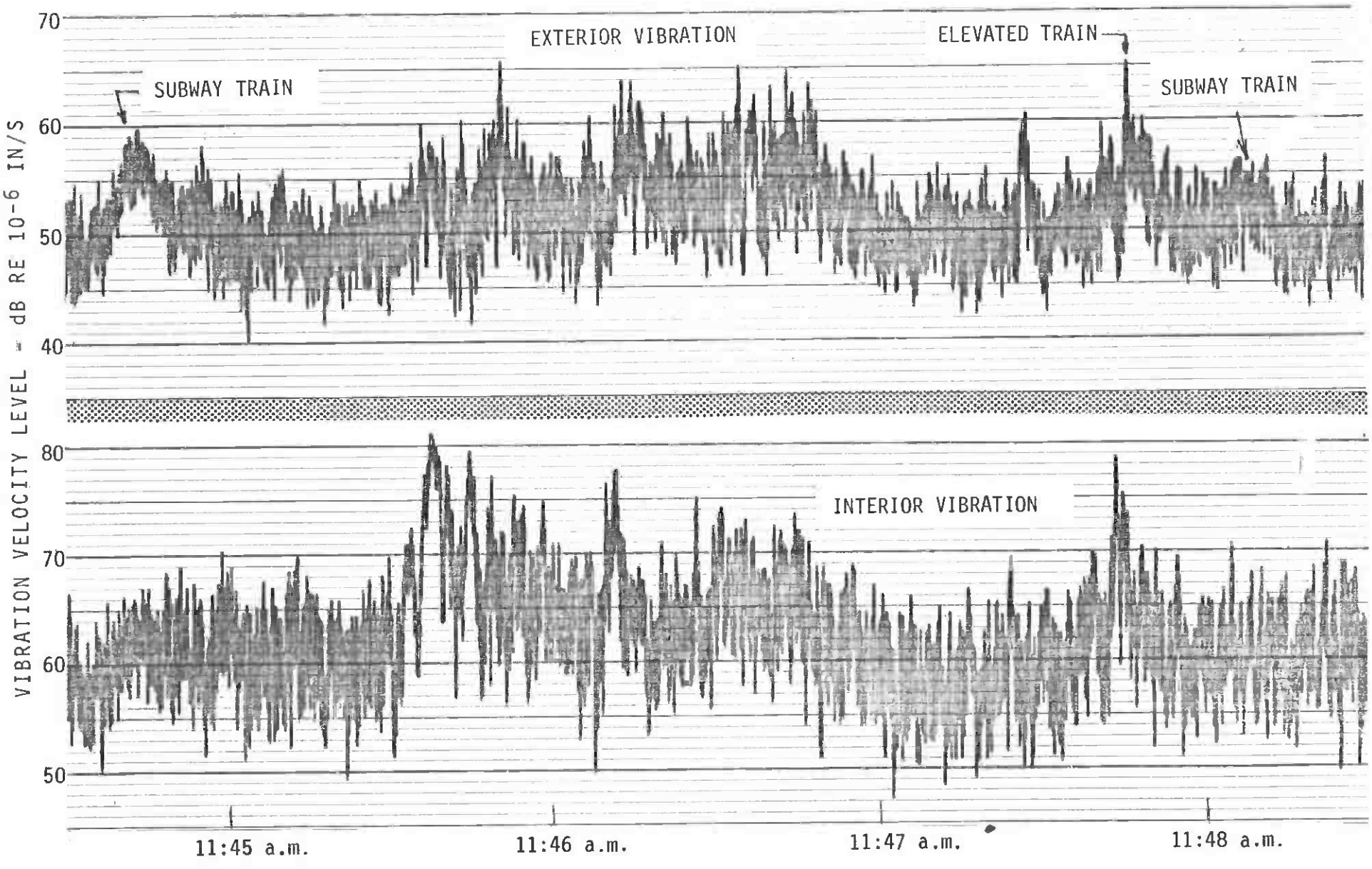


FIGURE 67 SECTION OF THE TIME HISTORY OF THE VIBRATION VELOCITY LEVEL INSIDE AND OUTSIDE THE ABC (WLS-TV) STUDIOS (STUDIO 2), CHICAGO, MEASURED ON THURSDAY, 17 SEPTEMBER 1987

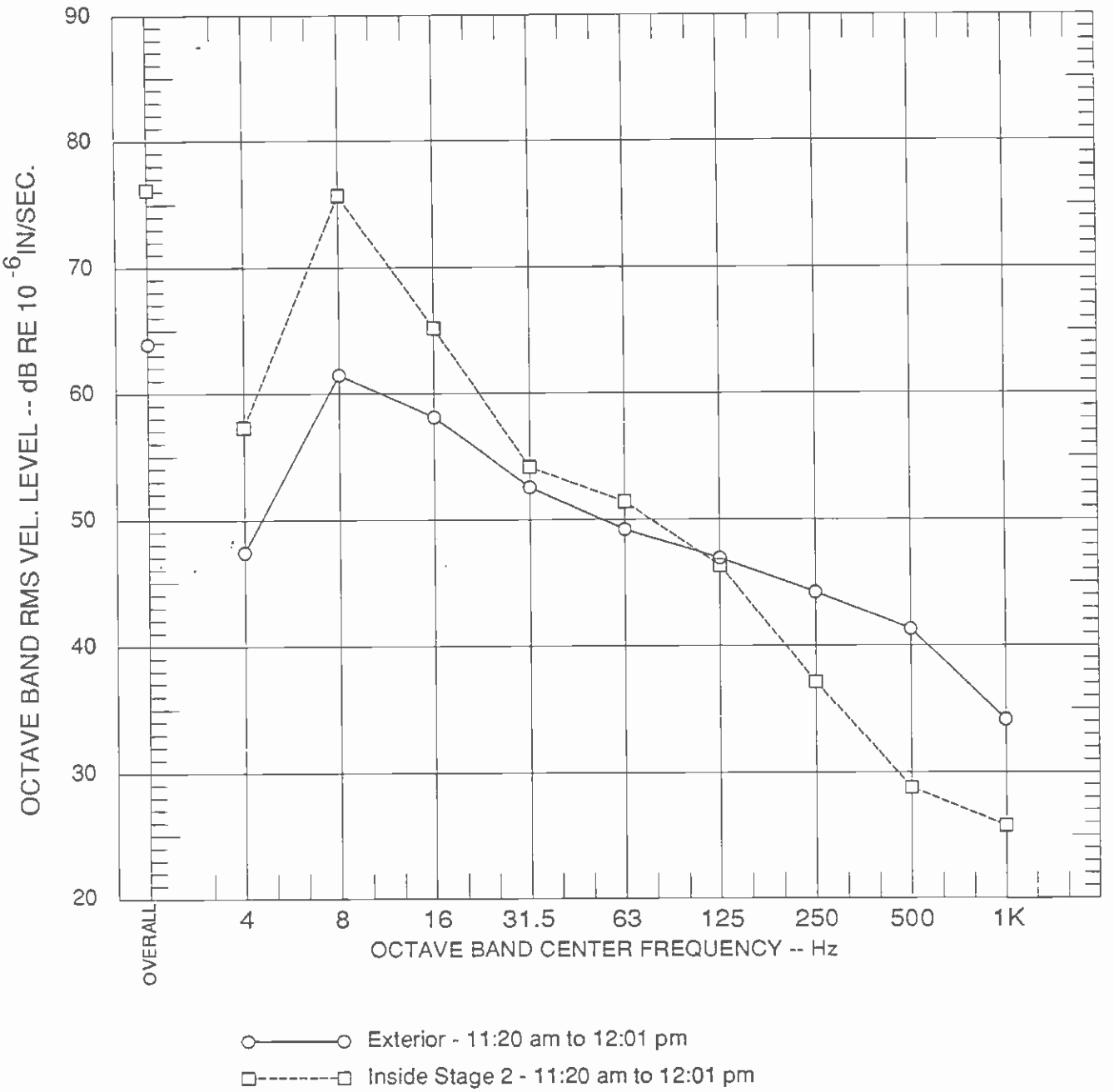


FIGURE 68 EXTERIOR AND INTERIOR L1 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 1% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

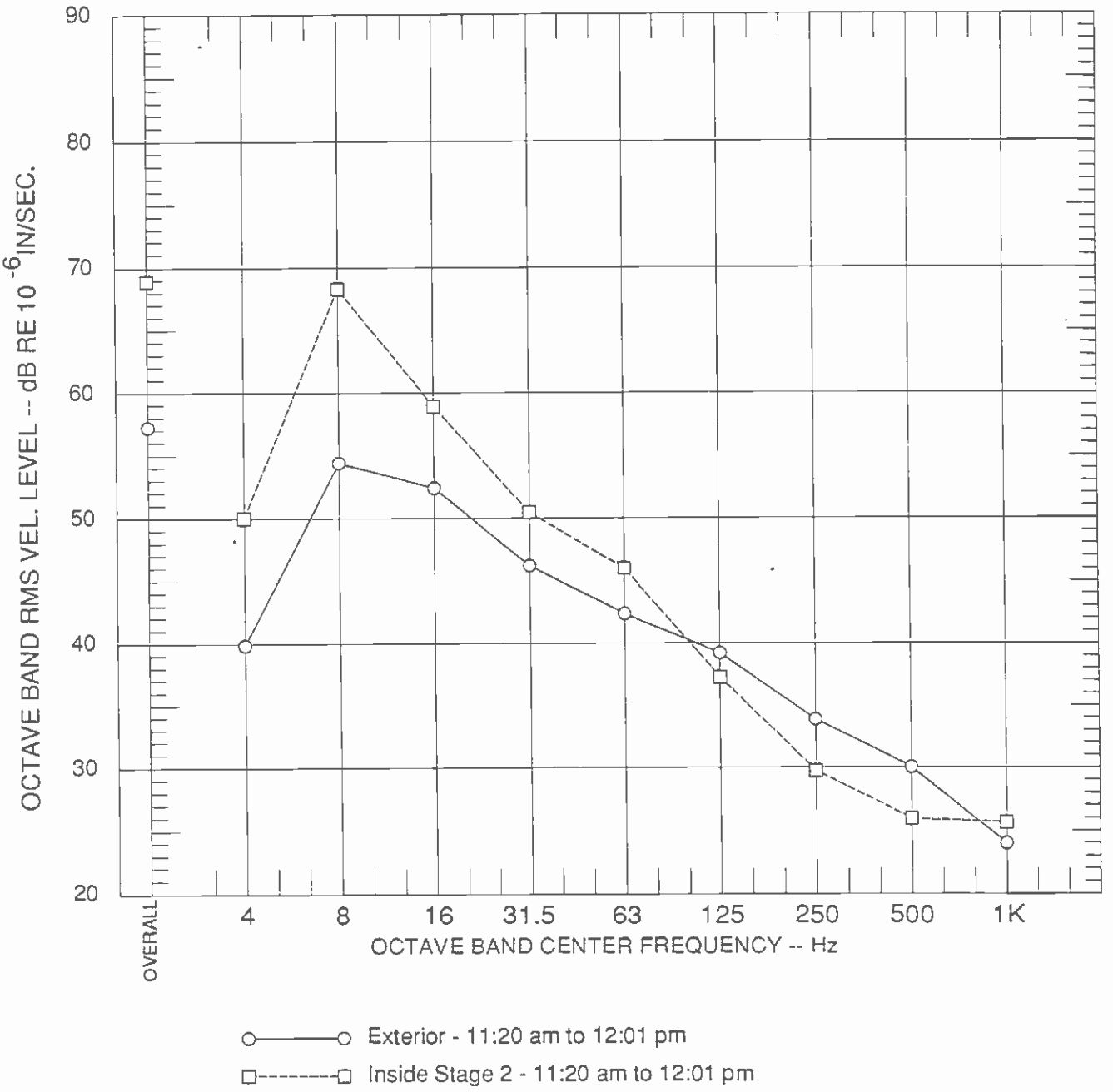


FIGURE 69 EXTERIOR AND INTERIOR L10 VIBRATION VELOCITY LEVELS (LEVELS EXCEEDED 10% OF THE TIME) MEASURED AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON THURSDAY, 9/17/87

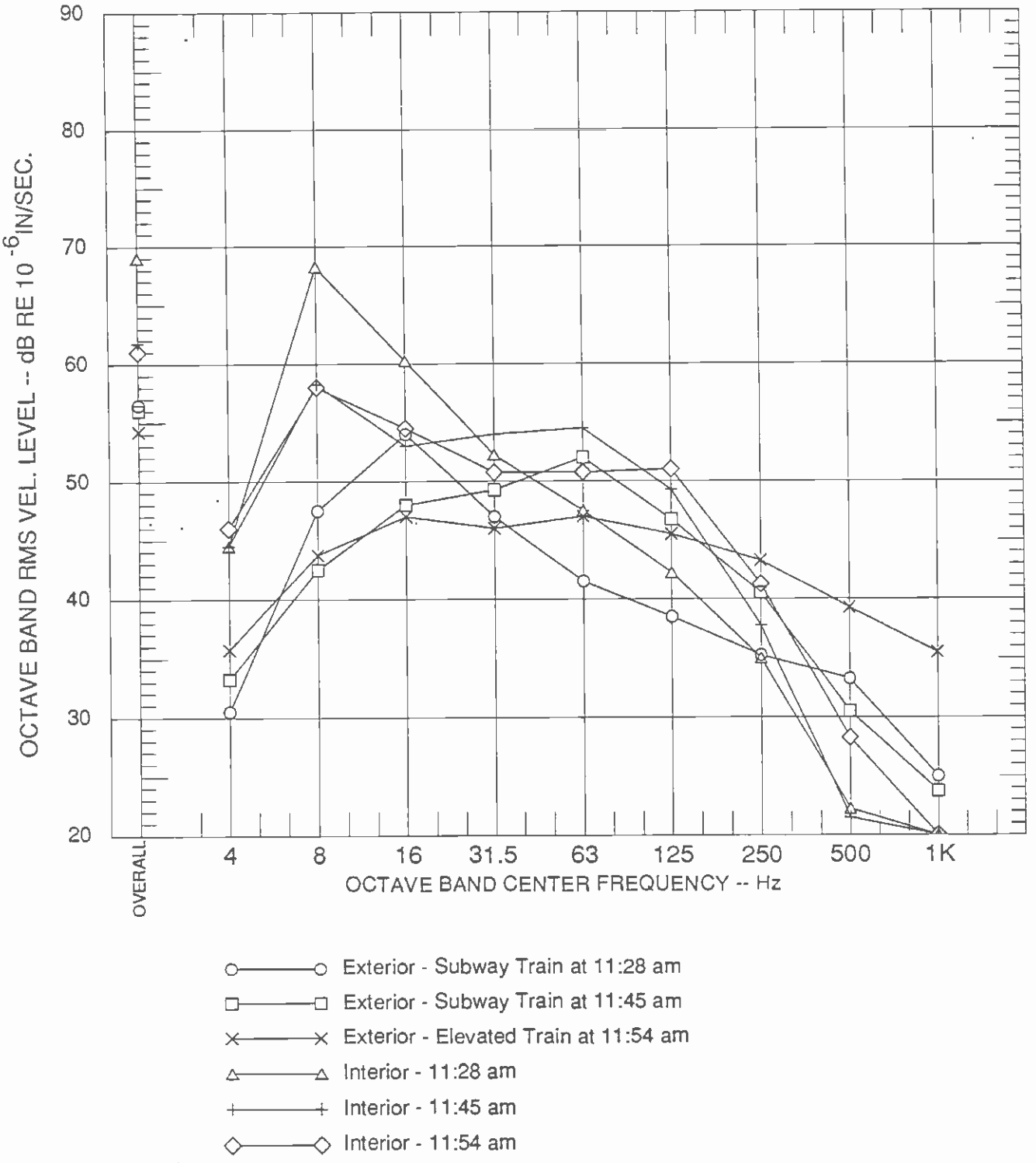


FIGURE 70 TYPICAL EXTERIOR AND INTERIOR VIBRATION VELOCITY LEVELS MEASURED DURING TRAIN PASSBYS AT THE ABC (WLS-TV) STUDIOS IN CHICAGO ON 9/17/87

APPENDIX A

PHOTOGRAPHS OF ALL MEASUREMENT LOCATIONS

EXTERIOR MEASUREMENT LOCATION AT KTTV CHANNEL 11, LOS ANGELES ON TUESDAY, 8 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT KTTV CHANNEL 11 (STAGE 6) ON TUESDAY, 8 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT KTTV CHANNEL 11 (STAGE 7) ON TUESDAY, 8 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT THE SELF REALIZATION FELLOWSHIP PREMISES (MEETING AREA) ON TUESDAY, 8 SEPTEMBER 1987.

EXTERIOR MEASUREMENT LOCATION AT THE SELF REALIZATION FELLOWSHIP PREMISES ON TUESDAY, 8 SEPTEMBER 1987.

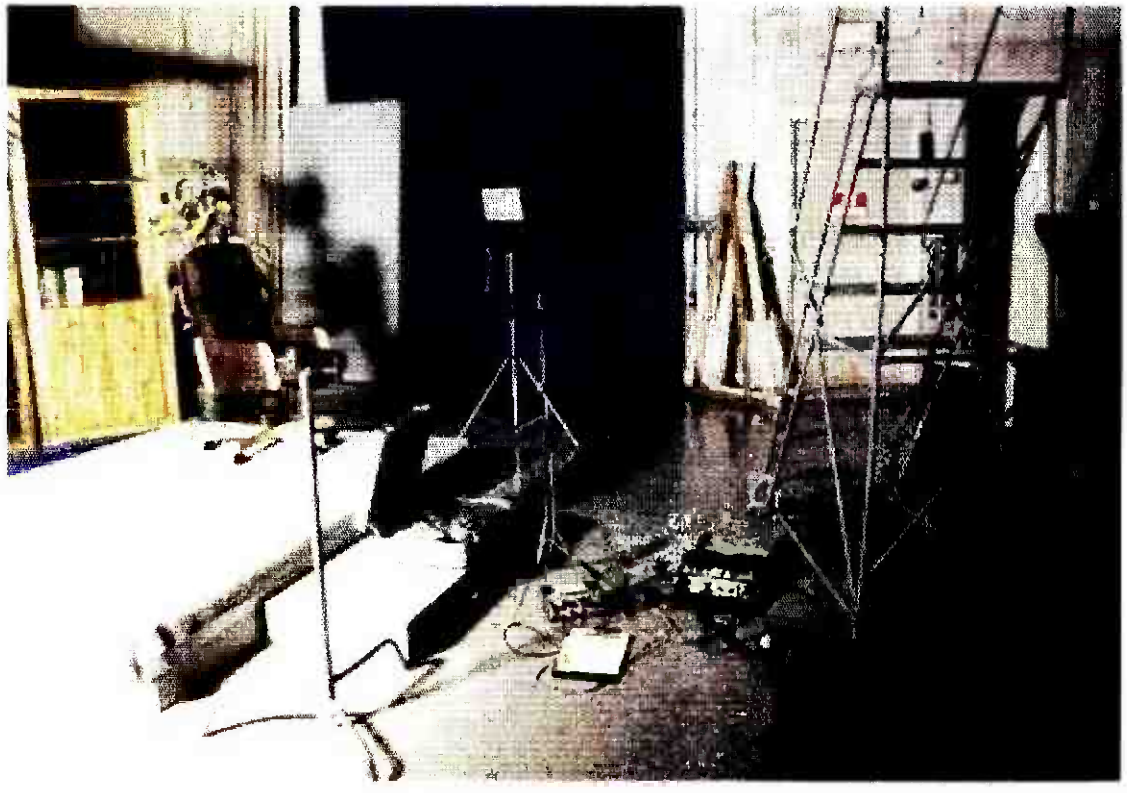
INTERIOR MEASUREMENT LOCATION AT THE SELF REALIZATION FELLOWSHIP PREMISES (TEMPLE) ON TUESDAY, 8 SEPTEMBER 1987.

EXTERIOR MEASUREMENT LOCATION AT THE KMPC/KUTE COMPLEX ON THURSDAY, 10 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT THE KMPC AM STUDIOS (CONTROL ROOM B) ON TUESDAY, 8 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT THE KMPC AM STUDIOS (PRODUCTION STUDIO) ON THURSDAY, 10 SEPTEMBER 1987.

EXTERIOR MEASUREMENT LOCATION AT KWHY CHANNEL 22 ON TUESDAY, 8 SEPTEMBER 1987.

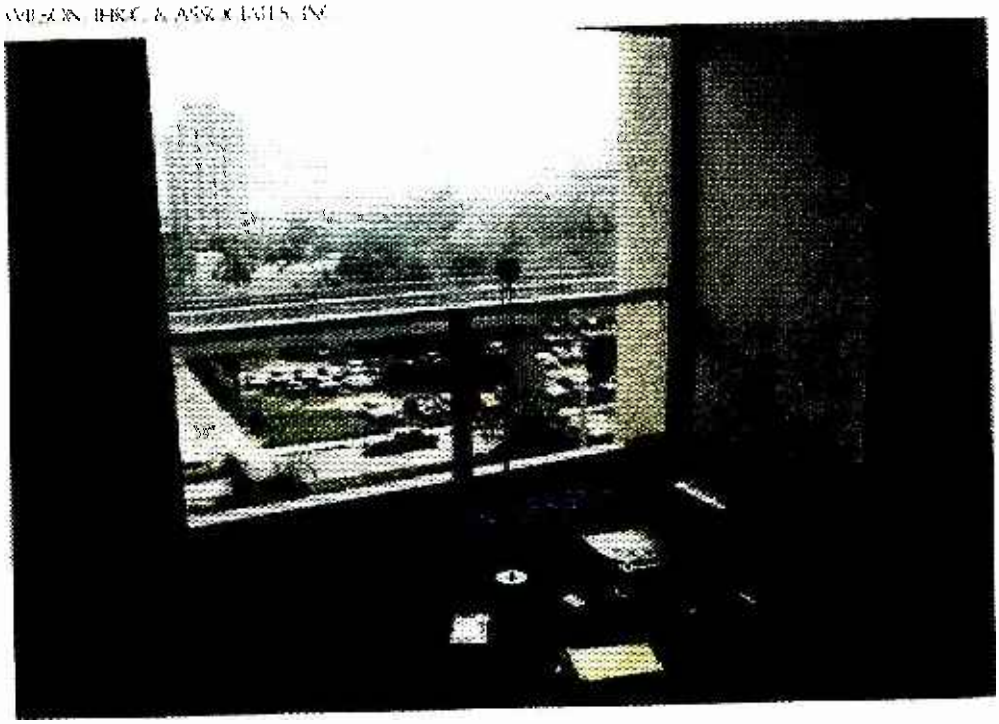


INTERIOR MEASUREMENT LOCATION AT KWHY CHANNEL 22 (STUDIO B) ON TUESDAY, 8 SEPTEMBER 1987.

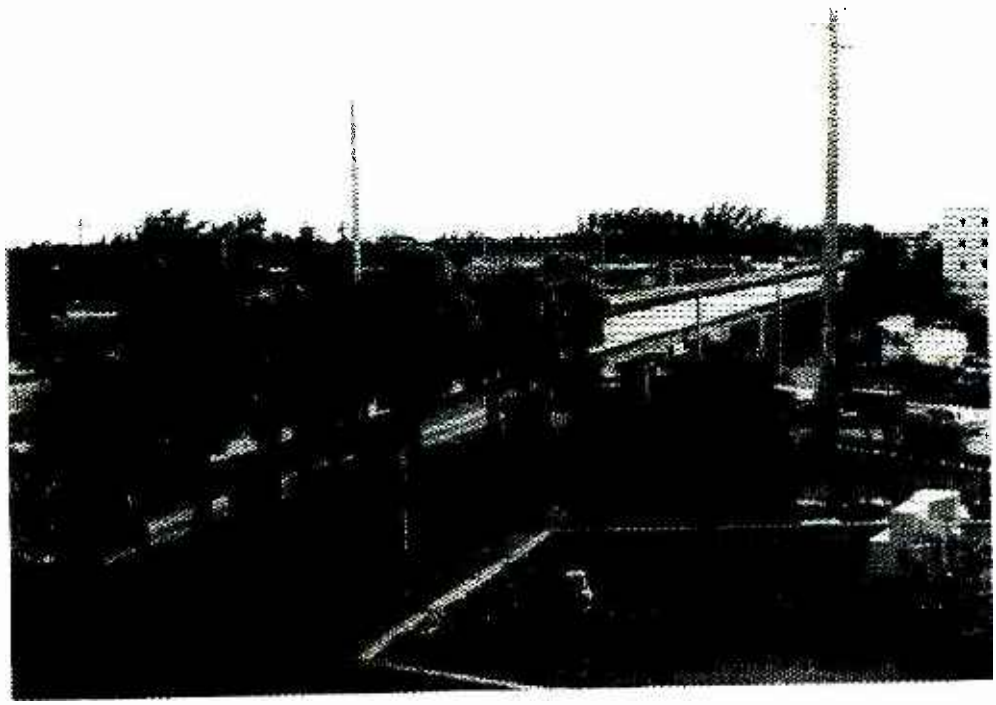
INTERIOR MEASUREMENT LOCATION AT KWHY CHANNEL 22, (STUDIO A) ON TUESDAY, 8 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT KTLA CHANNEL 5 (STAGE 9) ON THURSDAY, 10 SEPTEMBER 1987.

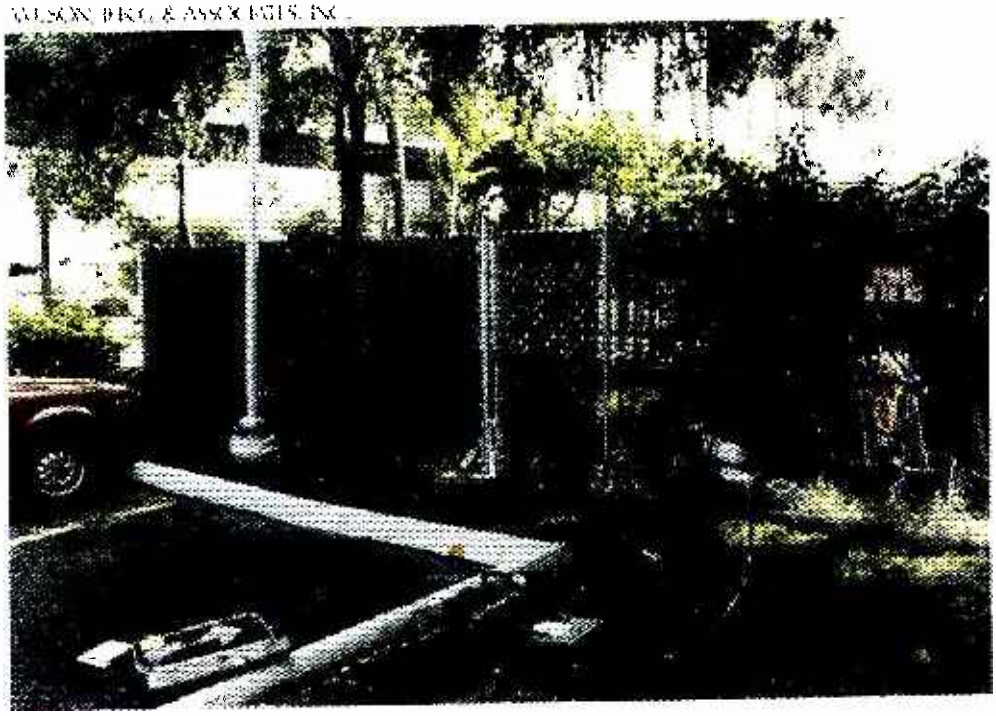
EXTERIOR MEASUREMENT LOCATION AT CEDARS MEDICAL CENTER MIAMI, ON TUESDAY, 15 SEPTEMBER 1987.



INTERIOR MEASUREMENT LOCATION AT CEDARS MEDICAL CENTER (4TH FLOOR CORRIDOR) ON TUESDAY, 15 SEPTEMBER 1987.



ELEVATED STRUCTURES NEAR SOUTH MIAMI HOSPITAL, SHOWING SOUND BARRIER WALLS.

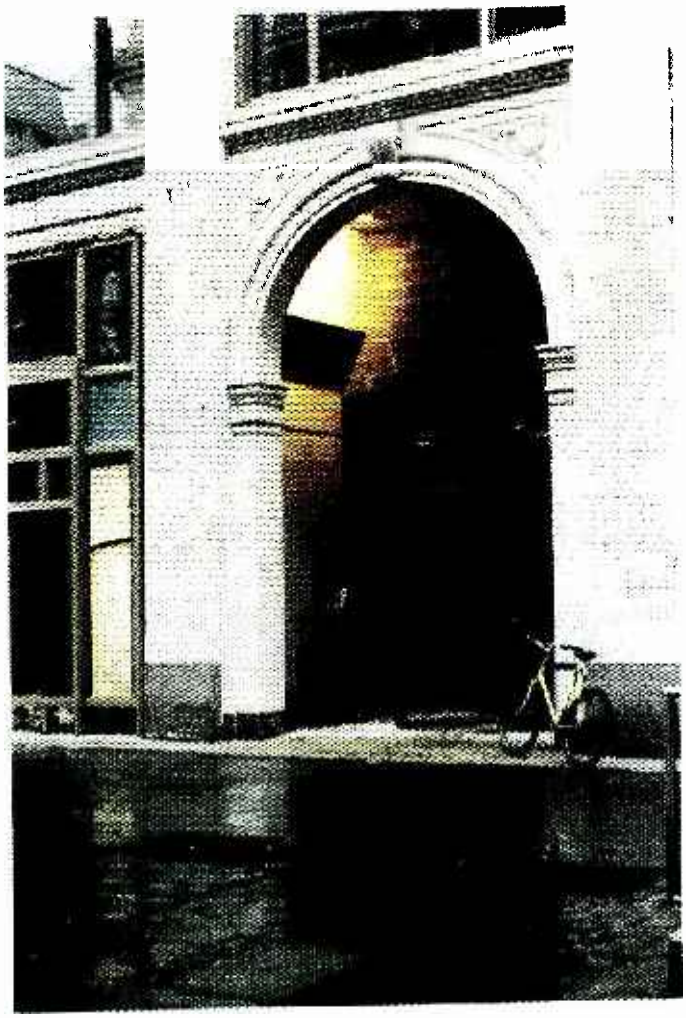


EXTERIOR MEASUREMENT LOCATION AT SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER 1987.

INTERIOR MEASUREMENT LOCATION AT SOUTH MIAMI HOSPITAL ON TUESDAY, 15 SEPTEMBER 1987.

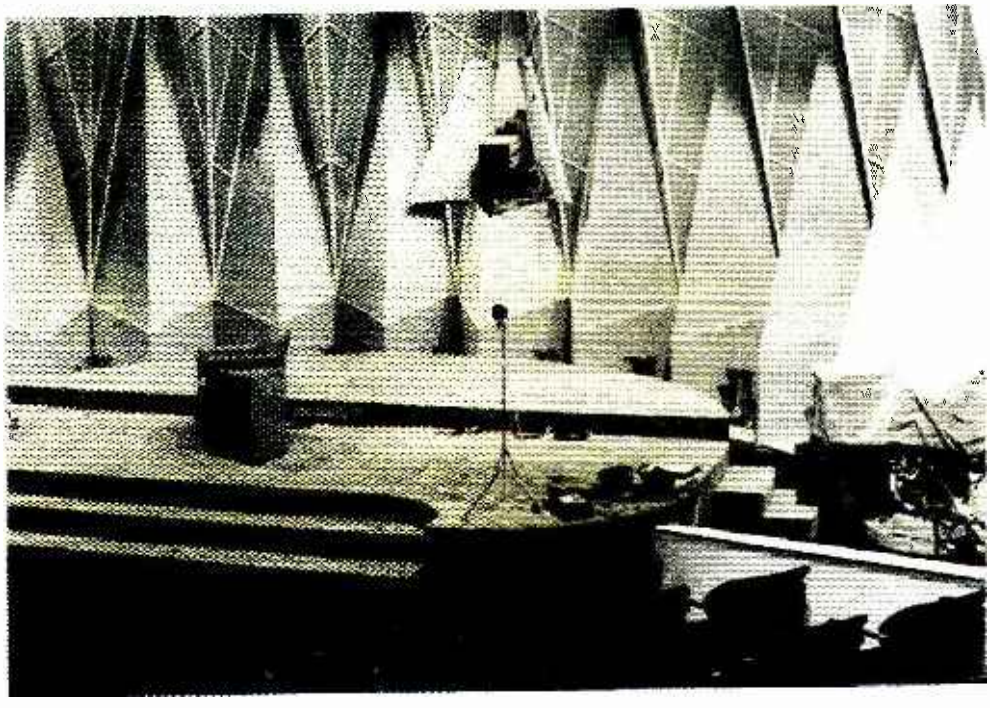
SILVERCUP RECORDING STUDIOS, ADJACENT TO QUEENSBORO BRIDGE, NEW YORK CITY.

EXTERIOR MEASURMENT LOCATION AT SILVERCUP RECORDING STUDIOS, ON WEDNESDAY, 16 SEPTEMBER 1987.



EXTERIOR MEASUREMENT LOCATION AT ABC (WLS-TV) STUDIOS, CHICAGO, ON THURSDAY, 17 SEPTEMBER 1987.

LAKE STREET ELEVATED STRUCTURE ADJACENT TO ABC (WLS-TV) STUDIOS IN CHICAGO.



INTERIOR MEASUREMENT LOCATION AT ABC (WLS-TV) STUDIOS (STUDIO 2), ON THURSDAY, 17 SEPTEMBER 1987.

APPENDIX B

GLOSSARY AND SIGNIFICANCE OF ACOUSTICAL TERMS

Glossary of Terms

A-WEIGHTED SOUND LEVEL (dBA):
The sound pressure level in decibels as measured on a sound level meter using the internationally standardized A-weighting filter or as computed from sound spectral data to which A-weighting adjustments have been made. A-weighting de-emphasizes the low and very high frequency components of the sound in a manner similar to the response of the average human ear. A-weighted sound levels correlate well with subjective reactions of people to noise and are universally used for community noise evaluations. Figure B-1 shows typical dBA levels from various sources of noise.

ACCELEROMETER:
A vibration sensitive transducer that responds to the vibration acceleration of a surface to which it is attached. The electronic signal generated by an accelerometer is directly proportional to the surface acceleration.

ACCELERATION LEVEL:
Also referred to as "vibration acceleration level." Vibration acceleration is the rate of change of speed and direction of a vibration. An accelerometer generates an electronic signal that is proportional to the vibration acceleration of the surface to which it is attached. The acceleration level is 20 times the logarithm to the base 10 of the ratio of the RMS value of the acceleration to a reference acceleration. The generally accepted reference vibration acceleration is 10^{-6} g (10^{-5} m/sec).

AMBIENT NOISE:
The prevailing general noise existing at a location or in a space, which usually consists of a composite of sounds from many sources near and far.

BACKGROUND NOISE:
Noise from all sources other than the source of interest. Generally background noise consists of a large number of distant noise sources and can be characterized by L_{90} or L_{99}.

C-WEIGHTED SOUND LEVEL (dBC)
The sound pressure level in decibels as measured on a sound level meter using the internationally standardized C-weighting filter or as computed from sound spectral data to which C-weighting adjustments have been made. The C-weighting network weights the frequencies between 70 Hz and 4000 Hz uniformly, but below and above these frequency limits the sound is discriminated against. Generally, C-weighted frequencies are essentially the same as overall sound pressure levels, which require no discrimination at any frequency.

COMMUNITY NOISE EQUIVALENT LEVEL (CNEL):
The L_{eq} of the A-weighted noise level over a 24-hour period with a 5 dB penalty applied to noise levels between 7 p.m. and 10 p.m. and a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m.

DAY-NIGHT SOUND LEVEL (L_{dn}):
The L_{eq} of the A-weighted noise level over a 24-hour period with a 10 dB penalty applied to noise levels between 10 p.m. and 7 a.m.

DECIBEL (dB):
The decibel is a measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power, intensity) with respect to a standardized reference quantity.

ENERGY EQUIVALENT LEVEL (L_{eq}):
The level of a steady noise which would have the same energy as the fluctuating noise level of interest integrated over the time period of interest. L_{eq} is widely used as a single-number descriptor of environmental noise. L_{eq} is based on the logarithmic or energy summation and it places more emphasis on high noise level periods than does L_{50} or a straight arithmetic average of noise level over time. This energy average is not the same as the average of sound pressure levels over the period of interest, but must be computed by a rather complex procedure involving logarithms and integrals. Taken into account are the total times for which various noise levels are exceeded, thus the actual or assumed time history of the noise level must be known.

FREQUENCY (Hz):
The number of oscillations per second of a periodic noise (or vibration) expressed in Hertz (abbreviated Hz). Frequency in Hertz is the same as cycles per second.

L_1, L_{10}, L_{50}, L_{90} AND L_{99}:
The noise (or vibration) levels that are exceeded for 1%, 10%, 50%, 90% and 99% of a specified time period, respectively. Environmental noise and vibration data are often described in these terms. See section A-2 for a more detailed discussion of the statistical distribution terms.

NOISE REDUCTION COEFFICIENT (NRC):
Noise reduction coefficient is a measure of the acoustical absorption performance of a material, calculated by averaging its sound absorption coefficients at 250 Hz, 500 Hz, 1000 Hz and 2000 Hz.

OCTAVE BAND - 1/3 Octave Band
One octave is an interval between two sound frequencies that have a ratio of two. For example, the frequency range of 200 Hz to 400 Hz is one octave, as is the frequency range of 2000 Hz to 4000 Hz. An octave band is a frequency range that is one octave wide. A standard series of octaves is used in acoustics, and they are specified by their center frequencies. In acoustics, to increase resolution, the frequency content of a sound or vibration is often analyzed in terms of 1/3 octave bands, where each octave is divided into three 1/3 octave bands.

REVERBERENT FIELD:
The region in a room where the reflected sound dominates, as opposed to the region close to the noise source, where the direct sound dominates.

REVERBERATION:
The continuation of sound reflections within an enclosed space after the sound source has stopped.

REVERBERATION TIME (RT):
The time taken for the sound-pressure level in a room to decrease to one-millionth (60 dB) of its steady state value when the source of sound energy is suddenly interrupted. It is a measure of the persistence of a sound in a room and of the amount of acoustical absorption present inside the room.

SOUND ABSORPTION COEFFICIENT (α):
The absorption coefficient of a material is the ratio of the sound absorbed by the material to that absorbed by an equivalent area of an open window. The absorption coefficient of a perfectly absorbing surface would be 1.0 and for marble slate is approximately 0.01.

SOUND PRESSURE LEVEL (SPL):
The sound pressure level of a sound in decibels is 20 times the logarithm to the base of 10 of the ratio of the RMS value of the sound pressure to the RMS value of a reference sound pressure. The generally accepted reference sound pressure is 20 micro-pascals.

VELOCITY LEVEL:
Also referred to as the "vibration velocity level." Vibration velocity is the rate of change of displacement of a vibration. The velocity level is 20 times the logarithm to the base 10 of the ratio of the RMS value of the velocity to the reference velocity. In this report the reported vibration velocity levels are all referenced to 10^{-6} in/sec. The vibration velocity of a surface is generally measured by integrating the output from an accelerometer. Above approximately 10 Hz, human responses to a vibration is more closely correlated to the velocity level than the acceleration level.

WEIGHTED VELOCITY LEVEL:
The vibration velocity level to which a weighting factor has been added. The weighting de-emphasizes the low frequencies in a manner similar to human response to vibration. The weighting used in this report is based on that proposed in Reference 10, however, there is no internationally recognized velocity weighting filter.

STATISTICAL DISTRIBUTION TERMS

L_{99} and L_{90} are descriptors of the typical minimum or "residual" background noise (or vibration) levels observed during a measurement period, normally made up of the summation of a large number of sound sources distant from the measurement position and not usually recognizable as individual noise sources. The most prevalent source of this residual noise is distant street traffic. L_{99} and L_{90} are not strongly influenced by occasional local motor vehicle pass-bys. However they can be influenced by stationary sources such as air conditioning equipment.

L_{50} represents a long-term statistical median noise level over the measurement period and does reveal the long-term influence of local traffic.

L_{10} describes the average of the peaks or maximum noise levels occurring, for example, during nearby pass-bys of trucks, buses, automobiles, trains, or airplanes. Thus, while L_{10} does not describe the typical maximum noise levels observed at a point, it is strongly influenced by the momentary maximum noise level occurring during vehicle pass-bys.

L_1, the noise level exceeded for 1% of the times is representative of the occasional, isolated maximum or peak level which occurs in an area. L_1 is usually strongly influenced by occasional isolated short-duration noise events such as aircraft or vehicle passbys.

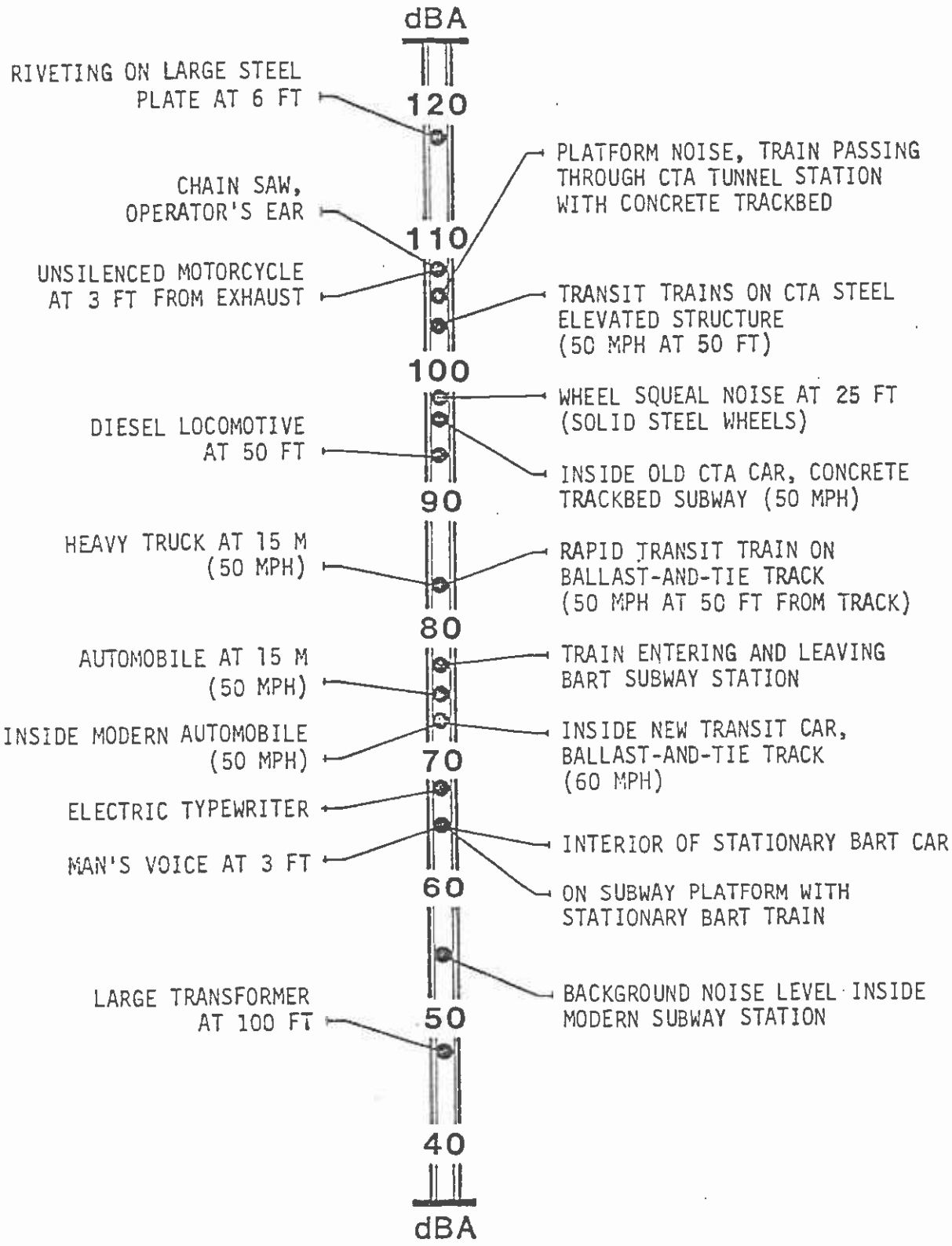


FIGURE B-1 TYPICAL NOISE LEVELS