



---

## NIOSH HEALTH HAZARD EVALUATION REPORT

**HETA #2004-0415-2963**

**Meijer  
East Lansing, Michigan**

**April 2005**



**DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health**

**NIOSH**

## PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Randy L. Tubbs of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing was performed by Shawna Watts. Editorial assistance was provided by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Meijer and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: <http://www.cdc.gov/niosh/hhe>. Single copies of this report will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

NIOSH Publications Office  
4676 Columbia Parkway  
Cincinnati, Ohio 45226  
800-356-4674

After this time, copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

**For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.**

## Highlights of the NIOSH Health Hazard Evaluation

### Noise assessment of checkout lanes at a retail department store

In September 2004, NIOSH was asked to evaluate the noise levels produced by the scanner/scale units used by cashiers to price customers' purchases at a Meijer store in East Lansing, Michigan.

#### What NIOSH Did

- We measured noise to determine the loudness and pitch of sounds made by the scanner/scales.
- We interviewed the cashiers about the workplace and work-related concerns.

#### What NIOSH Found

- The noise levels were not loud enough to damage workers' or customers' hearing.
- The cashiers had concerns about the scanner/scales and bag carousels and how they might harm their backs and shoulders.

#### What Meijer Managers Can Do

- Communicate the findings of this report to all of the cashiers that the noise levels are safe.
- Set up test projects on a few checkout lanes that have changeable bag carousels and display screens to see if employees are more comfortable.

#### What the Meijer Employees Can Do

- Report to management any increases in the noise levels at the checkout lanes.
- Participate in the test projects and give feedback about the changes to the project manager.



**What To Do For More Information:**  
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2004-0415-2963



# **Health Hazard Evaluation Report 2004-0415-2963**

## **Meijer**

## **East Lansing, Michigan**

## **April 2005**

**Randy L. Tubbs, Ph.D.**

---

## **SUMMARY**

The National Institute for Occupational Safety and Health received a request for a health hazard evaluation at a Meijer store in East Lansing, Michigan on September 28, 2004. Employees at the store were concerned about potential hearing damage from recently installed scanner/scale units in the store's checkout lanes. The units were loud enough that customers were commenting on them.

A site visit was made to the facility on November 30 and December 1, 2004. An opening conference was held with management and employee representatives followed on the second day with a noise analysis of all the store's checkout lanes. The cashiers on duty during the noise survey were interviewed about any concerns they had with their work environment. The spectral measurements showed overall noise levels less than 65 dBA at each of the work stations. The siren-like sounds from the scanner/scales were associated with the spectral peaks measured at 500 and 1000 Hz. The cashiers also reported concerns about poor ergonomic conditions in the new checkout lanes.

The NIOSH investigator determined that a health hazard does not exist from noise emitted by the scanner/scale units at this facility. Recommendations are offered to Meijer on addressing the ergonomic issues raised by employees and on communicating the results of the noise survey to employees and customers.

Keywords: 5311 (Department Stores) noise, checkout lanes, scanner/scales, ergonomics

## Table of Contents

Preface.....	ii
Acknowledgments and Availability of Report.....	ii
Highlights of the NIOSH Health Hazard Evaluation .....	iii
Summary.....	iv
Introduction.....	1
Background .....	1
Methods.....	1
Evaluation Criteria .....	2
Results .....	3
Discussion and conclusions.....	4
Recommendations.....	5
References.....	5

## INTRODUCTION

On September 28, 2004, the National Institute for Occupational Safety and Health (NIOSH) received an employee request for a health hazard evaluation at a Meijer store in East Lansing, Michigan. The employees reported a constant humming sound coming from the checkout scanner/scales. These sounds were loud enough that the customers also commented on them. The employees expressed concern about the effects the humming might have on their hearing.

From November 30 to December 1, 2004, a site visit was made at the facility by a NIOSH investigator. On the first day, an opening conference was held with the store manager and an employee representative to discuss the problem of the scanner/scale noise. On the morning of December 1, the NIOSH investigator made area spectral measurements of the sound emitted by the scanner/scales at each checkout in the store. A short debriefing session describing the measurements made at the store was given to the store manager and employee representative at the end of the evaluation.

## BACKGROUND

Meijer operates over 150 grocery and general merchandise stores in the Midwest. The stores operate 24 hours per day, 7 days a week. At the East Lansing store, approximately 110 associates are employed. The cashiers work at the front of the store at the 37 checkout lanes. Twenty-nine of the checkout lanes are operated by a cashier who rings up merchandise, bags it, and takes payment from the customer. Eight of the checkout lanes are self-serviced by the customer with a cashier available for assistance as needed. On June 3, 2004, the East Lansing store installed new scanner/scales and bag carousels at each checkout lane.

The store has 37 checkout lanes at the front of the store. Thirty of the lanes are in the larger checkout area and the remaining seven lanes are at the other end of the store front, separated by a customer service area. Each section has four U-

scan lanes operated by the customer under the supervision of a Meijer cashier. During the NIOSH noise survey, the smaller checkout section was closed to customers and had no activity in the immediate vicinity. In the larger section, three checkout lanes were open and operated by Meijer associates. The U-scan lanes in this part of the store were also operational during the survey.

## METHODS

On the morning of the noise survey, most of the checkout lanes were closed due to low customer demand. Only three associate-assisted lanes were operating during the survey period along with four self-serve scanner/scales. Each of the store's 29 associate-assisted checkouts was analyzed for noise; the two sets of self-serve scanners were not measured. The noise analyzer was mounted on a tripod which positioned the microphone at an employee's ear level at each checkout station near the scanner/scale and keyboard location. No employee was present at checkout lanes that were closed while the noise measurements were made.

The spectral area noise measurements were made with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559  $\frac{1}{2}$ " random incidence response microphone. The analyzer allows for the analysis of noise into its spectral components in a real-time mode. The  $\frac{1}{2}$ "-diameter microphone has a frequency response range ( $\pm 2$  decibels [dB]) from 4 Hertz (Hz) to 21 kilohertz (kHz) that allows for the analysis of sounds in the region of concern. One-third octave bands consisting of center frequencies from 25 Hz to 20 kHz were integrated for 30 seconds and stored in the analyzer for later analysis.

The tripod and noise analyzer were placed in each lane at the point where a cashier would stand while serving the customer. For the open checkout lanes, the tripod and analyzer were located next to the cashier. In all cases, the analyzer's microphone was located at about ear level of a standing employee. The NCR RealScan 7875 Bi-Optic Scanner/Scale installed

at the store in June 2004, has a standby power mode that shuts the system down when it is not in use. When the scanner/scale senses that a cashier has entered the checkout area, it turns on with an audible sound whose pitch increases as the device reaches full power. All 30-second integrated noise measurements were made when the individual scanner/scale was in this powered up condition. After the sound was recorded and the analyzer moved away from the scanner/scale, the unit powered down with an audible, decreasing pitch.

## EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits

(RELs),<sup>1</sup> (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),<sup>2</sup> and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).<sup>3</sup> Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.<sup>4</sup> While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hz (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before

the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.<sup>5</sup>

The A-weighted decibel (dBA) is the preferred unit for measuring sound levels to assess worker noise exposures. The dBA scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dBA scale is logarithmic, increases of 3 dBA, 10 dBA, and 20 dBA represent a doubling, tenfold increase, and hundredfold increase of sound energy, respectively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)<sup>6</sup> specifies a maximum PEL of 90 dBA for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship, or exchange rate. This means that a person may be exposed to noise levels of 95 dBA for no more than 4 hours, to 100 dBA for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dBA is allowed by this exchange rate. NIOSH, in its Criteria for a Recommended Standard,<sup>7</sup> and the ACGIH,<sup>2</sup> propose exposure criteria of 85 dBA as a TWA for 8 hours, 5 dB less than the OSHA standard. The criteria also use a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dBA for 8 hours, but to no more than 88 dBA for 4

hours or 91 dBA for 2 hours. Twelve-hour exposures have to be 83 dBA or less according to the NIOSH REL.

The occupational noise regulation promulgated by OSHA,<sup>6</sup> as well as the limits published by NIOSH<sup>7</sup> and ACGIH,<sup>2</sup> are not appropriate for the situation observed at this work location. The above referenced criteria are designed to prevent hearing losses from exposures to intense noise levels. However, noise of intensities lower than that which may cause a loss of hearing can be disruptive in the workplace. Interference with speech is a possible result of unwanted noise. The noise can interfere with the efficiency and productivity of the staff and can be detrimental to the occupants' comfort, health, and sense of wellbeing.

One set of noise criteria for occupied interior spaces, the balanced noise criteria (NCB) curves, has been devised to limit noise to levels where satisfactory speech intelligibility is achieved.<sup>8,9,10</sup> The noise criteria were devised through the use of extensive interviews with personnel in offices, factories, and public places along with simultaneously measured octave band sound levels. The interviews consistently showed that people rate noise as troublesome when its speech interference level is high enough to make communications difficult. The recommended space classifications and suggested noise criteria range for steady background noise heard in various indoor occupied activity areas are shown in Table 1.

## RESULTS

The median overall sound level for all checkout lanes was 61.2 dBA and 68.4 dB on the weighted (dBA) and unweighted sound pressure level (dB SPL) scales. The values ranged from 57.1 to 64.7 dBA on the A-weighted scale for the 29 checkout lanes and from 66.6 to 70.5 dB SPL on the unweighted scale. The one-third octave band levels for the three open checkout lanes and the three unused lanes at the far end of the store were compared in Figure 1. The data for the closed lanes show higher one-third octave bands at 500 and 1000 Hz. The open

checkout lanes have higher one-third octave band values above 160 Hz, except at the 500 and 1000 Hz center frequencies where the two conditions are the same. A NCB curve was calculated from data collected on the 29 checkout lanes and is shown in Figure 2. The data equate with a room noise criterion of NCB-55.

Informal interviews were conducted with the cashiers on duty at the time of the evaluation. They reported that the scanner/scales produced a siren-like sound that both they and the customers heard. It was also described as being similar to a vacuum cleaner. The cashiers also reported that they had concerns about the ergonomic configuration of the recently installed checkout lanes and bag carousels. The height of the six-bag carousel is not adjustable and taller cashiers reported that they had to bend down to place items into the bags, leading to back pain. The video display screen used by the cashier is adjustable in the vertical plane (up and down) but not in the horizontal (in and out) plane. The shorter cashiers must reach over the scanner to touch the buttons on the screen. Cashiers reported resting one foot on a shelf 5-6 inches above the floor to relieve back strain. It was noted that anti-fatigue mats are at each checkout lane for the cashiers to stand on while waiting on customers.

## DISCUSSION AND CONCLUSIONS

The overall sound levels measured at the East Lansing Meijer store are well below the OSHA and NIOSH hearing loss criteria. Noise exposures less than 65 dBA do not increase a worker's risk for occupational hearing loss. However, noise at this level can still result in interference in communications between the cashiers and the customers. The NCB calculated from the checkout lane data does show that the curve is greater than the recommendation for retail shops and stores. Recommended NCB values are between 35 and 45 dB. The octave band data reveal that the sound levels in the center frequency bands of 500 Hz and above are

what determines the NCB value for this area. The line curve (NCB-55) in Figure 2 generally touches the vertical bars representing the octave band levels at 500 Hz and above. Observations made during the noise measurements seemed to show that powering up the scanner/scale led to increase in the 500 Hz and 1 kHz one-third octave bands. Inspection of Figure 1 confirms this finding. Both the open and closed conditions have equivalent sound levels at these two bands. The open checkout lane also shows a higher sound level at 630 Hz that is not seen in the closed checkout condition. These sounds are the result of the beep produced by the scanner/scale when an item has been read. The figure shows that the sound level for these operations is 60 dB or less, levels that are not hazardous to the employees' hearing.

The reporting by cashiers that they and the customers notice the powering up and down of the scanner/scale as a siren or vacuum cleaner sound shows that the ambient noise levels in the store are not excessive. The levels of the scanner/scale noise when in the powered up mode and the beeping alert signal are great enough to be heard above the background noise levels. Perhaps over time, cashiers and customers will become used to the "siren sound" and treat it like all of the other extraneous background noises in the store. If Meijer management would like to have people habituate to the scanner/scale sound more rapidly, then the sound should remain fairly constant, and not repeatedly turn on and off. However, this would necessitate that the scanner/scales stay in a powered up mode all of the time which may cost additional money for electrical power or may reduce the life expectancy of the units.

The ergonomic concerns of the cashiers reported to the NIOSH investigator can lead to uncomfortable work conditions and potential work-related injury. Bending down to put items into the bags on the unadjustable carousel can lead to back discomfort in tall employees. Through discussions with the manufacturer of the carousel, it was discovered that a retro-fit could be added that would give three different height positions with a total range of motion of

3" from the lowest bag setting to the highest bag setting. An estimated cost of this retro-fit is \$380 - \$450. The manufacturer noted that the height of the carousel could not be raised too much adding an additional lift that the cashier would have to perform to get the item over the top edge of the bag before lowering it into the bag.

## RECOMMENDATIONS

Based on the information obtained in this evaluation of the Meijer store in East Lansing, Michigan from the noise measurements, interviews with cashiers, and the observations made by the NIOSH investigator, the following recommendations are offered to provide a safe and healthy workplace for employees working at the checkout lanes of this facility.

1. Make the results of this health hazard evaluation freely available and discuss them with employees. The finding that the noise from the scanner/scales does not yield an increased risk of hearing loss needs to be understood by all employees. This information can then be passed onto the customers whenever they comment on the siren or vacuum cleaner sounds that they hear.
2. Test the variable height bag carousel on a small number of the checkout lanes to see if they reduce concerns about strained backs by some of the employees. The employees chosen to operate these lanes will have to give feedback to the project manager to document the utility of the changes.
3. Contact NCR, the manufacturer of the scanner/scale and display screens, about the availability of a variable setting for both the vertical and horizontal position of the display to reduce the distance which cashiers must reach to operate these devices. A project similar to the bag carousel one could be initiated to test the effectiveness of such a change on how the cashiers perceive their work comfort.
4. Continue to provide foot rests and anti-fatigue mats for the cashiers, a good ergonomic practice recognized by OSHA in their

Guidelines for Retail Grocery Stores.<sup>11</sup> Meijer management should review this document for additional suggestions on improving the cashier's work area.

## REFERENCES

1. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
2. ACGIH [2004]. 2004 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. CFR [2003]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
4. Ward WD, Royster LH, Royster JD [2000]. Anatomy & physiology of the ear: normal and damaged hearing. Chapter 4. In: Berger EH, Royster LH, Royster JD, Driscoll DP, & Layne M, eds. The noise manual. 5<sup>th</sup> ed. Fairfax, VA: American Industrial Hygiene Association, pp 101-122.
5. Suter AH [1978]. The ability of mildly-impaired individuals to discriminate speech in noise. Washington, DC: U.S. Environmental Protection Agency, Joint EPA/USAF study, EPA 550/9-78-100, AMRL-TR-78-4.
6. CFR [2003]. 29 CFR 1910.95. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
7. NIOSH [1998]. Criteria for a recommended standard: Occupational noise exposure (revised criteria 1998). Cincinnati, OH: U.S. Department of Health and Human Services,

Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-126.

8. Beranek LL [1989]. Balanced noise criterion (NCB) curves. *J. Acoust. Soc. Am.* 86(2):650-664.

9. Beranek LL [1988]. Criteria for noise and vibration in communities, buildings, and vehicles. In: Beranek LL, ed. *Noise and Vibration Control*. Rev. ed. Cambridge,

Massachusetts: Institute of Noise Control Engineering, pp. 554-623.

10. ANSI [1995]. American national standard: Criteria for evaluating room noise. New York, NY: Acoustical Society of America, American National Standards Institute, ANSI S12.2-1995.

11. OSHA [2004]. Guidelines for retail grocery stores. Ergonomics for the prevention of musculoskeletal disorders. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration, DOL (OSHA) Publication No. 3192-06N.

Table 1  
 Suggested Balanced Noise Criteria Range for Various Occupied Indoor Areas  
 Meijer, Inc.  
 East Lansing, Michigan  
 HETA 2004-0415  
 December 1, 2004

Type of Space and Acoustical Requirements	NCB Curve
Concert halls, opera houses, and recital halls	10 – 15
Large auditoriums, large drama theaters, and large churches	Not to exceed 20
Small auditoriums, small theaters, small churches, music rehearsal rooms, large meeting and conference rooms, and executive offices	Not to exceed 30
Bedrooms, hospitals, residences, apartments, hotels	25 – 40
Private or semi-private offices, small conference rooms, classrooms, libraries	30 – 40
<b>Large offices, reception areas, retail shops and stores, cafeterias, restaurants</b>	<b>35 – 45</b>
Lobbies, laboratory work spaces, drafting and engineering rooms, general secretarial areas	40 – 50
Light maintenance shops, industrial plant control rooms, office and computer equipment rooms, kitchens, and laundries	45 – 55
Shops, garages	50 – 60 *
Work spaces where speech or telephone communication not required	55 – 70

\* Levels above NCB-60 are not recommended for any office or communication situation.

Figure 1  
One-Third Octave Band Sound Levels for Open and Closed Checkout Lanes  
Meijer, Inc.  
East Lansing, Michigan  
HETA 2004-0415  
December 1, 2004

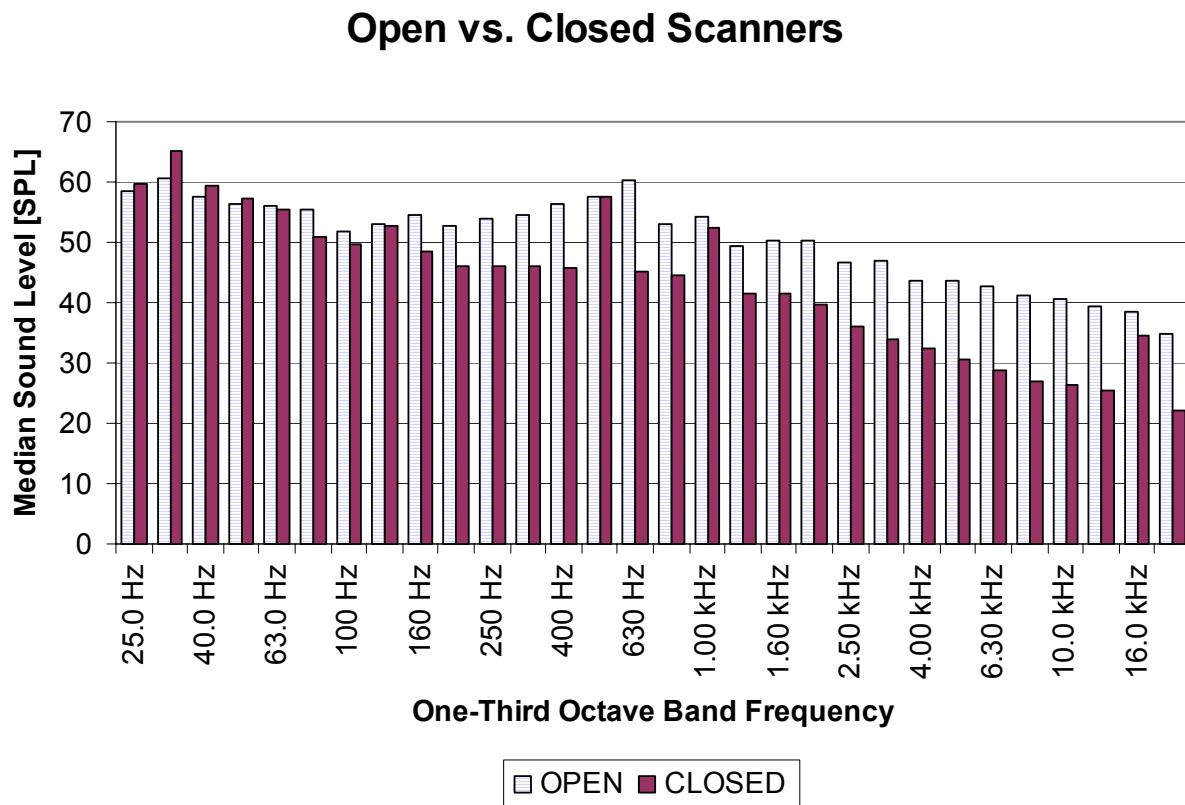
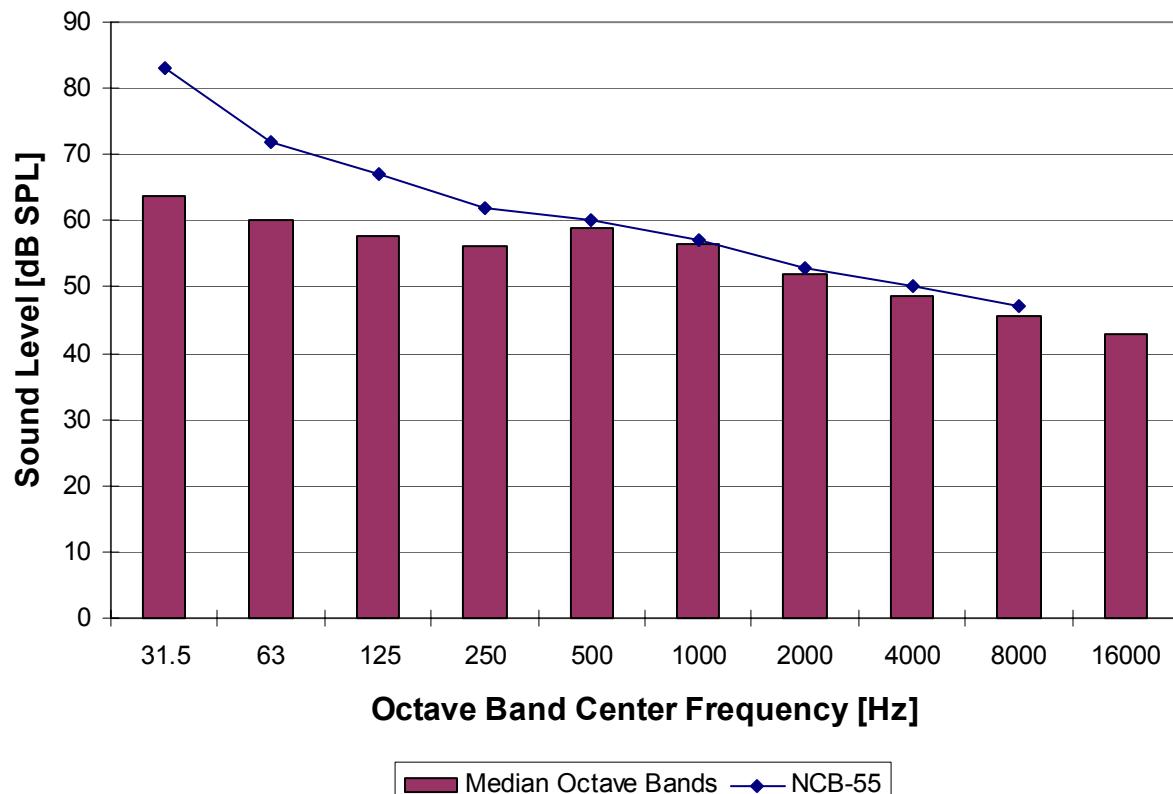
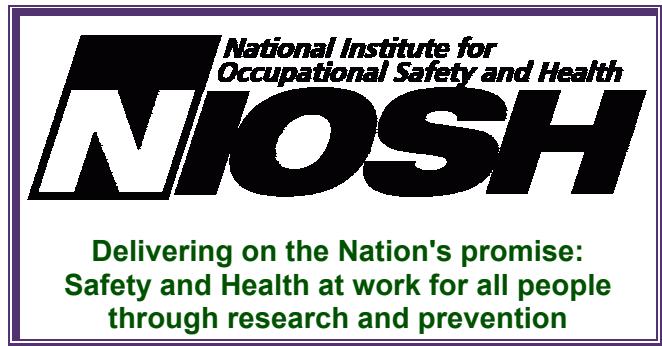


Figure 2  
Median Octave Band Sound Levels and NCB Curve  
Meijer, Inc.  
East Lansing, Michigan  
HETA 2004-0415  
December 1, 2004



DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health  
4676 Columbia Parkway  
Cincinnati, OH 45226-1998

OFFICIAL BUSINESS  
Penalty for private use \$300



To receive NIOSH documents or information  
about occupational safety and health topics  
contact NIOSH at:

1-800-35-NIOSH (356-4674)

Fax: 1-513-533-8573

E-mail: [pubstaff@cdc.gov](mailto:pubstaff@cdc.gov)

or visit the NIOSH web site at:

<http://www.cdc.gov/niosh>

**SAFER • HEALTHIER • PEOPLE™**