ASEE's 123rd Annual • Conference & Exposition • New Orleans, LA • June 26-29, 2016

Paper ID #14453

Safety Training on Warehouse Worker Hazards for Structural Steel Latino Workers: Phase 2 Implementation and Assessment

Dr. Carla Lopez del Puerto, University of Puerto Rico - Mayaguez

Carla Lopez del Puerto, Ph.D., Associate Professor Construction Engineering and Management Department of Civil Engineering University of Puerto Rico at Mayaguez email: Carla.LopezdelPuerto@upr.edu http://cem.uprm.edu

Jose J. Fontan-Pagan, University of Puerto Rico - Mayaguez

Jose J. Fontan-Pagan Graduate Student Construction Engineering and Management Department of Civil Engineering University of Puerto Rico at Mayaguez email: jose.fontan1@upr.edu http://cem.uprm.edu

Dr. Omar I. Molina-Bas, University of Puerto Rico - Mayaguez Campus

Omar I. Molina Bas, Ph.D. Associate Professor and Unit Coordinator Construction Engineering and Management Department of Civil Engineering and Surveying University of Puerto Rico, Mayagüez Campus email: omar.molina1@upr.edu http://cem.uprm.edu/molina.html

Prof. Tim L. Mrozowski, Michigan State University

Tim Mrozowski A.I.A., LEED® AP BDC, is the Program Leader and a Professor of Construction Management, in the School of Planning, Design and Construction at Michigan State University. He conducts research on construction management, sustainability and energy. Recent research and outreach projects include: construction project closeout process, change orders, vendor performance assessment, Post Occupancy Evaluation, construction management of steel construction, warehouse worker safety, application of LEED® to design and construction, energy codes, and energy assessments.

Safety Training on Warehouse Worker Hazards for Structural Steel Latino Workers: Phase 2 Implementation and Assessment

Structural steel workers are at an increased risk of work related injuries due to the nature of their work. Past research has shown that increasing awareness of warehouse hazards through formal training reduces the risk of workers being involved in accidents that may lead to injuries or fatalities. Latino workers are particularly exposed to workplace hazards because the safety training that they receive is often not delivered in a language and manner that they can understand. In order to address the barriers to adequate training for Latino workers, the research team successfully obtained a training grant from the Occupational Safety and Health Administration (OSHA) to develop an English and Spanish Warehouse Worker training curricula for use with worker training. The first phase of the project included developing the safety training curriculum which consists of six contact hour worker training that covers potential hazard exposures that result from warehousing and processing tasks. The second phase of the project included administering the training to structural steel workers and assessing the training. The objective of this paper is to assess the Spanish version of the training which includes analyzing the demographic characteristics of participants, the knowledge gained and their perceptions about the quality and usefulness of the training in their workplace. In order to meet the objective, a demographic survey and a knowledge pre-test were administered prior to the training. A knowledge post-test and an exit survey were administered after participants completed the training. The training was completed by 104 structural steel workers in the metropolitan area of San Juan, Puerto Rico in summer 2015. The results from the demographic survey indicate that 99% of participants were male and 42.2% of participants had less than 5 years working in the structural steel industry. The results from the knowledge pre-test and post-test indicate that while the training significantly increased participants' knowledge about common warehouse hazards (average pre-test score 41.3%; average post-text score 55.2%), the scores are still low. This is a common challenge when training Latino workers that needs to be addressed. The results from the exit survey indicate that 97.9% of participants believe that the training was good or excellent, 100% of participants believe that the information was timely and of interest and 94.8% of participants believe that they will use the information presented in the training in their work. Strategies to improve the training program with an emphasis on increasing participant learning and exploring multiple forms of learning assessment in addition to written tests, such as performance-based assessments and participant oral presentations, are discussed. As the total number of Latino worker in the United States continues to trend upwards, the need for students in Construction Engineering and Management programs to understand the demographic characteristics of the Latino workforce and attributes that make training programs effective and culturally appropriate for Latino workers is also increasing. This paper contributes to the body of knowledge by highlighting the results of a training program tailored to Latino structural steel workers and discussing non-traditional assessments to measure knowledge gained by participants who typically not perform well in written tests.

Introduction

Structural steel warehouse workers are exposed to a variety of hazards that can result in fatal and non-fatal injuries due to the nature of their work[1,2]. Workers in structural steel fabricating and supply companies are exposed to usual warehouse worker hazards as in other industries, and

moreover, to risks handling large, heavy and variable steel material[3]. The risks may increase due to diversity in age, experience and language existing from labor force in the structural steel fabricating and supply companies across the United States. Language is a challenging barrier because a large portion of structural steel warehouse workers employed in structural steel fabricating and supply companies in the United States speaks Spanish as their native language[4] and materials and trainings are typically available and presented in English. The Hispanics' inability to understand the workers training may increase the risks of fatal and non-fatal injuries[5].

In an effort to reduce the number of injuries and fatalities among the structural steel warehouse workers, Occupational Safety and Health Administration (OSHA) developed the Susan Harwood training program. As shown in figure 1, the first phase of the project consisted in the development of an English and Spanish Warehouse Worker training curriculum to increase the safety awareness in the structural steel warehouse fabricating and supply companies. The second phase of the project consists of the implementation and assessment of the training. This paper presents the results of the second phase.

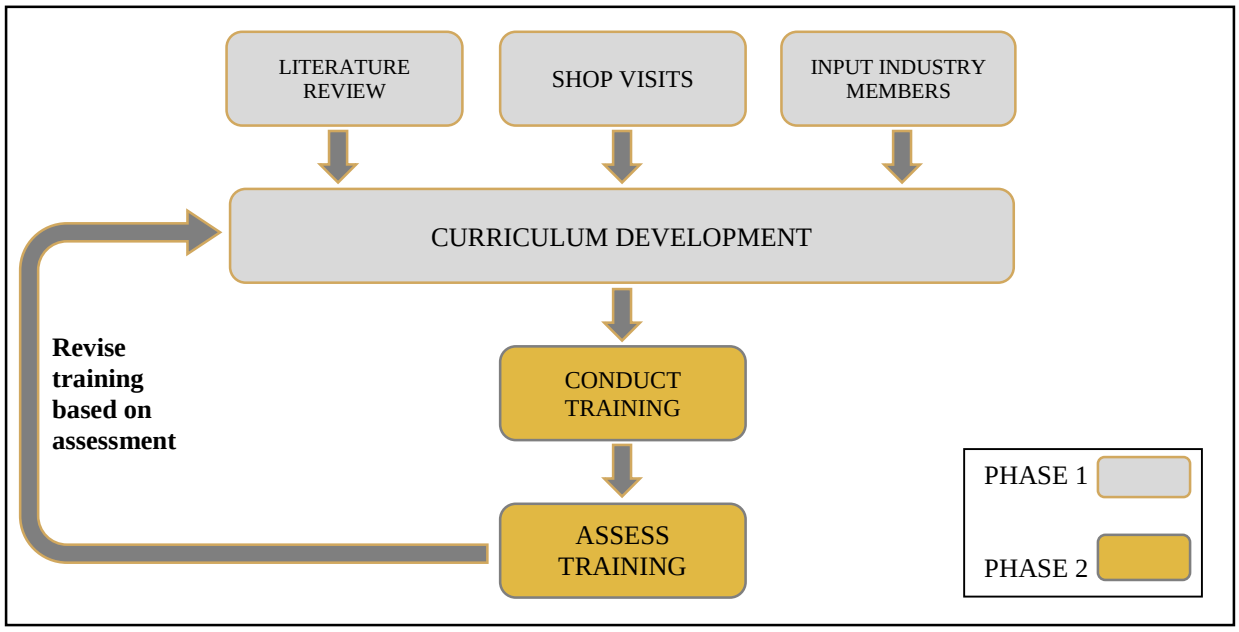

Figure 1. Structural Steel Training Program by Phase

The training program consists of six contact hours on safety educational material to aid Latino workers improve their knowledge on structural steel warehouse hazards. With the objective to reduce injuries and fatalities with employees in the structural steel industry, the project was produced in partnership with two US universities, The American Institute of Steel Construction (AISC) and a steel fabricating corporation.

A multi-prong approach included an extensive literature review, shop visits and input from experienced industry members who serve on the AISC Safety Committee. AISC Safety Committee mission is to "help its members achieve zero injury goals"[6]. The multi-prong approach was the base to identify the potential hazard exposures from warehousing and processing tasks which were included in each module of the training curriculum. As shown in table 1, the training curricula was divided in 10 modules: the first module provides an overview

of the training program, the second module identifies common hazards of warehousing activities in the industry, from third to eighth module specify particular hazards, the ninth module provides worker's rights as defined by OSHA, and the tenth module provides instructions for trainers to provide a secondary training to their co-workers.

Table 1: Training Modules[7]

Module
0) Program Overview
1) Hazards Overview
2) Material Handling and Storage
3) Material Handling and Storage Equipment Continuation
4) Hazard Communication
5) Preventing Musculoskeletal Injuries
6) Electrical Safety
7) Respiratory Safety and Personal Protective Equipment
8) Workers' Rights
9) Secondary Training

English and Spanish curriculums were developed following the guidelines for educational materials targeted to Hispanic workers[8]. In addition, the OSHA English-Spanish dictionary was required to maintain a translation consistency due to the variability of the Spanish terms across the Latin American. The translation process involved two faculty members with expertise in Safety Management and two undergraduate students who speak Spanish as their first language. The students translated the curricula from English to Spanish independently, to subsequently compare their versions and arrived at a consensus on which translation to use for each slide and bullet point. After a consensus about the translation was reached, the material was translated back to English and it was compared to the original version to ensure that the message was not lost in translation[7].

The second phase of the project included administering the training to structural steel workers and assessing the training to identify areas of strength and areas of improvement. The objective of this paper is to assess the training which includes analyzing the demographic characteristics of participants, the knowledge gained and their perceptions about the quality and usefulness of the training in their workplace.

Trainings

This paper presents the results of four training sessions that were conducted in summer of 2015. The first, second and third training sessions consisted of 30 participants and the fourth training session consisted of 14 participants. Participants were asked to complete a demographics survey and a knowledge pre-test prior to taking the training. Participants were asked to complete a knowledge post-test and an exit survey that inquired about their perceptions about the training at the end of the session. It is important to note that participants were able to skip questions that they did not want to answer or felt uncomfortable answering. Therefore the number of responses for a particular question may be less than the number of participants who completed the training. In the next section, the results of the training program which include an analysis of the

demographic characteristics of participants, the knowledge gained and their perceptions about the quality and usefulness of the training in their workplace is presented.

Results

After the surveys had been completed, the results were manually entered into a Microsoft Excel® spreadsheet. The raw data was then sorted and coded in preparation for analysis. When an open-ended question was used, individual responses were grouped and assigned a coded number. For example, if the open-ended survey question asked, "What is your highest educational degree?" and a participant answered "High School" this response was coded as "1". If the same survey question was answered with "Associate Degree" the response was coded as "2", for "Master Degree" the response was coded with "3", and so on. If any other participant provided "High School" on their survey, the same number (1 for high school) was assigned to that response. This process was repeated until every response was assigned a code number.

The survey was completed by 104 participants. Out of 104 participants who completed the survey, 97 participants responded the question that asked them to provide their primary language. Out of the 97 responding participants, 92.8% reported that their primary language is Spanish. Only one percent of the study population identified English as their primary language. Out of the 95 participants who responded when asked to identify their race, 83.2% reported that they are Hispanics; 11.6% reported they are White, 3.2% reported they are Indian American and one percent reported African American.

Ninety nine percent out of the 101 participants who responded the question regarding gender reported that they are male. This data is consistent with demographic data in the construction industry. Females make up less than five percent of laborers and less than ten percent of all workers in the construction industry [9]. When asked to provide their age, participants were given four possible answers: 30 or younger, between 31 and 40, between 41 and 50 and older than 50. As shown in table 2, out of the 98 participants who responded, 80% reported that they are younger than 40 years old. This finding is consistent with published literature which reports that 63% of the Latino workforce in the United States is between 18 and 41 years of age [10].

Table 2: Respondents' Age

Age	**N**	**(%)**
30 or younger	35	36%
Between 31 and 40	43	44%
Between 41 and 50	13	13%
Older than 50	7	7%

As shown in table 3, out of the 83 participants who responded to how many years they have worked in the steel industry, 42.2% reported that they had worked five years of less in the steel industry.

Table 3 - Years in the steel industry

Years in the steel industry	N	(%)
0-5 years	35	42%
6-10 years	13	16%
11-15 years	20	24%
More than 15 years	15	18%

Out of the 87 participants who provided their highest academic degree in the open-ended question, 58% reported that they completed high school (see Table 4). It is important to note that no participants reported an educational attainment lower than high school nor higher than bachelor degree. Published work by other authors reports a significantly higher number of Latinos who have not finished high school at 41% [10].

Table 4 - Highest academic

Highest academic degree	N	(%)
High school	51	58%
Associate degree	18	21%
Bachelor degree	18	21%

Fifty percent of the participants did not state how many hours of safety training they had received during the previous year, possible because they could not recall the exact number. Out of the participants who reported the number of safety training hours that they had received in the past year, 80.8% reported to that they had received more than five hours of safety training.

Participants were asked to self-report how well they understood safety trainings that they had received prior to this training. The purpose of this question was to be able to compare their comprehension level of our training program to those of prior programs that they had completed. Participants were given a scale of: Very Good, Moderately Good, Not Sure, Not Very Well and Not At All to rate their previous trainings. Sixty-nine percent of the participants who provided their understanding of the material presented in prior trainings reported their understanding as very good (see table 5).

Table 5 – How well they understood the material in prior trainings

How well they understood the material	N	(%)
Very Good	51	61%
Moderately Good	25	30%
Not Sure	7	9%
Not Very Well	0	0%
Not At All	0	0%

Eighteen questions were developed for the pre-test and post-test program assessment (see Appendix). Prior to the training, the average score in the pre-test was 41%. After the training, the average score was 55%. This means that participants increased their score by an average of 14% in the post-test. Five out of eighteen questions show higher than 30% increase between the pre-test and post-test scores with increases of 58%, 41%, 33%, 33% and 31% respectively (see table 6). Question #1 had the highest knowledge gained. It asked participants what OSHA regulations

apply to warehouse activities, the possible answers were OSHA 90.1(2007), OSHA 1910, OSHA 1926 or OSHA 2000. In the pre-test only 13% answered correctly (OSHA 1910), while in the post-test 71% answered correctly. It is important for participants to know which regulations apply to their industry so that they can look them up as needed and avoid confusion with regulations that do not apply to their industry. The next question that showed the highest knowledge gain asked about what was the most frequently cited OSHA Regulation in general warehousing. The possible answers were forklifts, portable fire extinguishers, exits or electrical lockout/tagout. In the pre-test 31% selected the correct answer (forklifts), while in the post-test 72% answered correctly. It is important for workers to know which is the most frequently cited OSHA regulation so that they are aware of it and can take steps when using forklifts to prevent accidents and to ensure compliance. The third question with the highest percentage of knowledge gained asked "At what maximum height should some form of protection from falls be provided for workers when working in platforms?" The possible answers were 2 feet, 4 feet, 6 feet, or 8 feet. Twenty four percent of participants answered correctly in the pre-test (4 feet), and 57% in the post-test. It is important to note that this standard is different than the OSHA 1926 standard Construction which states that above 6 feet workers need fall protection. The fourth question with the highest knowledge gained asked about the Hand-arm Vibration Syndrome (H.A.V.S.) abbreviation, the possible answers were a classification for industrial powered trucks, an electrical voltage rating system, a syndrome caused by vibration, or hand eye coordination. In the pre-test 12% answered correctly (a syndrome caused by vibration), while in the post-test 45% answered correctly. The fifth question that shows the highest knowledge gained asked about the meaning of the symbol "!" on a product label. The possible correct answers were explosives, acute toxicity (severe), acute toxicity (less severe), or gas under pressure. The question was answer correctly by 13% of participants (Acute Toxicity (Less severe)) in the pre-test, while in the post-test 44% answered correctly. Knowing what symbols mean on product labels is essential for workers to take adequate precautions.

Table 6- Pre-test and Post-test answers

	Pre-test	**Post-test**	
Question	**Average (%)**	**Average (%)**	**Difference (%)**
1	13	71	58
2	17	21	4
3	31	72	41
4	81	84	3
5	24	57	33
6	74	74	0
7	15	20	5
8	68	71	3
9	84	87	3
10	13	44	31
11	78	90	12
12	13	14	1
13	82	80	2
14	12	45	33
15	53	61	8

16	64	68	4
17	8	13	5
18	31	43	12
Total Average	41	55	14

The exit survey asked participants about their perceptions regarding the training program. When asked about the program quality, participants were given a scale of: Excellent, Good, Satisfactory and Poor. Out of the 96 participants who responded about the quality of the safety training program, 72.9% reported that they found the program excellent and 25% reported that the quality of the program is good (see table 7). This means that 98% of participants believe that the quality of the program is good or better.

Table 7- Program Quality

Program Quality	**N**	**(%)**
Excellent	70	73%
Good	24	25%
Satisfactory	2	2%
Poor	0	0%

When asked to report if they believe that they will use the information provided in a near future, the participants were given a scale of: Very Likely, Somewhat Likely, Not Sure and Improbable. Out of the 96 participants who responded about the usefulness of the information in the near future, 95% reported that they will very likely use the information provided in the near future (see table 8).

Table 8- Usefulness of the information in the future

Usefulness of information in the future	**N**	**(%)**
Very Likely	91	95%
Somewhat Likely	4	4%
Not Sure	1	1%
Improbable	0	0%

Out of the 94 participants who responded if they found the visuals provided in the safety-training program evaluation satisfactory or not, 99% reported that they found the visuals presented in the safety training satisfactory. When asked if the safety training was adequate, out of the 95 participants who responded the safety-training program evaluation, 100% reported that they found the training adequate.

Conclusions

This paper presented the results of four training sessions held in Spanish in the summer of 2015 in the metropolitan area of San Juan, Puerto Rico. Participants who completed the training program reported having an educational attainment level much higher than Hispanic workers in other states of the United States of America. All participants in this training program reported to have completed high school, while other studies show that 41% of Hispanic workers have not completed High school. A reason why the educational attainment in our study may be much

higher than other studies is that Puerto Rican workers are United States citizens and have better access to education that Hispanic workers who live in the continental United States and may have grown up in foreign countries and migrated to the United States as young adults. This training program was sponsored by OSHA and will be implemented at other locations in the United States which will allow us to compare the results across different US locations to investigate if participant demographics vary by region.

The results of the demographic survey also show that 80% of participants reported that they are younger than 40 years old. This finding is consistent with published literature which reports that 63% of the Latino workforce in the United States is between 18 and 41 years of age [10]. Young workers are an increased risk of injuries and fatalities due to their lack of experience. In this study 42.2% of participants reported that they have five or less years of experience working in the structural steel industry. While youth increases risk of accidents, it also allows us to provide training programs that if they are developed and implemented correctly can have a positive impact over many years of the participants' employment life.

The results of the pre-test and post-test indicate that participants have a moderate overall knowledge gain with an average pre-test score of 41.3% and an average post-test score of 55.2%. The program assessment outcome shows a better understanding by participants about the type of OSHA Regulations that apply to warehouse worker activities, the most frequently cited OSHA Regulation in the structural steel industry, the height in which fall protection is needed, the meaning of the symbol "!" on a product label and the H.A.V.S. abbreviation. While any knowledge gain is positive, the authors would have liked to see a higher knowledge gain. The authors are assessing the training program to investigate why the knowledge gained by participants is not higher.

The results of the exit survey indicate that participants believe that the quality of the training program is good or excellent and that the large majority of participants believe that they will use the information presented in the training program in the future. The fact that 99% of the participants found that the safety training visuals are satisfactory and help to reach better understanding about the topics is encouraging. The training program also included group exercise learning activities because prior studies have shown that participants learn better by doing [11]. The authors are planning to revise the training program for clarity as well as using other methods in addition to written tests to assess participant learning. This methods will include oral tests, drawing and illustrations, and participant demonstrations. The authors hope that by revising the training program for clarity and having multiple assessment methods, the program will be more effective in reducing the risk of injuries and fatalities among structural steel workers who participated in the study and make the structural steel industry safer for all. The authors also hope that the results of this research increase the understanding among construction engineering and management students about the demographic characteristics and learning profiles of structural steel workers that they may encounter during their professional careers and how to provide effective trainings for this population.

Limitations

Several limitations were faced through the implementation of this study. The training program was administered to 104 structural steel workers in the metropolitan area of San Juan, PR, and may not represent the whole population of Hispanic steel workers in other areas across the United States. Furthermore, the study was limited to a maximum population sample of 104 structural steel workers.

References

[1] Bratcher, B., Ruttenberg, R., and Obando, M., "Analysis of Work-Related Safety and Health Hazards of Unrepresented Workers in the Iron Industry," The Center for Costruction Research and Training(February), (2010).

[2] The Center for Construction Research and Training (CPWR), [The Construction Chart Book, The U.S. Construction Industry and Its Workers] , 5th ed. (2013).

[3] Forde, M.S., and Buchholz, B., "Task content and physical ergonomic risk factors in construction ironwork," International Journal of Industrial Ergonomics 34(4), 319–333 (2004).

[4] United States Department of Labor, "Labor Force Statistics from the Current Population Survey," 2015, <http://www.bls.gov/cps/cpsaat11.htm> (9 March 2016).

[5] AFL-CIO., "Immigrant Workers at Risk : The Urgent Need for Improved Workplace Safety and Health Policies and Programs," 2005, <http://www.aflcio.org/aboutus/laborday/upload/immigrant_risk.pdf>.

[6] American Institute of Steel Construction (AISC), "Safety," <http://www.aisc.org/content.aspx?id=36> (8 January 2016).

[7] Lopez del Puerto, C., Mrozowski, T., Kruth, L. and Schlafly, T., Molina, O., "Developing Safety Training on Warehouse Worker Hazards for Structural Steel Fabricating and Supply Companies," American Society of Engineering Education26.488.2–26.488.8 (2015).

[8] Brunette, M.J., "Development of Educational and Training Materials on Safety and Health: Targeting Hispanic Workers in the Construction Industry," Family and Comunity Health 28(3), 253–266 (2005).

[9] United States Department of Labor, "Women in the Construction Workplace: Providing Equitable Safety and Health Protection," 1999, <https://www.osha.gov/doc/accsh/haswicformal.html> (2 October 2012).

[10] Fox, S., and Livingston, G., "Latinos online: Hispanics with lower levels of education and English proficiency remain largely disconnected from the internet," Pew Hispanic Center and Pew Internet Project1–23 (2007).

[11] Thompson, M.R., "Lights, Camera, Action: Planning, Writing & Producing Employee Education Programs," American Society of Safety Engineers33–39 (2000).

Appendix

Pre/Post Program Assessment

1. What OSHA Regulations apply to warehouse worker activities?
    A. OSHA 90.1 (2007)
    B. OSHA 1910
    C. OSHA 1926
    D. OSHA 2000

2. What was the most frequently cited OSHA violation in steel fabrication facilities (2012)?
    A. Electrical Lockout/tagout
    B. Powered Industrial Trucks (forklifts)
    C. Respiratory Protection
    D. General Requirements

3. What was the most frequently cited OSHA Regulation in general warehousing?
    A. Forklifts
    B. Portable fire extinguishers
    C. Exits
    D. Electrical Lockout/tagout

4. Which tool below should be used to remove metal banding straps from bundled material?
    A. Hammer
    B. Long Crowbar
    C. Scissors
    D. Long handled shears

5. At what maximum height should some form of protection from falls be provided for workers when working on platforms?
    A. 2 feet
    B. 4 feet
    C. 6 feet
    D. 8 feet

6. How frequently should crane parts such as hydraulic lines, pumps and hooks be inspected for maladjustment, deterioration, leakage deformation or other damage?
    A. Daily
    B. Weekly
    C. Monthly
    D. Yearly

7. Which of the following statements is true
    A. Crane operators must be “certified” to operate a crane in the fabrication shop
    B. Crane operators are not required to be certified to operate a crane in the fabrication

shop, but if they operated a crane at a construction site they would need to be certified.

C. Crane operators are not required to be certified

8. When "backing up" trucks for offloading materials "spotters" should stand in which location?
    A. Behind the truck toward the middle
    B. To the side of the truck toward the rear
    C. In front of the truck
    D. In the space between the truck and an overhead door

9. Which of the following is true when leaving a Powered Industrial Truck (forklift) unattended?
    A. The load engaging means should be fully raised
    B. The load engaging means should be fully raised and the engine turned off
    C. The load engaging means should be full lowered and engine left running
    D. The load engaging means should be fully lowered and the engine shutoff
10. **!** This symbol on a product label indicates which of the following:
    A. Explosives
    B. Acute toxicity (Severe)
    C. Acute Toxicity (Less severe)
    D. Gas under pressure

11. SDS sheets can be maintained electronically provided they are readily accessible by employees.
    A. True
    B. False

12. Musculoskeletal Disorders (MSDs) account for what percentage of lost or restricted work time?
    A. about 1/10
    B. about 1/4
    C. about 1/3
    D. about 2/3

13. In order to decrease injuries form lifting heavy objects which muscle groups should be primarily used?
    A. Leg muscles
    B. Back muscles
    C. Abdominal muscles

14. H.A.V.S. is an abbreviation which is related to which of the following?
    A. A classification for Industrial Powered Trucks
    B. An electrical voltage rating system
    C. A syndrome caused by vibration
    D. Hand eye coordination

15. Arc flash can occur even when two energized parts are not connected by a physical wire.
    A. True
    B. False

16. For a respirator which must be fit tested, how frequently should a “seal check” be performed?
    A. Each time it is worn
    B. Daily
    C. Weekly
    D. Monthly

17. Respirators, filters and cartridges must be certified by which organization?
    A. ANSI
    B. ASTM
    C. OSHA
    D. None of the above listed

18. An employer is considering two forms of hearing protection. Product “A” has a NRR rating of 33 and the Product “B” has a NRR of 25. Which is the more effective hearing protection?
    A. Product “A”
    B. Product “B”