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# **The Development and Testing of Warnings for Automotive Lifts**

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16. Abstract <p>Fourteen warning labels (both symbols and text) for automobile lifts (hoists) were developed and tested in a three-part study. The warnings concerned the use of jack stands and extenders, selection of pick-up points, keeping feet clear, and so forth.</p> <p>In the first phase, six auto mechanics participated in two focus groups. The purpose was to learn more about how lifts were used and how often various types of accidents occurred. Reports of serious accidents are uncommon.</p> <p>In the second phase, 24 mechanics were given descriptions of the 14 warnings and drew a picture for each. They also restated the warnings in their own words. Most of the restatements were abbreviated versions of what was given. Pictures of hoists tended to show below-ground designs, typically side views.</p> <p>Based on this data 2-5 candidate pictures were developed for each warning along with several alternative wordings for each message. Fifty mechanics wrote down what they thought the pictures meant, ranked them from best to worst for each message, and selected the most informative text message for each warning in two ways. Based on this evidence, 14 standard warnings were developed. For several of the symbols, recognition was poor, so that the warning should include both pictures and words.</p>					
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# EXECUTIVE SUMMARY

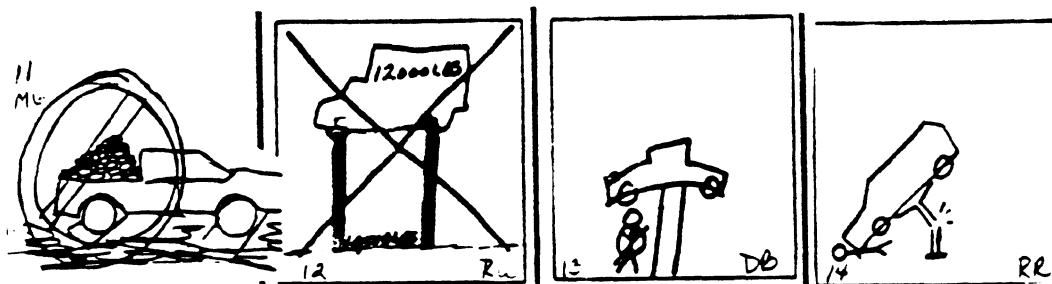
Eberhard J. and Green P. (1989). **The Development and Testing of Warnings for Automotive Lifts** (Technical Report UMTRI-89-26). Ann Arbor, MI: The University of Michigan Transportation Research Institute, October.

The purpose of this project was to develop and test 14 warning labels (both text and graphics) for automobile lifts (lifts) identified by the sponsor of this project, the Automotive Lift Institute (ALI). Warnings are most likely to be effective when designed with the users and their tasks in mind, in this case, motor vehicle lift operators.

In line with that idea, the authors interviewed six mechanics who were part of two focus groups. Issues addressed were: how much experience mechanics had, what kinds of injuries typical users had on the job, what current safety practices were, which lift designs were good and bad, and which warnings are on lifts they use now. The participants were very responsive, and seemed to appreciate the interest on their behalf. This preliminary step identified the terminology used, the need for plain language, the lack of formal training among older workers, and problems with maintaining warning labels.

The first experiment involved 24 male mechanics tested at their workplace. They were given the 14 warning descriptions (for example-"Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for a vehicle to fall off a lift and injure someone"). Subsequently they restated the warning in their own words and drew a symbol that represented the warning.

Based on the ideas from mechanics, the authors developed 2-5 candidate warning texts and symbols for each message. Mechanics' suggestions facilitated the development of warnings. For example, shown below are four depictions participants drew of warning #11, "Do not exceed weight capacity of the lift...."



The second experiment involved 50 mechanics, with demographics similar to the first set. They were given a booklet containing 42 candidate symbols in one of four random orders. They wrote what they thought each symbol meant. The second part of the booklet showed each of the candidate symbols and its meaning. The mechanics ranked the candidate symbols from best to worst for each warning. In the third section, participants ranked the candidate text messages from best to worst for each warning in the same manner as the previous section for the symbols. The last part gave six warning texts with all possible alternative wordings and asked participants to construct their own warning. This part was added on to the experiment after noticing patterns in the results of the first experiment.

- Executive Summary -

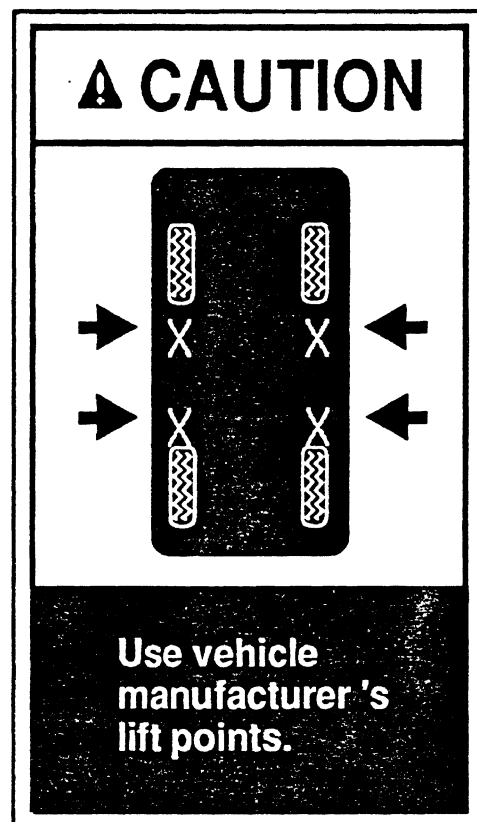
The symbols ranked as the best choice (part 2) were usually the candidates most accurately identified (part 3) as was expected. For example, the recommended symbol for the first warning shown below was chosen by 94% of the participants as the best choice, while they also accurately judged its meaning (90% correctly guessed the meaning) without the text. The texts ranked as the best choice were often the most detailed candidate text message (9 out of the 14). Although at first this seems unusual, upon examining the preferred text, most of the added details give critical information. For example, in the text preferred for warning #2, participants preferred the wording *manufacturer lift points* to simply *lift points*.

The majority of preferred symbols and texts picked by the participants are what the authors expected and feel are the most representative of the warning given. One exception was warning #9, where both the symbol and text had negative responses. However, in the rankings for text messages, all of the candidates were usually close (especially candidate texts for warning 8, 10, and 13), and several alternatives could serve equally well. While in all cases the symbol chosen was that preferred by mechanics, their feedback was used to modify the leading candidate to develop recommended symbols.

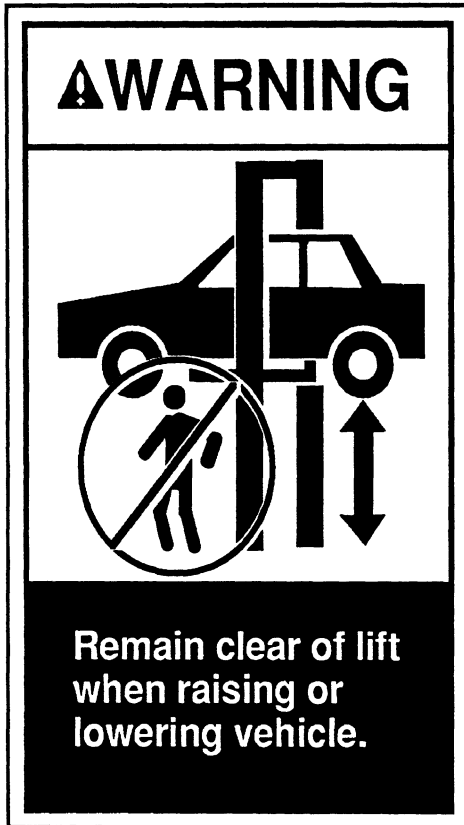
Following are reduced size versions of the 14 warning placards developed.



Warning #1



Warning #2



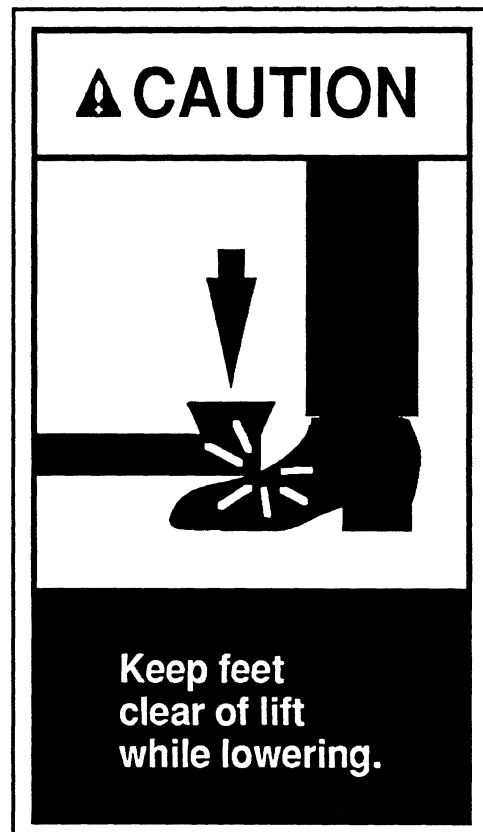
Warning #3



Warning #4



Warning #5



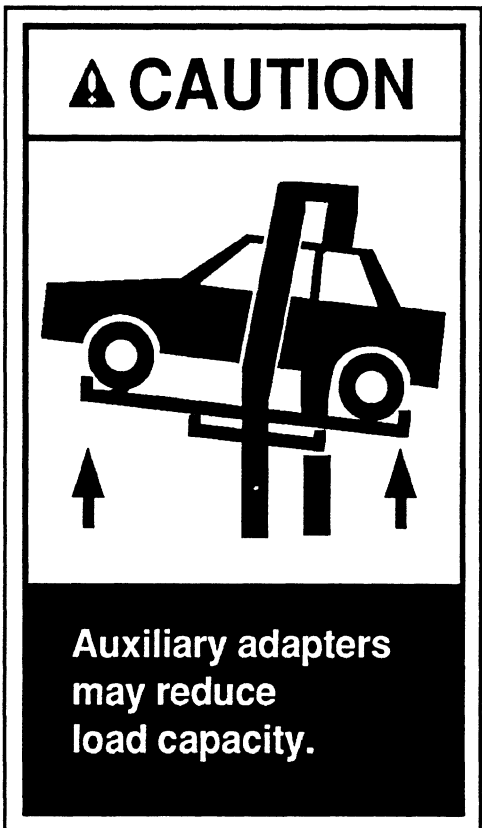
Warning #6



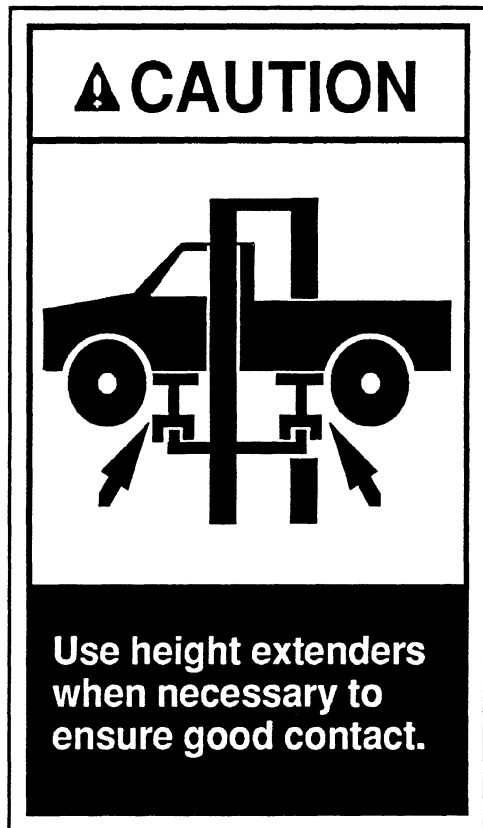
Warning #7



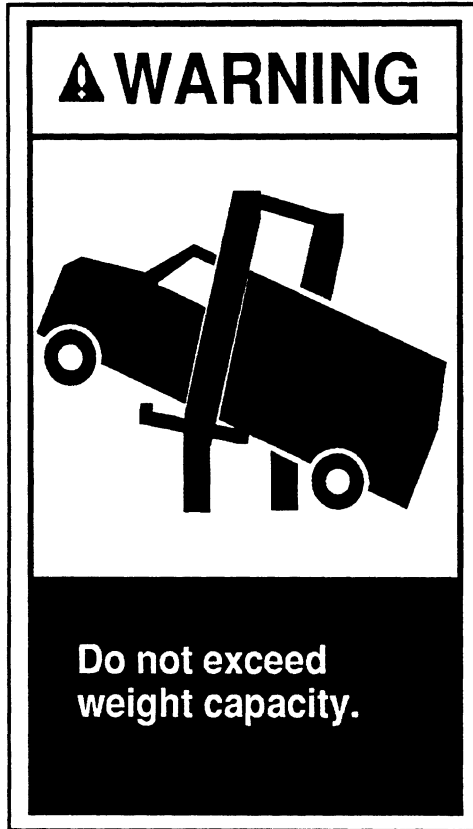
Warning #8



Warning #9



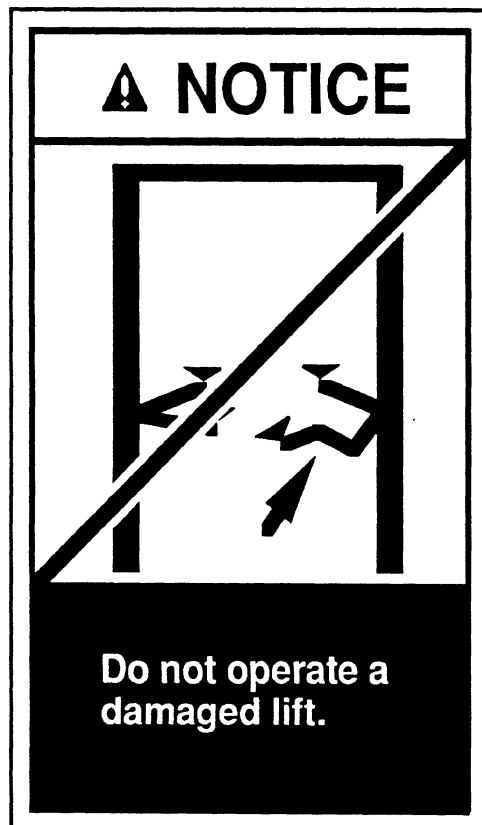
Warning #10



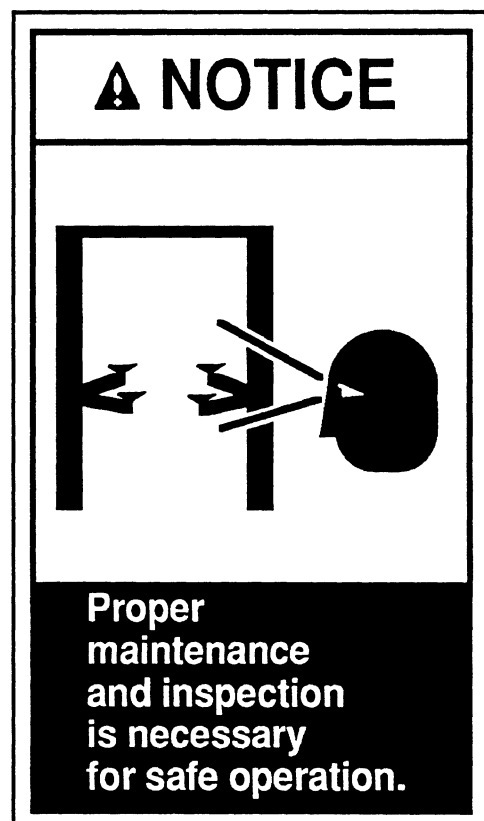
Warning #11



Warning #12



Warning #13



Warning #14

*- Executive Summary -*



## **ACKNOWLEDGMENTS**

This research was sponsored by the Automotive Lift Institute, the industry trade association of garage hoist manufacturers. Their desire to develop warnings that lift users genuinely understand, and provide supporting scientific data, indicates their interest in preventing hoist-related injuries. This approach is in stark contrast to common practice, where warnings are either developed ad hoc or with minimal assistance from a graphics consultant.

Terrence Grisim, President of Safety Management Consultants, served a key role in educating the authors about hoists and their use, and provided a sounding board for ideas.

- *Acknowledgments* -

# INTRODUCTION

## **DANGER!**

Smoking can be hazardous to your health.

## **WARNING!**

Workers must wear safety glasses.

## **CAUTION!**

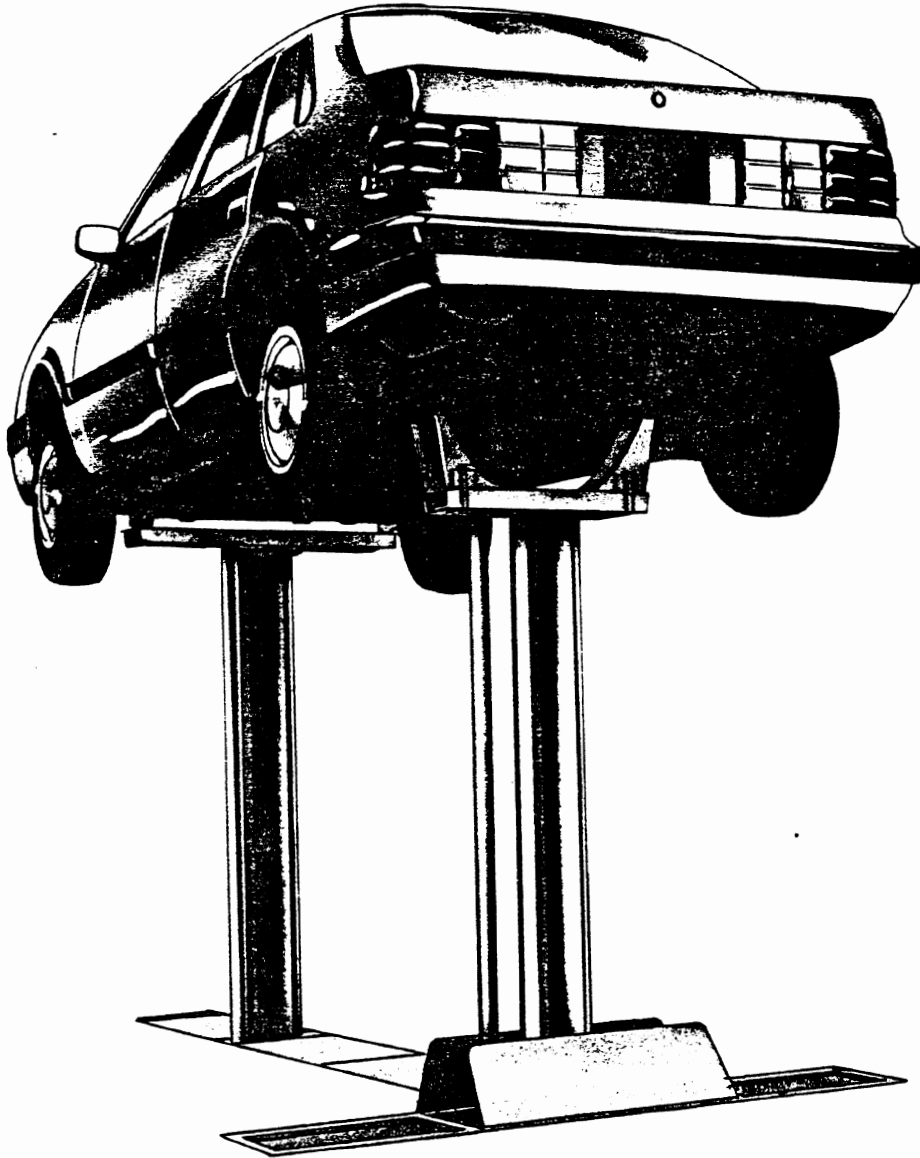
Beware of falling rocks.

Warnings like these are encountered by people every day. Yet, many daily tasks where hazards are involved have no written warnings associated with them. This report describes the development and evaluation of warning messages and symbols for one application, automotive lifts (commonly known as hoists).

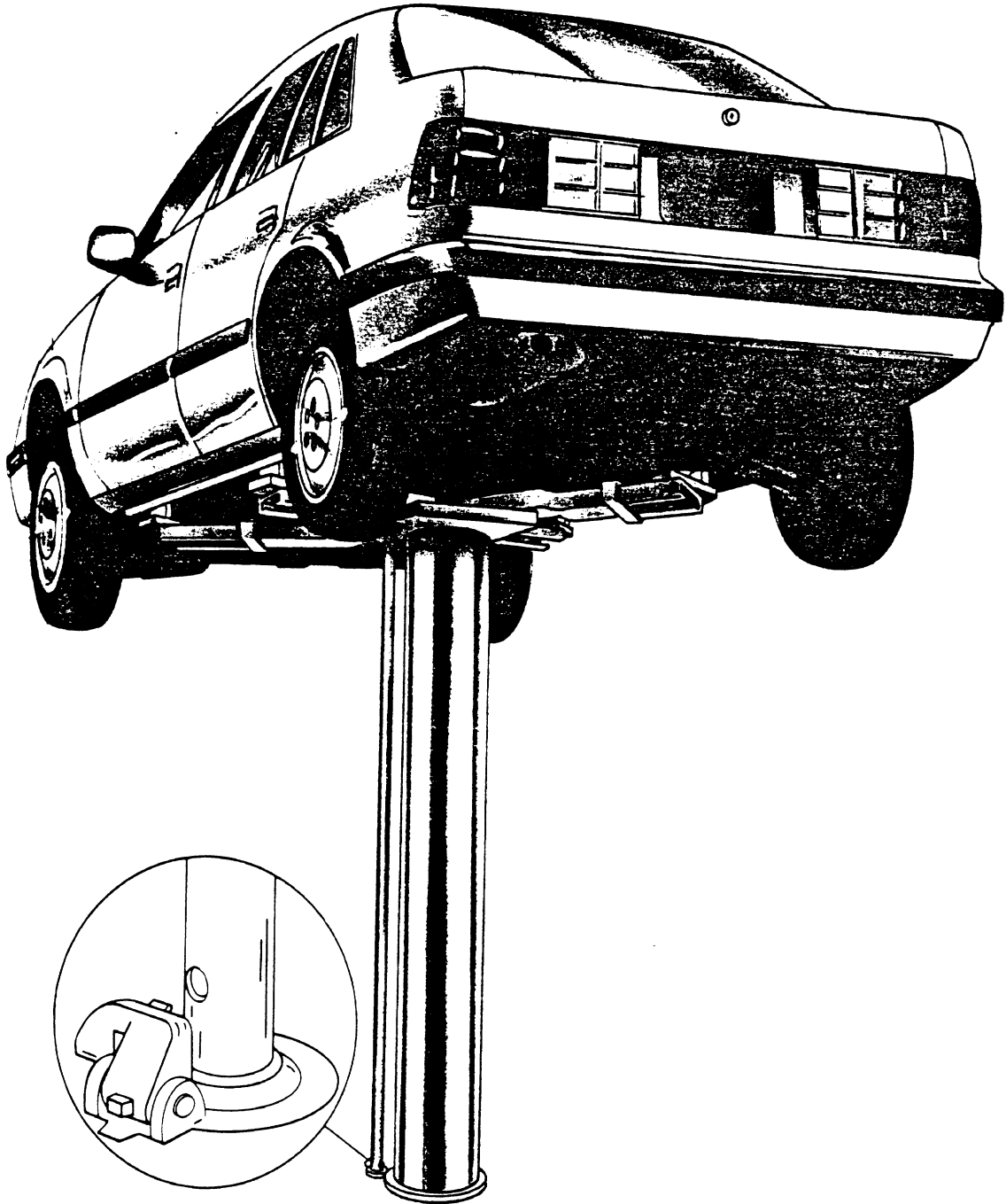
### **Brief Tutorial on Lifts**

While the sponsor of this research is intimately familiar with the various types of lifts, how they work, and what they are used for, many members of the safety and human factors community are not. Those familiar with lifts should skip this section.

There are two basic types of lifts, in-ground and above-ground. Until the 1970's almost all of the lifts found in service stations, car dealerships, body and muffler shops, and transmission shops were in-ground lifts. These lifts varied according to the way they contacted the underside of the vehicle to be lifted. They included axle-engaging (fore-aft post, see Figure 1), frame engaging (side-by-side or one post, see Figure 2), runway (drive-on, single post), and rocker panel (pad) lifts. Depending on the size of the vehicle and the type of the lift, either a single post or twin posts were used. Twin posts could be either fore-aft or side-by-side. In lifts for large trucks or buses either the posts used were larger in diameter or there were three of them. These posts were hydraulically operated and were underground when not in use.



**Figure 1. Axle-Engaging Lift (In-Ground)**



*Close up of latch*

**Figure 2. Frame-Engaging Lift (In-Ground)**

Although the above-ground lifts are not as common as the in-ground lifts, they are becoming a larger fraction of the market. Most of the above-ground lifts are two-column drive-through. These lifts use arms extending from both posts to lift the vehicle at the proper contact points. With the earlier models, the doors of the vehicle being lifted could not open fully because they were blocked by the posts. Now models with asymmetrical posts are more common, so the car doors can open freely. Other models include four-column drive-on lifts, sometimes used for wheel alignments, and short-rise service lifts usually used for tire, brake service, and auto body repair.



*Screw lifts use rotating screw pillars that move the lift arms (cover removed for illustration purposes).*

**Figure 3. Two-column Drive-through Lift**

Although space should not be a problem, the transition from in-ground to above-ground lifts can be difficult because of the difference in their construction. Many shops with side-by-side in-ground lifts did not allow enough space to install above-ground lifts to replace the in-ground. More information on lifts and the correct procedures for use and maintenance can be found in the ALI Safety Manual, Lifting It Right (Automotive Lift Institute, 1989).

## **Issues to Be Addressed**

Before warning signs can be developed and posted, both users and sign developers need to have a clear understanding of the function of each sign and how it might be used. Specifically, several questions need to be answered. They are:

1. What kinds of injuries occur and how do they occur?  
For which hazards are warnings really needed?
2. Who is the intended audience? How much do they know about the tasks they are performing? How well can they read?
3. How do the users think the various warnings should be stated?
4. Of the several candidate messages proposed for each warning, which is best understood?

## **Injuries Associated With Automotive Lifts**

To develop an effective set of warnings it is useful to know the kinds of injuries that occur and their relative frequency. Conversations with Terry Grisim, a consultant to the Automotive Lift Institute (the sponsor of this research) revealed they did not have any quantitative data on the frequency of accidents associated with garage lifts. Further, a review of the literature led to similar findings. Some useful information was obtained from the Bureau of Labor Statistics, from summary statistics generated by the Supplementary Data System. That system summarizes worker's compensation reports from 28 states. Unfortunately, the SDS summaries available from the U.S. Department of Labor were very general. (Those statistics appear in the Appendix.)

Further analysis, while possible if the SDS data tapes were purchased, was beyond the scope of this project. Therefore, the specific number of injuries related to automobile lifts is unknown. For this project, ALI provided the warnings based on their insights into common injuries and unsafe work practices associated with lifts.

## **What Are the Qualities of Good Warning Signs?**

A good warning sign is discriminable from its background, contains graphics and text that are legible at distances where users are likely to be, presents information in a manner that typical users can understand, is not visually or semantically confused with other signs in the set, and finally, presents the information in a manner that sufficiently impresses users, so they obey the warning. (See Lehto and Miller, 1986; Clark, 1988 for extensive discussion of these issues.) In addition, warning signs must often comply with specific design criteria, usually ANSI standards (for example, the Specification for Accident Prevention Signs (ANSI Z35.1-1972), and Proposed Specifications for Colors (ANSI Z535.1), Safety Symbols (Z535.3), and Environmental and Safety Signs (Z535.2)). Of these, the Z35.1 specification is particularly important. It contains requirements for sign layout, the use of signal words (e.g., "caution"), finish, colors, character size, and the use of symbols.

The FMC manual (FMC Corporation, 1985) also has some valuable suggestions for pictorial displays, as well as suggestions for warning sign format and colors involved. It gives details on pictorial design and sign format. Through examples, the FMC manual demonstrates how to design simple and direct warning signs that would be easy for others to duplicate.

### **How Important Are the Various Components of a Sign?**

A typical sign consists of several elements--a shape often coding the type of message, a background color, a signal word (e.g., "danger," "caution," etc.), a text message, and possibly a picture. The relative contribution of each of these elements to a sign's effectiveness has been examined in the literature. (See Clark, 1988; Lehto and Miller, 1988.)

Also having an influence over whether warnings are obeyed is the nature of the hazard, an issue addressed by Wright, Creighton, and Threlfall (1982). Specifically, they examined the conditions under which people would read written instructions accompanying a consumer product. Sixty products were examined, 30 electrical, 30 nonelectrical. Within the electrical category were three subcategories: complex to operate (e.g., VCRs), simple to operate (e.g., vacuum cleaner), and battery-powered (e.g., digital watch). Subcategories of the non-electrical products were convenience foods (e.g., cake mix), domestic tools (e.g., garden shears), and household "potions" (e.g., bleach).

Fifty-two people drawn from three age groups participated. People indicated how much of the instructions for each product they would read (none, some, all) and rated each product on several dimensions (familiarity, safety, simplicity, cost, frequency of use). Overall, people claimed they would read all of the instructions for 53% of the products, but none of them for 34%. Whether the product was electrical had a marked effect on their reported behavior, changing responses for individual categories by 15-25%. Within the electrical category, people were more likely to read the instructions if the product was complex or was not battery-powered. Within the non-electric category, people were more likely to read instructions for "potions," less likely for tools, and least likely for foods. For tools, either people did or did not read instructions. Few read some of them. Age had no significant effect on these responses.

With regard to product characteristics, all of the characteristics were significantly related to how often instructions were read. In general, people were more likely to read instructions for products that were unfamiliar, unsafe to use, complex, expensive, and infrequently used. The authors believe lift users would view that product as familiar, simple, expensive, and frequently used, which implies they might not read a separate set of instructions provided with a new lift. While it is difficult to say what the exact percentages might be, extrapolation from Wright's work suggests that possibly half of the users might not read the lift instructions at all. As lifts become more complex (with, for example, addition of warning lights and load indicators), the instructions for their use are more likely to be read.

With regard to sign, color, and shape, there has been little work to examine their influence on user performance. Easterby and Hakiel (1977) examined a related issue, user stereotypes for these items. In a pilot experiment several hundred students were asked to construct signs for the hazards shown in Figure 4, using the shapes shown in Figure 5. Each of these was available in seven colors: red, orange, yellow, green, blue, black, and white.





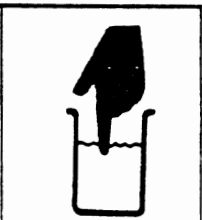






HAZARD	MODE		
	Descriptive	Prescriptive	Proscriptive
CAUSTIC			
POISON			
INFLAMMABLE			

Figure 4. Hazards Explored by Easterby and Hakiel (1977)











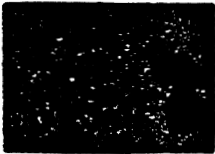

	SHAPE			
	Triangle	Circle	Rectangle	Square
Background				
Enclosure				
Surround				

Figure 5. Sign Shapes Explored by Easterby and Hakiel (1977)

The stereotypes are shown in Table 1 below. In general people wanted black and white triangular signs for poison and caustic warnings, and red and white triangular signs for fire.

**Table 1. Stereotypes Reported by Easterby and Hakiel (1977)**

Item	----- Hazard Stereotypes (and %) -----		
	Fire	Poison	Caustic
-----			
Color			
Image	red (45)	black (69)	black (41)
Background	white (57)	white (67)	white (66)
Enclosure	red (39)	black (44)	black (33)
Surround	null (56)	null (56)	null (55)
Shape			
Enclosure	tri up (46)	tri up (37)	tri up (36)
Background	tri up (48)	tri up (34)	tri up (41)
Surround	null (56)	null (56)	null (55)

This experiment was repeated (with slight modifications) in the field with an additional 80 people, and then repeated in the laboratory with an additional 53 people. Similar results were obtained and none of the stereotypes changed.

One of the better studies of warning sign content is that of Friedman (1988), which examined how adding symbols altered behavior. A total of 144 college students were shown containers for liquid drain opener (familiar product) and wood cleaner (unfamiliar). People were given each product and asked to unclog a sink or clean an antique coal bin. They were told the purpose of the study was to examine how listening to music affected their work. (All were in the "no music" conditions.)

On the front of each container was the product name, a logo, and the message, "Hazardous: See back panel." The back panel was split into five sections: a warning message, a promotional paragraph, how to use the product, what it could be used for, and a list of ingredients. There were six versions of the back panel for each product. Three of each warned about eye contact. Three warned about inhaling fumes. For each three there was a "words only" version, and two with symbols. The versions with symbols showed either what to do (e.g., a face with goggles on) or the consequences (e.g., crying as a result of the fumes).

While 88% noticed the warnings, only 46% read them completely, and only 27% followed them (put on nearby respirator or goggles). Less than half were able to recall the danger associated with these products or the precautions required. Neither the presence of a symbol nor the type of symbol used affected participants' behavior, though these factors did interact with others. It is quite possible that symbols had a minimal effect because the graphics were not well done.

This study is important because its conclusions are based on observations of real user behavior, not just survey data. However, the sample size was somewhat small (12 people in each of the 12 groups). Nonetheless, it does suggest that a critical problem in the design of warnings is getting people to read the warnings in the first place.

There are several studies that view symbols in a more positive light. For example, Paniati (1988) showed slides of 30 common highway signs at various visual angles. Within the set of 30 were pairs of signs, one of which had a text message ("stop ahead") and one of which had a graphic alternative. The viewers' task was to say when they could read each sign. In a second condition, the symbolic signs were shown ("at a large size") and people said what they meant. The symbolic signs were recognized at anywhere from equal to 4.4 times the distance of the word signs, with a mean of 2.8 times the distance. (These findings are in line with the work of Jacobs, Johnston, and Cole (1975), who reported a factor of two.) However, comparative comprehension data were not collected. These data suggest that symbol signs may be useful where display area is restricted.

Young and Wogalter (1988) explored the extent to which icons, coupled with modifications of text format, affected how well warnings were remembered. Sixty-four college students read 10-page manuals for a gas-powered electric generator, a product with which they were unfamiliar. There were four versions--either icons were present or absent, and the warning text was either conspicuous or not. (See Figure 6.)

Figure 1. Example of a Warning as a function of Conspicuous Print and Icons

*Plain Print, Icons Absent*

Warning: To prevent electric shock from faulty appliances, the generator should be grounded. Connect a length of heavy wire between the ground terminal and the ground source.

*Plain Print, Icons Present*



Warning: To prevent electric shock from faulty appliances, the generator should be grounded. Connect a length of heavy wire between the ground terminal and the ground source.

*Conspicuous Print, Icons Absent*

**Warning: To prevent electric shock from faulty appliances, the generator should be grounded. Connect a length of heavy wire between the ground terminal and the ground source.**

*Conspicuous Print, Icons Present*



**Warning: To prevent electric shock from faulty appliances, the generator should be grounded. Connect a length of heavy wire between the ground terminal and the ground source.**

*Note: Shading represents orange highlighting.*

Figure 6. Example Warnings from Young and Wogalter (1988)

Afterwards participants were asked 10 questions about what the warnings meant (e.g., What will happen if the generator is run with the choke OPEN?). They were also shown a set of 36 icons which included 9 from the warnings. They indicated which they had seen before and wrote down what each icon meant. Adding icons significantly improved warning recall (by 5-20%, depending on scoring criteria). While conspicuous print improved recall (by 1-18%), its effect was not statistically significant. The authors assert, quite correctly, that warnings that are recalled are more likely to be obeyed. However, the effect of warning format on performance was not demonstrated.

Another advantage of symbols is their reputed language-free nature (e.g., Collins, Lerner, and Pierman, 1982). There have been no empirical studies that compare the comprehension of symbols and words across languages or cultures.

All of the factors discussed--nature of the hazard, instructions, sign color and shape, and use of symbols--have not been tested extensively. However, in considering warning signs for lifts, the best method for warning the users appears to be symbols with accompanying concise instructions. It combines the greater flexibility of responding from greater distances (due to the symbol), and accurately providing instructions (through the text). Because the problems associated with lifts are often more complicated than the simple warnings given in the examples above (such as fire and smoke hazards), the users (for this experiment, mechanics) must be consulted in order to decide what should be displayed (symbols, text, color, shape) and how.

### **How Should Signs and Symbols Be Evaluated?**

The most widely accepted human factors approach to product development is that of iterative design. Gould and Lewis (1985) describe this approach as being based on three basic principles: early focus on the users and tasks, empirical measurement, and iterative design. Early focus on users and tasks means getting to know users on a first-hand basis, observing them directly, and soliciting their input during design. Empirical measurement refers to quantifying how well users do their tasks and then measuring their performance. Iterative design refers to design, testing, redesign, and retesting as a process that repeats until desired performance goals are met.

The general topic of symbol design is one for which there is a considerable body of literature. (See Zwaga, 1974; Green and Pew, 1978; Lerner and Collins, 1980a; 1980b.) Given the Gould and Lewis approach, a key first step in any message development process involves identifying what is in current use. In the case of symbols, that involves consulting compendia such as the Symbol Sourcebook (Dreyfuss, 1972). In the case of automotive lifts, there are no existing symbols. However, the recommended strategy is to develop symbols (and word messages) based on input from typical users of the messages. There is strong experimental evidence to support that approach.

Mudd and Karsh (1961) had 125 soldiers draw pictures that might be used to identify controls and displays in military vehicles (winch brake, starter, etc.). For example, in a second study 94 soldiers were shown 56 symbols, 22 of which were "distractors" for some of the functions of interest. Soldiers were asked to select the name from a list of 90 that matched each symbol. For 23 of the 34 symbols, matching performance was significantly better for those developed using the production method and in only 3 cases was it significantly worse.

In a subsequent experiment, an additional 96 soldiers were shown each of the 34 symbols one at a time and asked to select a matching name from a list of 34. Here 26 of the symbols developed using the production method were significantly better, while only 5 were significantly worse. When this experiment was repeated with an additional 21 officers from 8 countries (with the names available in their native languages), few differences were found. These negative findings may be because of the small sample size and because the stereotypes were based on data from American soldiers, not soldiers from their native countries. As a group these Army studies show that symbols based in stereotype input are much more likely to be understood than those developed without such information.

This procedure has been used in numerous studies conducted by UMTRI scientists over the years (e.g., Green, 1979; Green and Burgess, 1980; Gingold, Shteingart, and Green, 1981; Green, 1981; Sayer and Green, 1988a, 1988b). They have found the procedure to be a simple and effective method for identifying candidate symbols. It should be noted that just because a particular image is most common in participants' drawings doesn't mean it will be the optimum symbol for a function. It is important to give the drawings to an artist to "clean up" before further testing occurs. Further, it is clear that such tests should constrain what people are allowed to draw by forcing them to draw the image in a small area and use a wide tip felt pen, so that detail is minimized. This simplifies the artist's task. It is clear that test participants should have a perspective of the product similar to the intended users, but artistic skill is not important. For example, Gingold, Shteingart, and Green (1981) obtained useful information from truck drivers.

As noted earlier, good symbols and messages are immediately understood, but if not, easily learned, legible at great distances, and neither visually nor semantically confusable. It is clear from the literature that many of these properties are independent. For example, Green and Pew (1978) had 50 students respond to 19 symbols used to identify automobile controls and displays. In one task, people pointed to the symbol in an array matching the one identified in a driving scenario. Subsequently, they were shown picture-name pairs and asked to rate how communicative the symbol was. (The standard was the international front hood symbol, assigned a value of 10.) In a paired-associate learning task, people were shown all symbols one at a time and asked to name them. The process was repeated until all could be named without error. In the response time task, a symbol name was read and then people were shown a slide of a symbol. They responded by pressing one of two buttons ("same" or "different").

While the tasks were reliable, performance in only a few of the tasks was correlated. The highest correlation was .73, between the association norms and the communicativeness ratings. These data reinforce the notion that symbol and message attributes (e.g., initial identification, legibility, discriminability, etc.) should be viewed as independent qualities, which to varying degrees are assessed by specific tests. Because no single paper and pencil like task can adequately assess a message's effectiveness, a battery of tests is required.

In summary, the literature contains a reasonable exploration of alternative methods for evaluating signs, but few studies that compare alternative methods. Particularly lacking, however, are studies that examine the influence of content (color, shape, use of symbols, wording, etc.) on actual behavior, as opposed to reputed behavior obtained from surveys.

## **Research Plan for This Project**

The first phase of this experiment was to meet with groups of lift operators in their work setting. The purpose was to get to know the users and their tasks. These focus groups considered various issues related to the use of lifts, including the training and background of operators in both automotive work and using lifts, the hazards associated with lifts, lift-related accidents people have seen, and how lift design might be improved. This early focus on users gave the experimenters a better sense of who the users were, suggested what information needed to be collected about study participants, and guided participant selection.

After this step was completed, 24 lift operators were given 14 warning descriptions and asked to write in their own words what an appropriate warning sign should say corresponding to the message given. They were then asked to draw a graphic representation of the warning. This second step follows Gould and Lewis' first principle by focusing on what lift users do (and need to know).

Based on that input from lift users, several warning signs for each function were developed. The second experiment of this project tested the effectiveness of the warnings developed from Experiment 1, by using 50 lift operators. They were shown several candidate symbols in a random order and wrote down what they thought each meant. Subsequently they ranked each symbol and text message from best to worst. In line with the empirical measurement principle, statistics summarizing participant performance were computed, and from that evidence, candidate symbols were identified.

Finally, in line with the iterative design principle, comments and other feedback from participants were used to modify the candidates, and produce the final designs.

## **FOCUS GROUP**

### **Purpose**

The purpose of the focus groups was to get a sense of the lift users' perspective of their jobs, the hazards involved, protective equipment and measures used (or needed), and how warnings should be designed and placed to benefit the user.

### **Test Plan**

#### **Test Participants**

The authors met with two focus groups consisting of three men each. The first group worked for a local lift distributor, and was interviewed on June 1, 1989. The second group, all employees at a major auto manufacturer's proving grounds, was interviewed on June 7, 1989. These volunteers were identified by their employers as knowledgeable lift users. They had 6-25 years of experience.

#### **Test Equipment and Materials**

The materials consisted of consent forms that participants completed and a list of questions used by the experimenters to guide the discussion. The list (not seen by participants) contained 19 questions divided into three categories--operators (their experience, training, safety practices, and injuries), warnings (types currently used, characteristics that make a warning more readable), and lift design (how could it be improved, repairs, what types are used most often). (The complete list is in Appendix A.)

The experimenters took several pictures with an Olympus OM-1 35-mm camera, and audio taped the session with a Kenwood KX48C stereo cassette deck connected to a Crown PZM-30R pressure zone microphone.

#### **Test Activities and Their Sequence**

The focus group session was very informal. The experimenters and participants in the focus group sat at tables facing each other. The experimenters began the dialogue by introducing themselves. Subsequently, the participants did likewise and described their current job. For the remainder of each session, the experimenters used the question list as a guide rather than asking every question in a fixed order. In some cases participants' responses to questions eliminated the need to ask others. Each session lasted one hour.

### **Results**

Most of the participants were very responsive to the authors' probes and would elaborate on their responses with minimal prodding. Following are the highlights from the interviews with questions and responses grouped by category--operators, warnings, and lift design.

## Questions About Operators

*Where did you learn to operate a lift? How did you get your training?*

Most of the operators knew the basics of vehicle mechanics before they specifically began using lifts. They professed to be mechanically inclined, although they usually did not have any formal training on lifts, and learned through experience. For many, learning about machinery, including lifts, was part of growing up. For example, one mechanic grew up on a farm. Another worked in a stamping plant where he learned the basics of hydraulics. Others worked in family businesses. (One man's father had a garage.) Training in the armed forces was also important. Participants reported that many of the younger mechanics are now trained in vocational schools or special training programs sponsored by their employer. Many of the operators simply learned through experience.

The three people from Allied were involved with the installation and maintenance of lifts. They noted that training lift users about safety is part of the installation process, though the training is not formalized. They indicated that they use feedback from mechanics to determine how much time to spend on training. All training is informal. For people who are familiar with lifts, most users, training sessions last about 10 minutes. For engineers and others who do not use lifts on a regular basis, sessions last 30 minutes to an hour.

*Have you or anyone you know been injured using a lift?*

Most of the operators knew someone who had been hurt on the job, but none of the participants reported they had been injured. The most common injuries reported were pinched fingers, mild concussions, smashed toes, etc. These were sometimes the result of carelessness on the part of the mechanic (incorrect pick-up points, running into the lift post, hitting head on the underside of the car, etc.).

Severe injuries and deaths were thought to be rare. Only one operator cited an example of death as a result of a lift mishap. (The victim was trapped under a falling car.) Severe injuries generally occur when cars are incorrectly spotted on lifts (to provide front door clearance as described later) and when major components are removed, leading to major shifts in the center of gravity. This combination makes it much easier for vehicles to fall off lifts. (This was particularly likely, for example, when the engine or transmission was removed from a Pontiac Fiero.) In other scenarios, low fluid levels led to a lift dropping rapidly and the vehicle bouncing.

Minor injuries were much more common. One participant mentioned that he has witnessed several tool boxes crushed by lifts being lowered. Despite the risk for injuries, most mechanics and lift operators do not seem to be too concerned with safety. One interviewee remarked that most mechanics have a "cocky, don't care" attitude.

One interviewee expressed the view that problems often arise not with mechanics but with engineers and other occasional users. Their problems were examined in only one focus group.



*Do the operators wear safety equipment on the job?*

Although there are regulations to wear hard hats and safety glasses, many operators never wear any protection (perhaps due to their attitude, as noted previously). One of the interviewees noted that hard hats are awkward to wear when under the car because they have a tendency to fall off. In order to see what they are doing, mechanics often tilt their heads back. One solution might be to provide a helmet with a chinstrap. If it was light-weight, well ventilated, didn't reduce their field-of-view, and thin (so as not to reduce clearance), such as with "open style" bicycle helmets, mechanics might be persuaded to wear them.

The mechanics' attitude towards safety depended very much upon their employer, and was much more positive for large organizations. Those working at auto manufacturer proving grounds were very concerned about safety practices and many had completed safety classes. However, many of the small "Mom & Pop" garages were reported to be less concerned with educating their employees about safety practices. The participants noted that, in general, there has recently been an increase in the awareness of the importance of safety, apparently due to OSHA's stiffer inspection policies.

### **Questions About Warnings**

*Are there any warning signs relating to lift use and protection?*

Generally speaking, there are no warning signs on or around the lifts. The only warnings used, if at all, were weight capacities, which were usually worn off after a couple of years. Mechanics noted that in some instances posted weight capacities were too high because the air pressure being supplied was well below the design level.

*If warnings were to be added, what should they look like, and where should they be located?*

According to a couple of the participants, the in-ground lifts are repainted frequently and so any warnings located on the lift itself are likely to be painted over. The dirt, grease, and overall condition of the garage could make a warning difficult to see or hide it completely. One of the participants suggested providing stencils so the warnings could be reapplied. They also suggested painting the warnings on the floor, or possibly using placards that could be hung on a wall and then removed if the lift was moved to a new location or was painted. All of the participants enthusiastically endorsed the use of pictures for warnings. They also suggested that the text messages be short and simple, and in large print so they could be easily read.

## Questions About Lift Design

### *What are the problems with lift installation and operation?*

According to the participants from Allied, Inc., most mechanics are very familiar with lifts, especially in the dealerships. However, that familiarity does not always result in following standard procedures when operating a lift. For example, most new cars have a manual that shows the proper pick-up points, but most mechanics do not refer to them. One of the interviewees mentioned that the manual pick-up points are not always accurate. Retrieving that documentation is invariably difficult. Evidently, when mechanics cannot find the pick-up points, they guess rather than consult the manual. Another interviewee commented that he has seen mechanics pick up a car from the bumpers, or other weak and relatively unsupported areas. Mechanics commented that a standard set of markings underneath the vehicle to identify pick-up points would be a possible solution to this problem. One mechanic noted that Rolls-Royce marked the pick-up points. With incorrect spotting, the problem is usually one of damage to the underbody of a customer's vehicle, not an injury to a mechanic because of vehicle movement.

In one participant's opinion, the biggest problem with above-ground lifts is opening the front doors of a car while it is on the lift. To make opening the doors easier (so they can get in and out) there was a report that mechanics drive the car too far forward on the lift. This problem was most severe when front-wheel-drive cars first came out (because of the extra weight in the front). Now several lift manufacturers have developed surface lifts that allow the front doors to swing completely free (assymetric posts and arms).

Also cited were problems with lift locks that were difficult to engage or did not hold. When coupled with situations where lifts dropped too quickly (mentioned earlier), injuries could occur.

Another problem mechanics identified occurs when above-ground lifts are installed to replace in-ground lifts. The above-ground lifts take up more room because the posts are situated far enough apart for a vehicle to drive through rather than over the posts as in the in-ground lifts. The additional width required can create problems. One interviewee described a situation where the spacing was so tight that people would have to walk underneath a car elevated on a lift in order to get to the other side. There was no room for them to go around the lift. The spacing also makes cleaning around the above-ground lifts more difficult.

Low light levels underneath lifts was also raised as a concern. When a car is on the lift, it tends to block the light from above, thus making it more difficult to work on the underside of the car. One participant suggested painting the floor white. Attaching lighting fixtures to the sides of the posts is also a possibility.

It should be emphasized that at no time did people in the focus groups describe lifts as unreasonably dangerous pieces of equipment.

# EXPERIMENT 1, SYMBOL PRODUCTION

The purpose of this experiment was to obtain suggestions from lift users as to what text and pictures should be used for 14 warnings related to lifts.

## Test Plan

### Participants

Twenty-four men, ages 18 to 57, participated in this study (mean age=37). They were volunteers from local (Ann Arbor) service stations, car dealerships, The University of Michigan heavy equipment garage (Transportation Services), and the General Motors Proving Grounds (Milford, Michigan). Most of the participants were full-time mechanics (17), 2 were heavy equipment mechanics, and 3 were service managers. Free juice and doughnuts were used to encourage participation. The participants were not paid because the mechanics employed by the General Motors Proving Grounds (GMPG), were not allowed to accept pay from outside sources. Because the GMPG provided 1/3 of those tested, the authors decided all participants should be unpaid. All of the men tested had at least a high school education, 4 had trade school education, and 5 had some college education.

All participants had experience with automotive lifts (1 to 35 years, mean=14). Six participants had received injuries from lifts. A few mentioned hitting their head or feet on the hoist, walking into the hoist post, or pinched fingers as injuries they had received. Only one mentioned a serious injury, where a faulty drop light caused gasoline fumes to explode, resulting in serious facial burns to the worker.

All of the operators were familiar with in-ground lifts of various types, with axle (88%) and frame-engaging (63%) being the most common. Only 38% used runway lifts, and 29% used rocker panel lifts. Those who had experience in above-ground hoists, 8 out of the 24, all used the 2-column hoist. Only 1 mechanic had used a four-post above ground lift, and 2 had used a short-rise above-ground lift. Most of the participants (84%) had learned how to operate a hoist through an experienced operator or friend.

### Test Materials

The experiment materials were photocopies of a ten-page test booklet and broad-tipped felt pens. A biographical sheet and consent form were also included. (See Appendix B.) The first page of the test booklet contained instructions and an example. The following pages contained descriptions of 14 warnings (provided by ALI), 2-1/4 inch square boxes in which to draw symbols, and lines to write the message in their own words.

### Test Activities and Their Sequence

The participants were tested on the job, and slides were taken with a 35-mm Olympus OM-1 camera. Broad tipped felt pens were used in an attempt to limit the amount of detail people included in their drawings. Fine details cannot be easily or economically incorporated in the actual symbols for warning labels.

Participants completed the test booklet at work, usually in a neighboring office, conference room, or lounge. After completing the biographical data sheet and signing

the consent form, participants proceeded with the drawings and text. The warnings were grouped in two categories. The first 11 were specific warnings, which were critical to the well-being of the operator, and the last 3 were general warnings dealing with basic operational and safety principles for automotive lifts. (The warnings are listed below in condensed fashion.)

### **Specific**

1. Use jack stands
2. Vehicle pick-up points
3. Don't stand under hoist
4. Don't shake vehicle
5. Run away if vehicle falls
6. Keep feet clear of hoist
7. Unauthorized people stay out
8. Trained operator only
9. Use auxiliary adapters
10. Use extenders
11. Don't overload hoist

### **General**

12. Read manual before using
13. Don't operate if malfunctioning
14. Periodic inspection required

The survey took participants 30-50 minutes to complete.

## **Results**

Reduced versions of the participants' drawings are shown in Appendix B. A few of the drawings are shown on the following pages; however, it is worthwhile to look at the complete list of drawings in the appendix. The authors designed the warnings based solely on the interpretations of the participants. The text messages written by the participants are shown in unedited form immediately following the drawings, in Appendix B. The participants found the specific warnings relatively easy to draw symbols for (e.g., "Don't stand under hoist while raising or lowering vehicle"), while the general warnings were more difficult (e.g., for "Periodic inspection required", seven participants left the spaces blank). Also, participants often included words in their pictures for warnings they found difficult to represent (contrary to the instructions).

For the most part, the authors found many of the drawings very insightful and frequently entertaining. All of the participants, except one, chose to draw symbols using in-ground lifts, corresponding to the lift in which case they were most familiar. Most of the drawings were done from a side view, probably because it was easier to draw. The participants were very helpful and offered good suggestions.

For some of the warnings (e.g., "Use jack stands when removing heavy objects") there were surprisingly several similarities in what people drew. In the jack stand case, almost all of the drawings included a picture of a jack stand, and many showed an engine being removed to represent a large component with which jack stands would be needed for stability. (For warning #1 see drawings from participant #1, 2, 9, 18 and #5, 10, 12, 13, 14.) Other warnings such as warning #11-"Do not exceed the weight capacity," showed very clever ways of depicting too much weight on a hoist. Some used large trucks or vans, others used loaded vehicles, and some showed a hoist breaking under the strain of the weight. Warnings like #3-8 involved drawing people interacting with a hoist. These pictures were often very creative and humorous (warning #6-"Keep feet clear of hoist").

- Experiment 1, Symbol Production -

Not all of the pictures were accurate or even completed. Warning #9, on use of auxiliary adapters, was very confusing for some participants. Several asked the authors what an auxiliary adapter was. Many seemed to get it confused with extenders as shown in warning #10. For the general warnings (#12-14) participants often left spaces blank, as mentioned previously. It was very difficult for them to draw a symbol representing "Periodic inspection required" (Warning #14). But in general, the participants were able to understand the warning descriptions, and the need for simple but meaningful drawings.

When creating text to accompany the symbol, many chose to use language similar to the warning description given, only shorter. One very interesting development was the strong patterns shown in several of the texts. (See Figure 7.) These six patterns were incorporated into the next experiment. Warning #1-Always use jack stands, had a pattern that fit 8 of the 24 responses. The other warnings with strong patterns were, warning #4-Don't shake vehicle while on hoist, which had 9 texts that fit a pattern, warning #6's-Keep feet clear of hoist, which had 11 responses that fit a pattern, warning #8's-Experienced operator only, with 9 responses fitting a pattern, warning #10's-Use extenders when required, with 10 responses fitting a pattern, and warning #12's-Read safety manual before using, with 8 responses fitting a pattern.

2.	Don't	rock (ing)	vehicle	--- while on hoist
	Never	shake (ing)	car	
	Avoid (excessive)	jolt (ing)		
		jounce (ing)		

Figure 7. Patterned Text for Warning #2

Preferences for terminology varied with the participant. Some preferred the wording "safety stands" instead of "jack stands," "extentions" for "extenders," and, as mentioned previously, extenders and adapters were often interchanged. Many participants simply shortened the message description given. A complete listing of the texts is shown following the drawings in Appendix B.

- Experiment 1, Symbol Production -

# EXPERIMENT 2, SELECTION OF SYMBOLS AND TEXT

## Test Plan

The purpose of this phase was to evaluate candidate symbols and texts based on suggestions previously obtained from the mechanics. From that data recommended symbols and warning texts were developed.

## Participants

Fifty automotive service managers, mechanics, and technicians participated in this experiment. The men were paid \$10 in cash upon completion. They were paid as an incentive to participate, because of the difficulty in recruiting subjects for Experiment 1. They were recruited by telephone conversations with general managers, service managers, and service directors at local dealers, service stations, and the General Motors Proving Grounds. As before, participants at the Proving Grounds were not paid because of rules in effect there.

Participants ranged in age from 19 to 55 (mean age=32). The majority of the men had completed high school (98%). Most had been trained by an experienced operator, someone at the shop or service manager, etc. (74%). On the average, the participants had 11 years experience working on lifts (range of 1-35 years). Only 30% worked on above-ground lifts on a regular basis, although a large portion had some experience or exposure to above-ground lifts. Again, the most popular types of lifts were the axle and frame-engaging in-ground lifts (80% and 66% respectively). The majority of garages where the participants worked had only in-ground lifts installed. (A few of these had a four-post above ground runway lift for wheel alignments as well.) Only two shops tested and the GM Proving Grounds had above-ground lifts installed.

The participants had very similar characteristics to those of Experiment 1. Only 10 participants reported receiving minor injuries while working on a lift. Again these injuries consisted of pinched fingers, hitting head on lift, and crushing feet under lift. Eleven of the mechanics said they knew of others who had been injured. These injuries were similar to those mentioned above.

## Test Materials

Participants were given a 39-page booklet, a consent form and biographical data sheet. The first page of the booklet contained some instructions and two examples. The remaining pages contained four parts. The first part, also the longest, (16 pages) showed all of the warning pictures in a random order. The second part showed the candidate symbols grouped by the warnings they represented. The warning description was at the top of each page followed by 2-5 candidate symbols. The last two portions of the experiment dealt with the warning text. The pictures and text messages were developed based on the suggestions from participants in the Symbol Production Experiment (Experiment 1).

## Test Activities and Their Sequence

Participants were tested at their workplace at convenient times during their work day, including before and after hours. After completing the consent form and biographical data sheet, they began working on the test booklet. Participants wrote above each picture what they thought it meant. The second part involved ranking the 2-5 pictures from best to worst for each warning. Best was defined as "the picture which most accurately described the warning given." Participants then wrote a "1" next to the best choice, a "2" by the second best choice and so forth. In the third part, participants ranked three candidate texts for each warning in the same manner as the pictures (1 for best, 2 for second, and 3 for worst). Lastly, the participants were asked to construct their preferred warning text for six selected warnings, given several word selections from which to choose. (See Experiment 1, Figure 7.) The experiment took between 45 minutes and an hour to complete.

## Results

The analysis of the lift users' preferences for warning symbols and texts appears on the following pages (one warning per page). After the test was completed the experimenter "scored" the participants answers based on the "correctness" of their interpretation (responses to the first part of the experiment as described above) and gave a number corresponding to their answer. The scoring was as follows:

- 1 = Completely correct answer
- 2 = Partially correct but still not specific enough
- 3 = Wrong
- 4 = No response

These numbers corresponded with the ranking from best to worst, given to the symbols. Ideally, the most preferred symbol should have a low mean value (since 1=best, 2=second and so on), and a low response (or correctness) score (mean for each symbol where 1=completely correct, 2=partially correct, and so on). For consistency, only one person scored the responses (the first author).

Computation of the "correctness" score was done in three steps. The initial step was to decide if the participant's message was the same or very close to the warning intended. The first author looked for key words in the participant's responses. Phrases like "Watch your feet" for the warning #6-Keep feet clear while lowering hoist, would get a score of (2). The participant understood that he needed to watch his feet, but neglected to mention why (the lift was being lowered), and did not include all the information. However, participant #34, (see responses in Appendix C for reference) wrote "Keep feet clear when lowering hoist." This response received a score of (1) because all of the necessary information was included.

The second step in scoring was to determine if the intended action (what to do) was correct. Some of the responses, although accurate according to the picture, did not reflect the warning intended. For example, participant #49 mistook picture #21, Warning #4-"Do not shake the car while on the hoist" to be "Do not run the car while on the hoist", because the picture representing a shaking car also looked like a car that was running. That person received a score of (3) for the response. Another example of a participant's misinterpreted action was for warning #8, picture 9-"Only trained operator should operate hoist", depicted an operator with a lightbulb above his head. This was supposed to represent someone who knew what to do, and was trained to



- Experiment 2, Selection of Symbols and Text -

operate the lift. However, it was misinterpreted by subject #5 and others to mean "Use plenty of light." This response also received a score of (3).

The third step concerned whether the participant really understood the nature of the hazard (what's wrong). This was the most difficult factor to score. An example of this problem would be the response to candidate symbol #11, warning #14-"Periodic maintenance required." Participant #7 stated "Always notify others of equipment in repair." This received a score of (2). The participant understood the nature of the hazard, but neglected to mention that a routine check-up is necessary for the lift.

The participants' responses were candid first impressions of what they thought about the meaning of the symbol. Because no words or previous identification could help them, the participants tried to figure out what the symbol meant at the first glance. From their responses, the authors modified the preferred candidates in several cases to reduce the number of misinterpretations.

On the following pages, the recommended symbol for each of the 14 warnings is shown, followed by the results for the warnings text. At the top left-hand corner is a table showing the rankings for each of the candidate symbols (how many chose symbol A as their number one choice, how many chose symbol B as their number one choice, etc.), along with the missing data tally. (People either skipped the page, or they didn't like any of the symbols listed, so they chose to leave that page blank.) Also given are the mean rankings for each of the candidate symbols. The means range from 1 to 5 (depending on the number of candidate symbols), with smaller values representing better warnings (since 1=best, 2=second, 3=third and so on). Following the mean rankings are the response scores for each candidate symbol. Following this data is the percent correct score for each candidate (percentage of participants who received a grade 1 for the response (naming) task) and the mean correctness score. Ideally the recommended symbol, always represented as symbol A, will have a low mean ranking, a high percent correct, and a low correctness score.

Following the fourteen warning symbol rankings are the rankings for the text messages. These follow the same format without the performance data. For warnings with patterns, the data from the patterned text are shown. The number of participants who chose each word selection is shown next to the word.

- Experiment 2, Selection of Symbols and Text -

1. Use jack stands when removing large parts

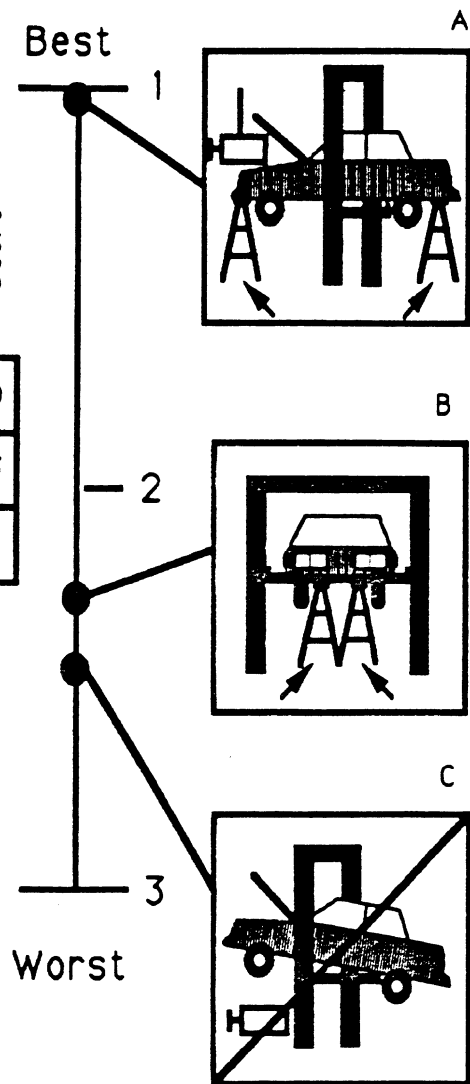
Candidate	Preference				Mean	Performance					Correctness Score
	Rank			Missing		1	2	3	4	% Correct	
	Best	Worst	1								
A	47	2	1	0	1.08	39	7	4	0	78	1.30
B	3	20	27	0	2.48	32	8	9	1	32	1.53
C	3	27	20	0	2.34	8	3	36	3	17	2.60

1= correct  
 2= partially correct  
 3= wrong  
 4= no response

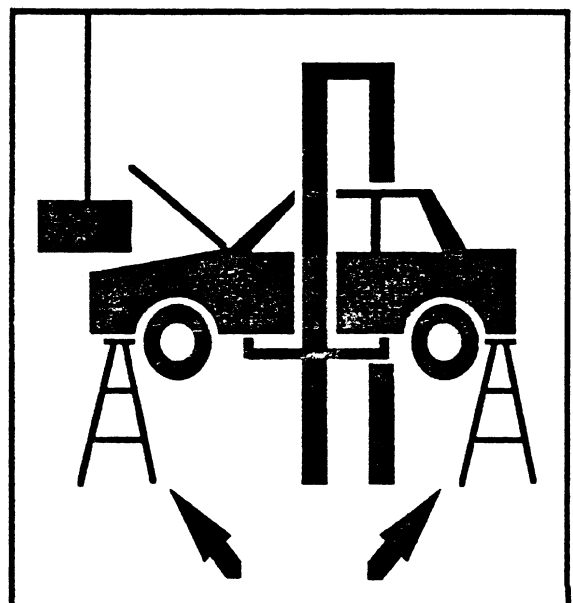
Where people were asked to rank these symbols from best to worst, symbol A was preferred by 47 of the 50 people. This difference was statistically significant (Chi-Square=116,  $p < .001$ ). Symbol A also had the highest score in the naming task, 1.30 (Kruskal-Wallis statistic= 41.977,  $p < .001$ ). Almost all of the participants (78%) correctly identified the meaning of symbol A.

Responses identified as correct include: "Use support stands when removing engine," "Use additional support for vehicle when performing heavy component changes," "Use jack stands when changing weight of car on hoist." Responses identified as partially correct include: "Use safety stands," "Correct usage of hoist." Very few participants completely missed the meaning of symbol A. One interpretation was, "Watch for obstructions." Refer to Appendix C for the exact wording of the responses.

The recommended symbol was modified slightly to accommodate drawing guidelines as shown in the FMC manual (FMC, 1985). Because of the high rankings and high average correctness score, few changes were introduced. However, the car and engine were colored in black rather than gray in accordance with the FMC manual (which does not recommend gray).



**Recommended Choice**

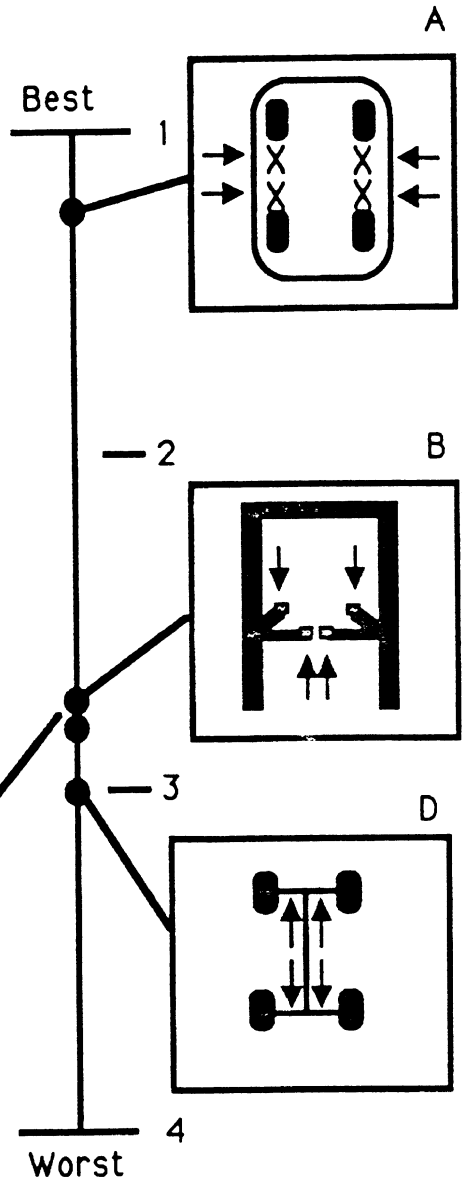
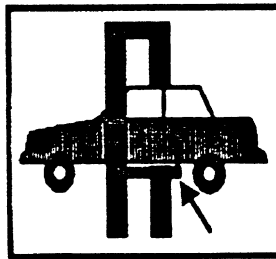


2. Use recommended vehicle pickup points

Candidate	Preference					Performance						
	Rank				Missing	Mean					% Correct	Correctness Score
	Best	→	Worst				1	2	3	4		
1	2	3	4									
A	43	3	2	2	0	1.26	26	17	4	3	55	1.53
B	2	18	15	15	0	2.86	7	10	18	15	20	2.31
C	3	17	13	17	0	2.88	17	12	10	11	44	1.82
D	2	12	20	16	0	3.00	5	12	18	15	14	2.37

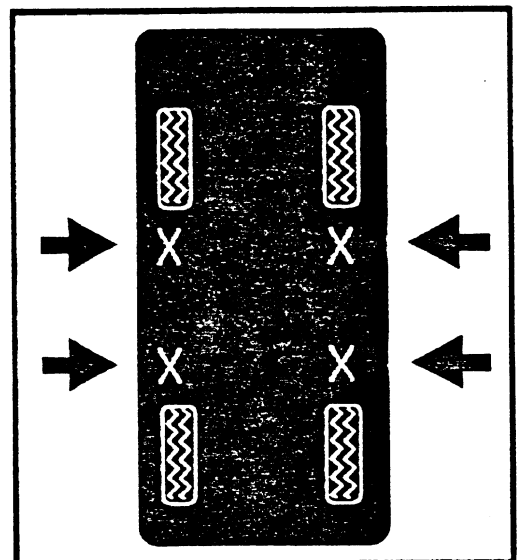
Candidate symbol A was preferred by 43 of the 50 people tested, a statistically significant difference (Chi-Square=136,  $p < .001$ ). However, only slightly over half of the participants (55%) could identify the correct meaning. Though the difference between symbols was statistically significant (Kruskal-Wallis statistic=26,  $p < .001$ ).

1=correct  
2=partially correct  
3=wrong  
4=no response



Most people got the general idea about the warning with partially correct responses such as "Position arms, raise vehicle between front and rear wheels on body, frame points for raising vehicle." However, as shown by this sample of responses, many participants seemed to miss the connection between contact points, and using proper or recommended pickup points. Yet, as suggested by the majority of the correct responses, such as those for symbol A, were more specific, "Use correct lift points," "Use approved lift points on vehicle," "lift vehicle at approved lifting points only." The responses for symbols B, C, and D were generally more vague than for symbol A. Some of the participants were confused completely by these symbols. For example, symbol C was sometimes referred to as "Center vehicle on hoist" or "Support load evenly." Perhaps showing the car on the lift only led to more confusion. Also, for symbol D, many participants responded with: "Check wheel base," "rotation of tires," "four wheel drive," "Means nothing to me." The final drawing was modified to make the tires look more realistic and reversed the drawing to white on black.

Recommended Choice



3. Don't stand under hoist while raising or lowering vehicle

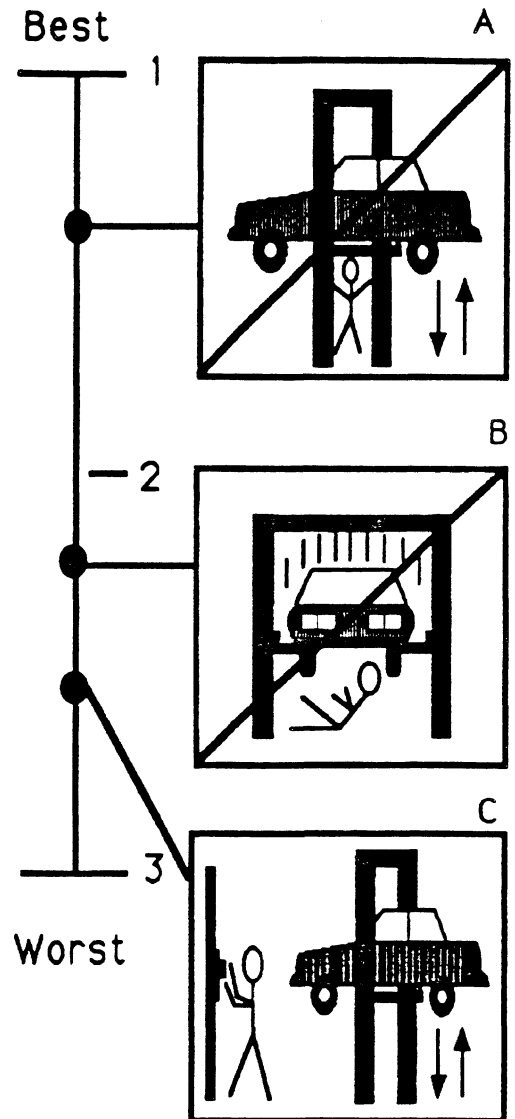
Candidate	Preference					Performance					
	Rank		Missing	Mean					% Correct	Correctness Score	
	Best	Worst			1	2	3	4			
1	2	3		1	2	3	4				
A	38	10	2	0	1.28	42	4	1	3	89	1.13
B	3	31	16	0	2.26	25	17	5	3	53	1.58
C	9	9	32	0	2.46	11	6	21	12	29	2.26

1=correct  
2=partially correct  
3=wrong  
4=no response

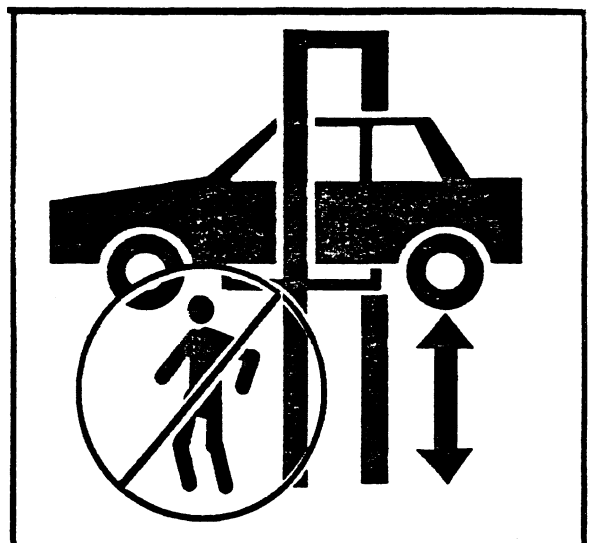
Symbol A was the overwhelming favorite with 38 out of the 50 participants ranking it as their number 1 choice (statistically significant, Chi-Square=88,  $p < .001$ ). It also scored well in the naming task where 89% of the participants correctly identified that symbol (Kruskal-Wallis statistic=30,  $p < .001$ ).

As shown by the unusually high correctness score, most responses were similar to the following; "Do no stand under a moving hoist," "Do not stand under vehicle while raising or lowering," "Do not stand under vehicle during hoist operation." Many participants interpreted symbol B as a man "laying down" while the lift dropped, rather than the author's intended interpretation of a man falling while caught under a lift that was being lowered. ("Do not lay under car when working on hoist.") Another faulty interpretation commonly used was with symbol C. Many thought the symbol as focusing on the controls, rather than the car. For example, one participant wrote "Keep hoist controls far enough from hoist for safety purposes." Another wrote, "Be sure of how to control hoist prior to using."

The symbol was modified using the recommended figures shown in the FMC manual rather than the stick figures. Again the car was painted in black in keeping with the standards previously mentioned.



Recommended Choice



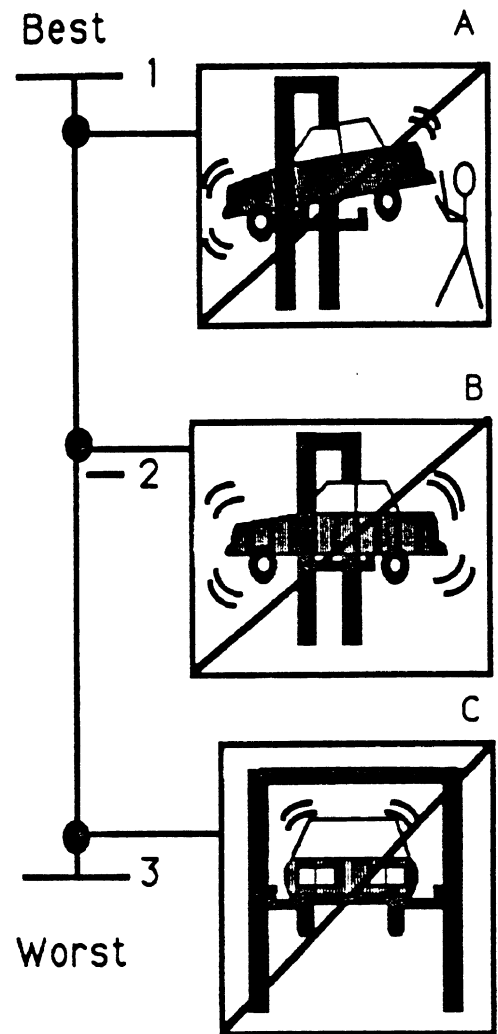
4. Don't excessively shake vehicle

Candidate	Preference					Performance					
	Rank			Missing	Mean					% Correct	Correctness Score
	Best	Worst	1			2	3	4			
A	45	5	0	0	1.14	10	13	24	3	21	2.30
B	5	43	2	0	1.94	16	16	16	2	33	2.00
C	0	4	46	0	2.92	14	7	23	6	32	2.21

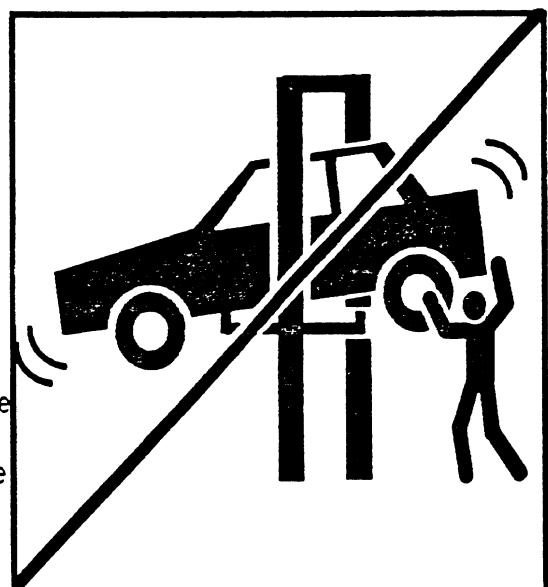
1=correct  
 2=partially correct  
 3=wrong  
 4=no response

A contradiction appears when looking at the data for the preferred symbol A. An overwhelming 45 out of the 50 participants chose this symbol as their top choice (a significant difference, Chi-Square=213,  $p < .001$ ). However, it had the worst correctness score, with only 21% of the participants correctly identifying the message. (The Kruskal-Wallis statistic=3,  $p < .244$  was not significant.)

Many of the responses seemed to indicate that participants viewed the symbol as a man trying to save a falling vehicle. ("Don't try to stop a car that's falling from falling," "Do not attempt to steady falling vehicle," "Don't teter vehicle on hoist.") Yet it appears that when ranking the symbols, and having the corresponding text available, participants preferred the human interaction with the shaking of the vehicle. Another misconception was with symbols B and C. Many participants thought the lines around the car meant that the car was "running" on the lift, not shaking. Several responded with phrases such as, "Do not run vehicle while on hoist." Perhaps this warning is a good example of how text messages are needed to avoid misleading interpretations. Again in this symbol the figure was changed in accordance with the FMC standards. A gap was introduced to separate the rest of the image from the graphic elements.



Recommended Choice



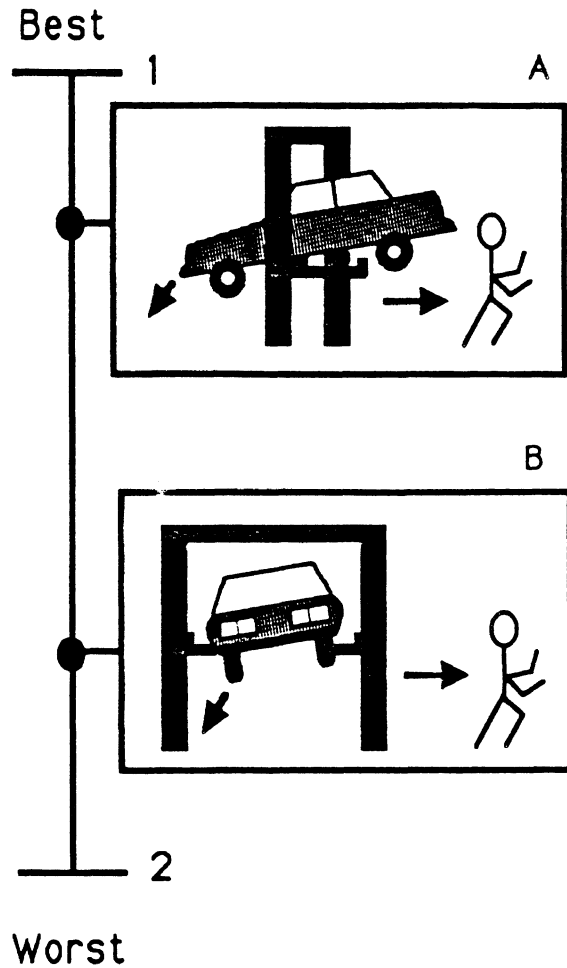
5. Run away if vehicle starts to fall

Candidate	Preference				Performance				% Correct	Correctness Score
	Rank		Missing	Mean	1	2	3	4		
	1	2								
A	42	8	0	1.16	41	6	3	0	82	1.24
B	8	42	0	1.84	35	11	4	0	70	1.38

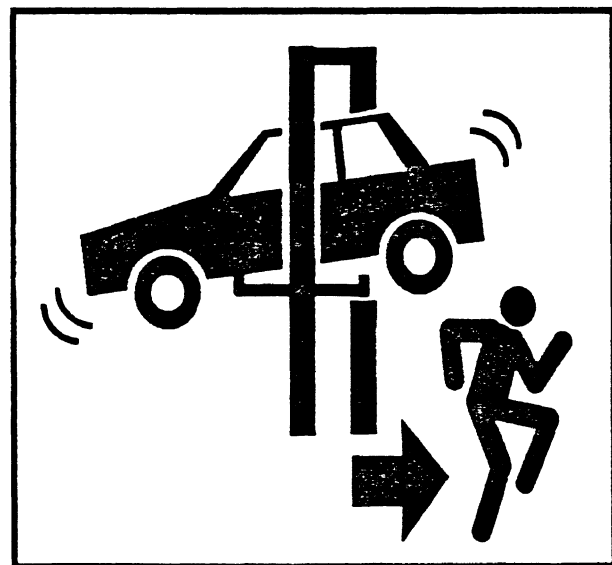
1=correct  
 2=partially correct  
 3=wrong  
 4=no response

For both symbols A and B, their correctness scores were very high (Kruskal-Wallis statistic=1,  $p < .316$ ). However, there was a big difference in preferences as 42 out of the 50 chose symbol A as their top choice (Chi-Square=46,  $p < .001$ ).

As shown by the drawings of the participants for Experiment 1, most showed the side view of a car on a lift rather than the front view when indicating their preference. Of the warning symbols chosen for this experiment, none of them are a front view. When asked to write down what the symbols meant, responses for both symbols were very close to the original message. Examples are: "Run away when car is falling," "Move in opposite direction of falling cars," "Get out of the way if a vehicle gets out of control on a hoist." In developing the recommended symbol, the preferred symbol tested (A), was modified to bring the graphics in line with FMC recommendations (replace gray car with black, replace stick figure person, increase lift-vehicle separation).



Recommended Choice



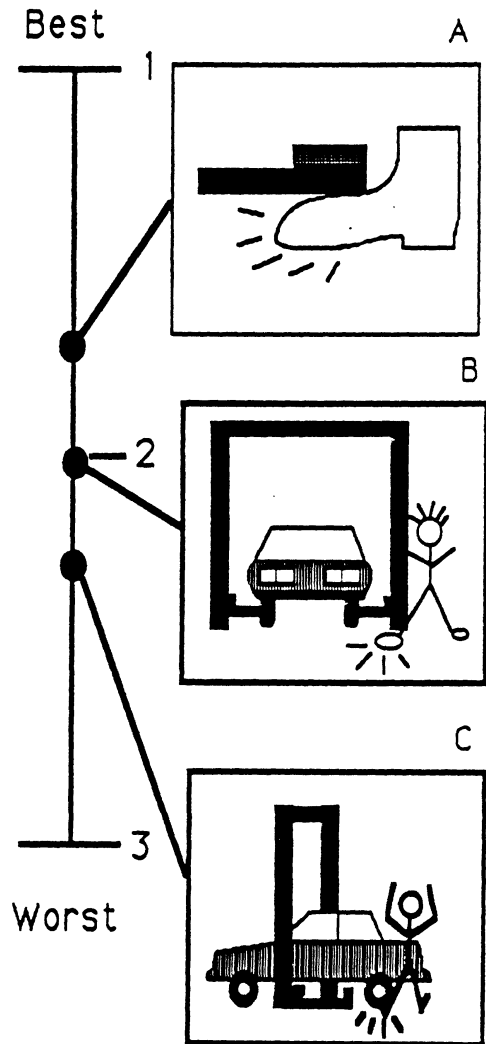
6. Keep feet clear of hoist

Candidate	Preference					Performance				% Correct	Correctness Score
	Rank		Missing	Mean	1	2	3	4			
	Best	Worst									
1	2	3									
A	25	13	12	0	1.74	35	11	4	0	70	1.38
B	10	28	12	0	2.04	26	20	3	1	53	1.53
C	15	9	26	0	2.20	31	16	3	0	62	1.44

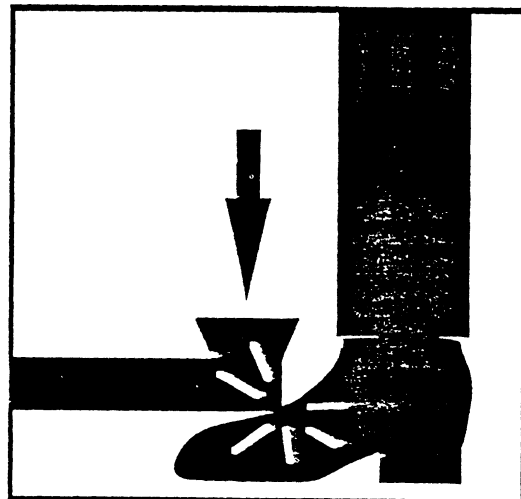
1=correct  
 2=partially correct  
 3=wrong  
 4=no response

All three correctness scores were fairly high for the symbols A, B, and C. However, symbol A was preferred with 25 out of 50 of the participants picking it as their favorite. This difference was statistically significant (Chi-Square=27,  $p < .001$ ). In the naming task, 70% correctly identified the symbol A (not significantly different from the other candidates, Kruskal-Wallis statistic=2,  $p < .431$ ).

Some examples of typical responses for symbol A were: "Keep feet from under hoist," "Watch feet while lowering hoist." Some of the participants focused more on protective safety gear as two participants wrote, "Wear safety shoes," "Always wear steel toed boots when operating hoist." On symbol B, participants tended to use more general warnings, perhaps because the emphasis wasn't on the foot as much as the individual. For example, several wrote "Keep clear of hoist area when letting down vehicle," "Stay back when lowering," "Don't do this!" Symbol C was correctly identified most of the time, but just wasn't preferred. Maybe it was the hair. Symbol A's foot was modified slightly to make it more realistic, and the radiating lines were moved to emanate from the point of contact.



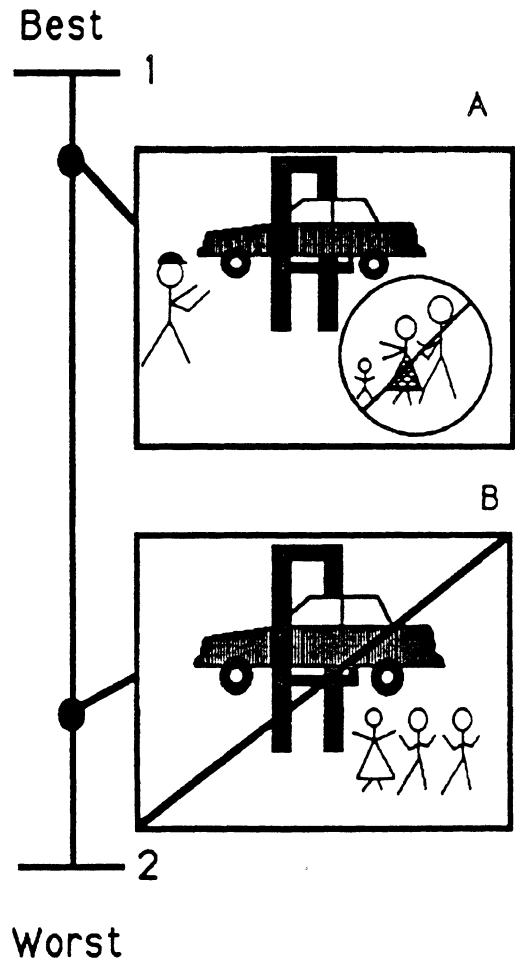
Recommended Choice



7. Unauthorized people stay out

Candidate	Preference				Performance					
	Rank		Missing	Mean	1	2	3	4	% Correct	Correctness Score
	1	2								
A	43	7	0	1.14	39	7	2	2	81	1.23
B	7	43	0	1.86	34	12	3	1	69	1.37

1=correct  
 2=partially correct  
 3=wrong  
 4=no response



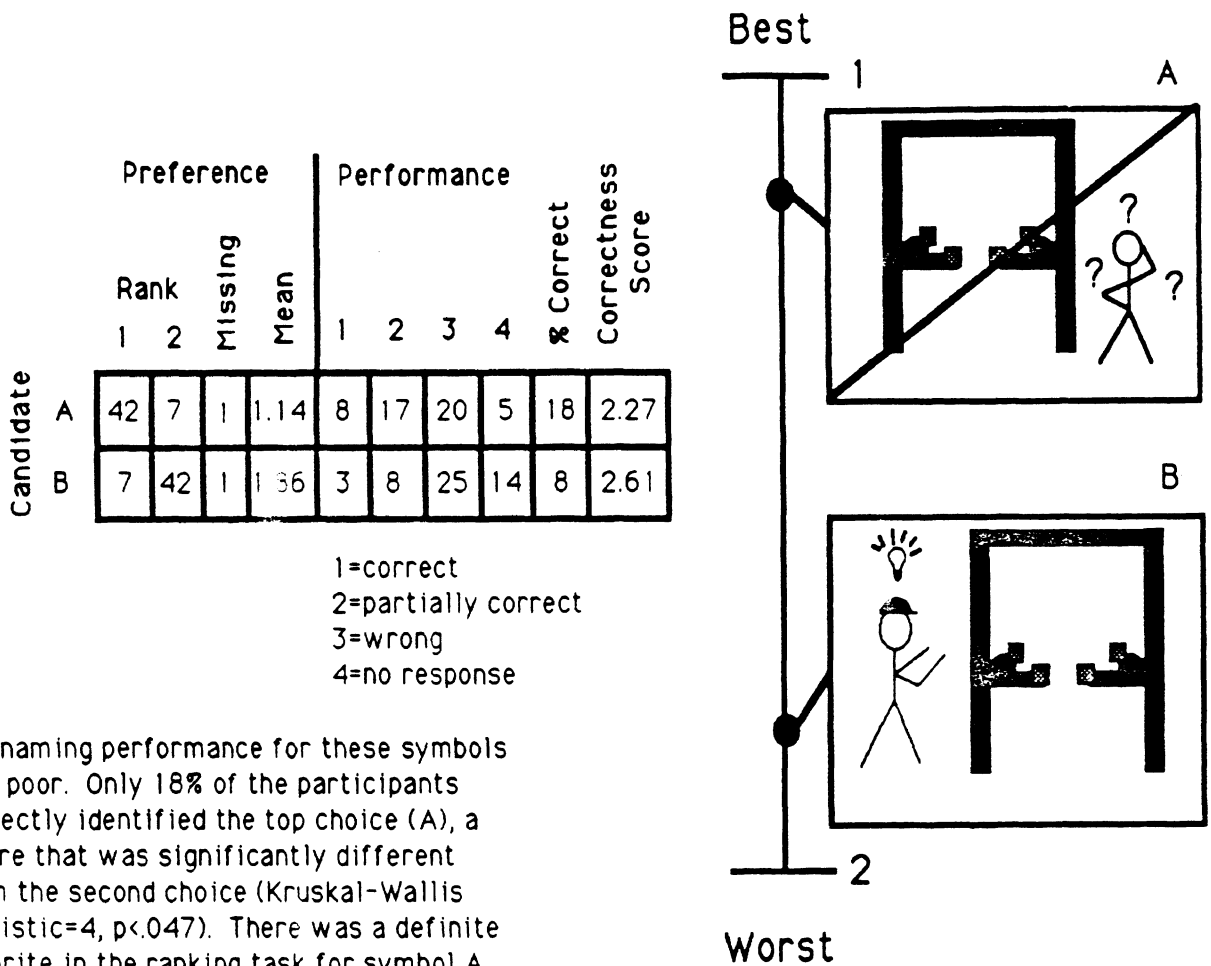
This is another example of two candidate symbols with very high response ratings. Symbol A was the clear favorite with 43 out of 50 choosing it as the best (Chi-Square=52,  $p < .001$ ). The difference between candidates in the naming task was not significant (Kruskal-Wallis statistic=1,  $p < .320$ ), with 81% correctly indentifying candidate A. Most of the participants responded to both symbols A and B with responses such as "No customers in work area," "Authorized personnel only," "employees only in lift area." A few participants thought that symbol B looked like it should say "No Dancing under the Hoist" or "Children not Allowed." For symbol A a few participants mentioned that it should say "No families Allowed." The idea these thoughts convey is still correct, especially since it is difficult to represent "unauthorized people." But with modifications based on standards in the FMC manual, the figures were modified to be more uniform with greater distinction between the authorized operator and the unauthorized people.

Recommended Choice





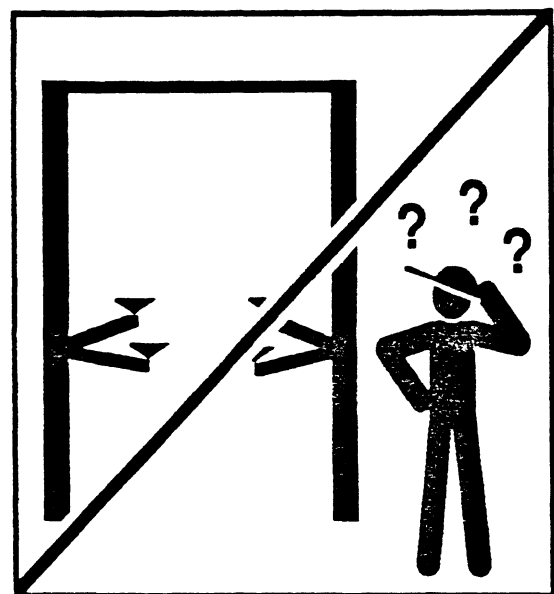
8. Only trained operator allowed



The naming performance for these symbols was poor. Only 18% of the participants correctly identified the top choice (A), a figure that was significantly different from the second choice (Kruskal-Wallis statistic=4,  $p < .047$ ). There was a definite favorite in the ranking task for symbol A (42 out of 50). The difference was statistically significant (Chi-Square=50,  $p < .001$ ).

Part of the difficulty with this warning is that the message is hard to show pictorially. It's difficult to make a simple drawing of what a trained operator looks like. Many individuals confused these warnings with "Think before using" or "Read the manual," which are similar in concept to the meaning of this particular warning, but not entirely correct. Some confused the light bulb in symbol B to mean "Use in well-lighted areas only." Although these pictures were not interpreted correctly most of the time, the authors felt it was difficult to draw this concept. This is another good example where text added to the picture would make the warning much more effective. In the recommended choice, the stick figure was replaced in symbol A as in previous symbols.

Recommended Choice



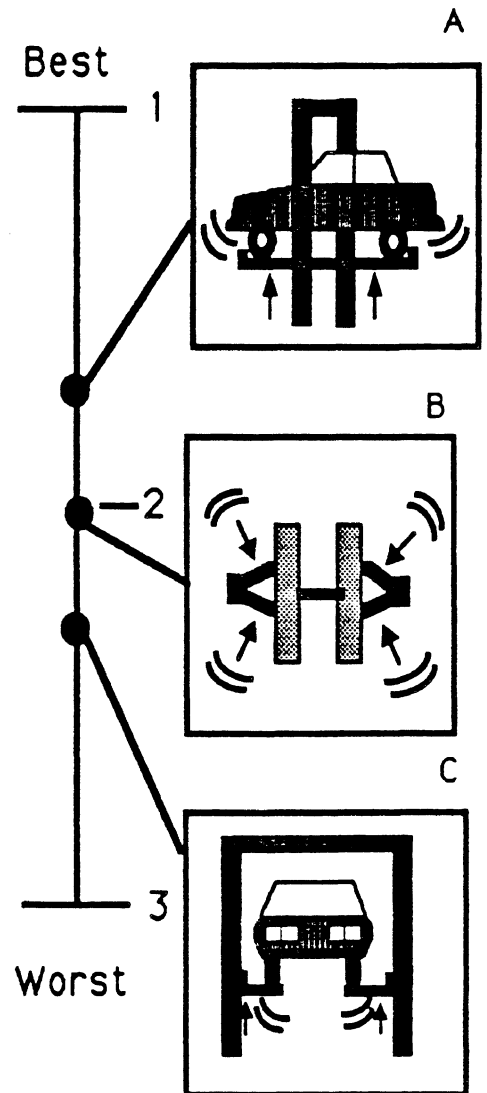
9. Use of auxiliary adapters may affect hoist capacity

Candidate	Preference					Performance					
	Rank		Missing	Mean	1	2	3	4	% Correct	Correctness Score	
	Best	Worst									
1	2	3	4	1	2	3	4	% Correct	Correctness Score		
A	18	16	12	4	1.76	1	1	38	10	3	2.93
B	16	12	18	4	2.04	2	2	28	18	6	2.81
C	12	13	21	4	2.19	0	1	31	18	0	2.94

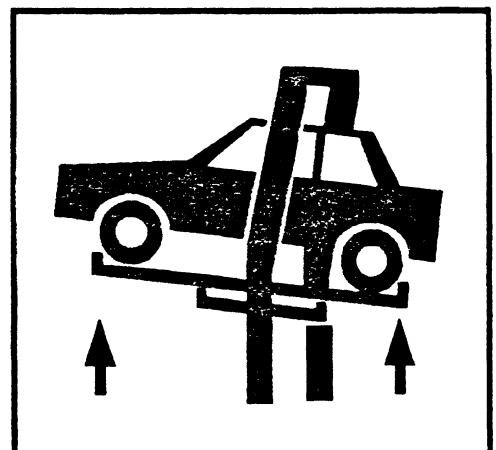
1=correct  
 2=partially correct  
 3=wrong  
 4=no response

This warning was very confusing to most participants. All of the warnings had very low correctness scores, with no one getting symbol C correct. There were also virtually no differences in preferences for symbols (Chi-Square=11,  $p < .0217$ ). The differences between symbols in the naming task were not significant (Kruskal-Wallis statistic=.50,  $p < .793$ ). Participants only slightly preferred symbol A (18) over symbol B (16).

Many seemed to get this warning confused with the next one on extenders. The authors had to explain this warning in great detail before the participants would understand. Perhaps the reason for such poor response is that many of the participants do not use above-ground lifts, much less adapters. Many of the larger shops have their own four-post lift for wheel alignments, so adapters are not even necessary. Many of the participants left the responses to these warnings blank (symbol A-10 left blank, symbol B-18 left blank, and symbol C-18 left blank), or their answers were like "Use blocks to keep wheels from rolling," "Do not raise unstable lift," "Vehicle bouncing," "Lift by wheels." Because of the poor performance of these symbols, some modifications have been made to symbol A. The shaking marks were eliminated, and the car and lift were simplified and colored in black.



Recommended Choice



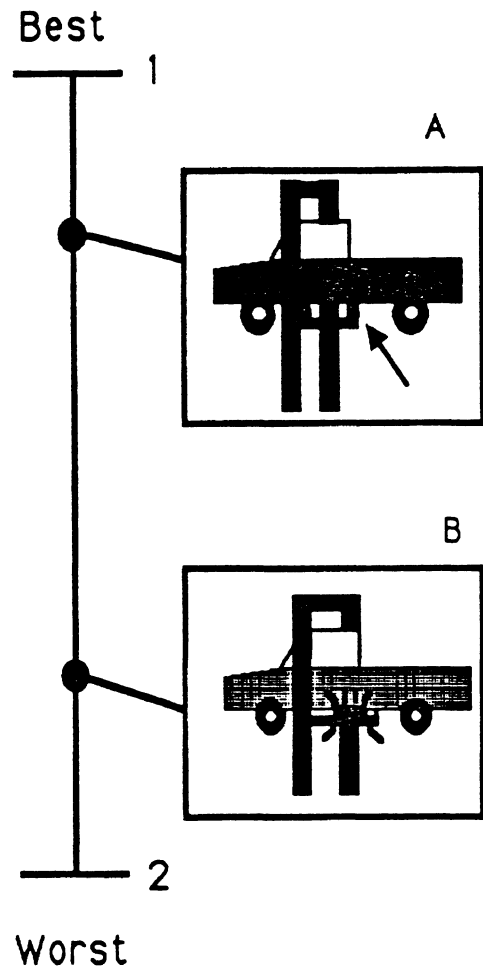
10. Use extenders when necessary

Candidate	Preference				Performance					Correctness Score
	Rank		Missing	Mean	1	2	3	4	% Correct	
	1	2								
A	39	11	0	1.22	11	13	20	6	25	2.20
B	11	39	0	1.78	1	8	31	10	3	2.75

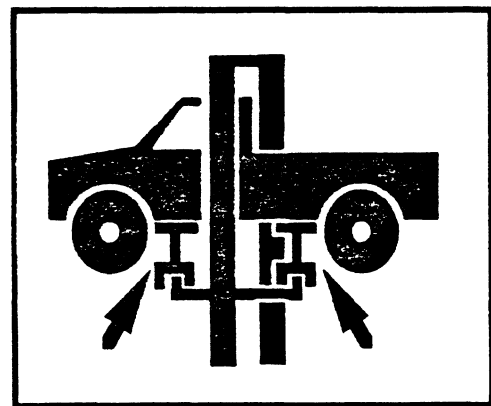
1=correct  
2=partially correct.  
3=wrong  
4=no response

This warning also seemed to give the participants several problems. Symbol A was the first-choice (39 out of 50), and had the best correctness score, a value that was statistically significant from the alternative (Chi-Square=31, p<.001). However only 1/4 of the participants gave the intended response, though the difference between candidates in the naming task was significant (Kruskal-Wallis statistic=8, p<.004).

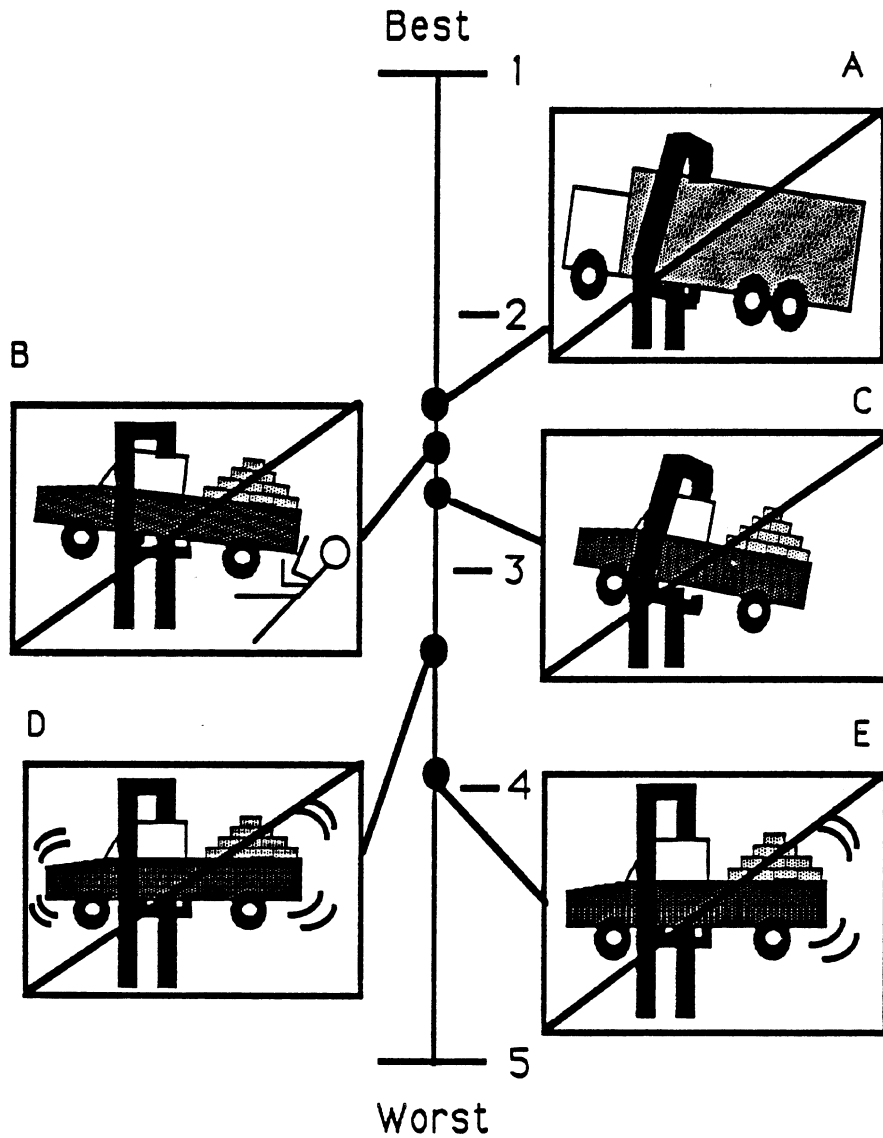
Several people used adapters in reference to symbol A, while others used the word extensions. No one used the word extenders to refer to the warning. Those who correctly interpreted symbol A referred to it as "Use height adapters when required," "Use proper extentions on hoist," "Use hoist with pads in up position." However, many responded in very different contexts, "Support load evenly," "Use correct contact points," "Secure rear post." Symbol B was misinterpreted by participants, as meaning "Center vehicle on frame, not on the body parts." Because no extenders were shown, very few people realized that was the key element in what the picture was trying to say. With text, this symbol should become much clearer. Some changes were made to the extenders shown in symbol A to make them more prominent as well as the solid black used for the truck. Furthermore, since extenders add primarily to the height of the lifting pad, and are commonly used with 4x4 vehicles, the drawing was modified accordingly.



Recommended Choice



1.1. Don't exceed weight capacity



Candidate	Preference							Performance					
	Rank					Missing	Mean					% Correct	Correctness Score
	Best	2	3	4	Worst			1	2	3	4		
1	2	3	4	5									
A	25	7	2	4	12	0	2.42	31	10	9	0	81	1.56
B	14	8	22	1	5	0	2.50	6	16	25	3	13	2.40
C	9	23	3	9	6	0	2.60	19	19	12	0	38	1.86
D	2	10	10	23	5	0	3.38	13	15	20	2	27	2.15
E	1	3	13	12	21	0	3.98	13	22	15	0	26	2.04

1=correct  
 2=partially correct  
 3=wrong  
 4=no response

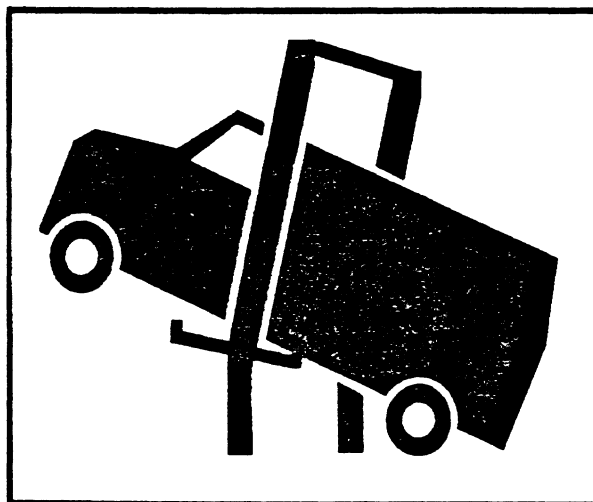
## 1.1. Don't exceed weight capacity (continued)

In this particular warning message five candidate symbols were introduced. After ranking the symbols, participants were asked if they liked the pickup with cargo better or the large truck. Most people, as indicated by the diagram preferred the large truck. However, since there were five symbols spread across two pages of the experiment booklet, many subjects forgot that the symbols were continued on the next page and they ranked each page separately. This caused some problems for the authors who tried to tabulate the data. The experiment booklet stated that the warning symbols continued on the next page, but most people ignored the instructions or did not read them.

The large truck (symbol A) was the first choice of half of those responding, and it was significantly preferred over the alternative (Chi-Square=136,  $p < .001$ ). In the naming task, 81% of those responding correctly identified it (and the differences in the naming task were statistically significant, Kruskal-Wallis statistic=26,  $p < .001$ ).

Most of the responses for symbol A were completely correct. "Do not overload hoist," "Vehicle not for this hoist," "Too heavy for hoist," "Don't lift vehicles that are overweight for the hoist" were some of the typical responses. Participants also seemed to prefer symbol C as well, perhaps because of the bent lift. Responses included, "Don't overload hoist," "Over weighted loads may tip," and "Excessive loads may cause vehicle imbalance during lifting." Symbols B, D, and E, were all confused with an unbalanced load, rather than overloaded. Participants often responded with "Don't lift unbalanced load," "Do not shake with tail heavy loads," and "Improperly balanced trucks." The shaking marks only confused the participants, who thought that was because the load was unequal. The stick figure in symbol B was often confused with someone trying to hold up an unbalance load rather than someone caught under a falling load. One participant wrote "You can't stop or hold back unstable load." The authors thought a preferred symbol for this warning should show too much weight, but have the weight evenly distributed so as to avoid confusion, as in the symbol of the large truck. Symbol A was modified to show a van rather than a large truck, because it is very unrealistic to expect a large dual-axled truck on an above-ground lift.

### Recommended Choice



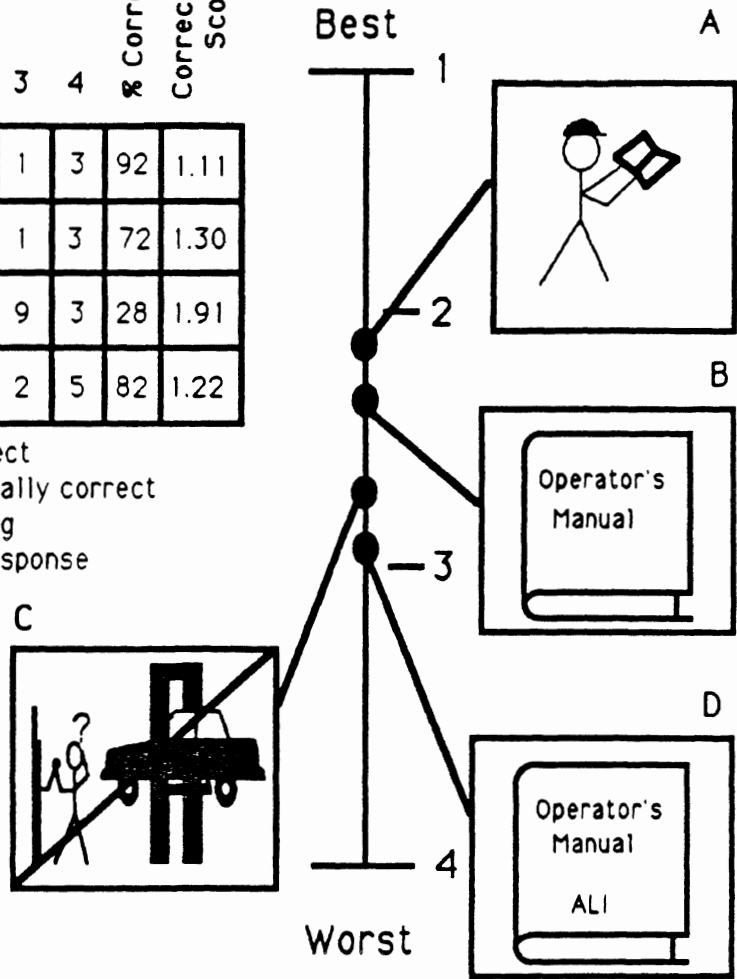
12. Read ALI manual

Candidate	Preference					Mean	Performance					% Correct	Correctness Score
	Rank				Missing		1	2	3	4			
	Best 1	2	3	Worst 4									
A	23	7	12	8	0	2.10	43	3	1	3	92	1.11	
B	11	21	13	5	0	2.24	34	12	1	3	72	1.30	
C	13	11	1	25	0	2.76	13	25	9	3	28	1.91	
D	3	11	24	12	0	2.90	37	6	2	5	82	1.22	

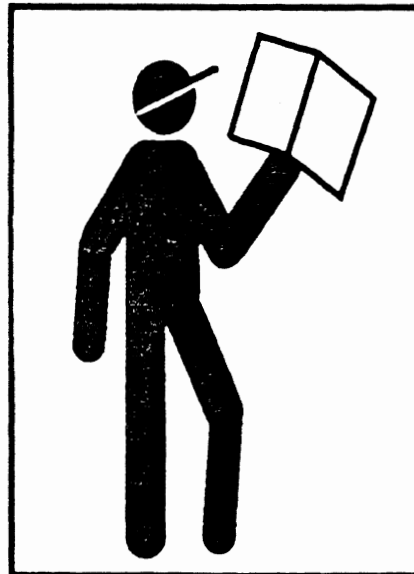
1=correct  
2=partially correct  
3=wrong  
4=no response

Of the 50 participants, 43 correctly identified symbol A as reading the manual. The differences between symbol A and the alternatives were statistically significant (Chi-Square=65,  $p < .001$ ). With regards to preferences there were again significant differences (Kruskal-Wallis statistic=35,  $p < .001$ ), with almost half preferring symbol A, almost double the number favoring the second choice.

Participant responses included the following: "Read manual," "Read operator's manual," "read instructions before operation." Symbols B and D also had similar responses. However some various answers were given for symbol C. Some examples are the following, "Do not use hoist if not trained," "Don't raise vehicle without watching what you are doing," "Do not stand in front of vehicle while lifting." The figure for symbol A was again modified to reflect recommendations in the FMC manual.



Recommended Choice



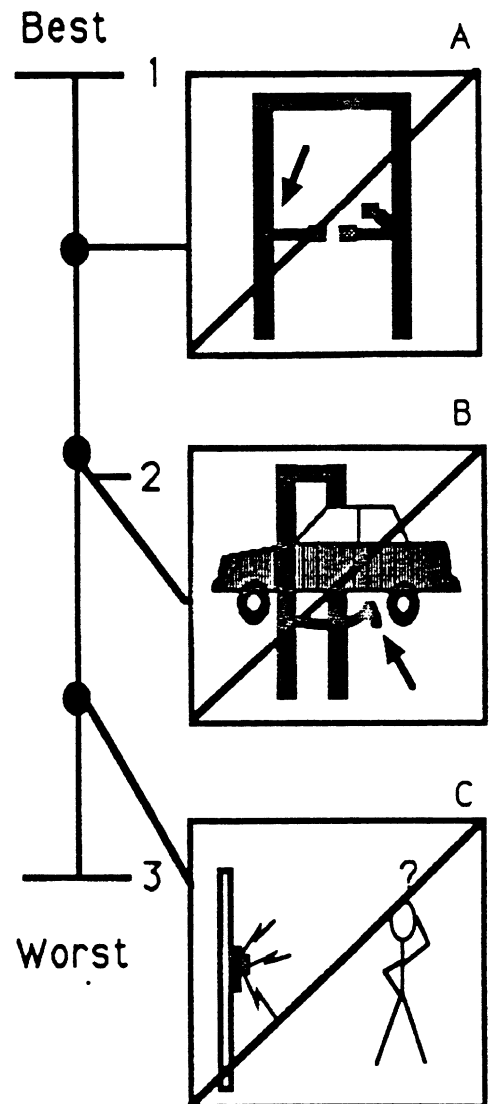
13. Hoist must be in proper working order before using.

Candidate	Preference				Mean	Performance				% Correct	Correctness Score
	Rank		Missing			1	2	3	4		
	Best	Worst									
1	2	3									
A	30	19	1	0	1.42	12	18	14	6	27	2.05
B	16	21	13	0	1.94	14	17	8	11	36	1.85
C	4	10	36	0	2.64	2	5	23	20	7	2.70

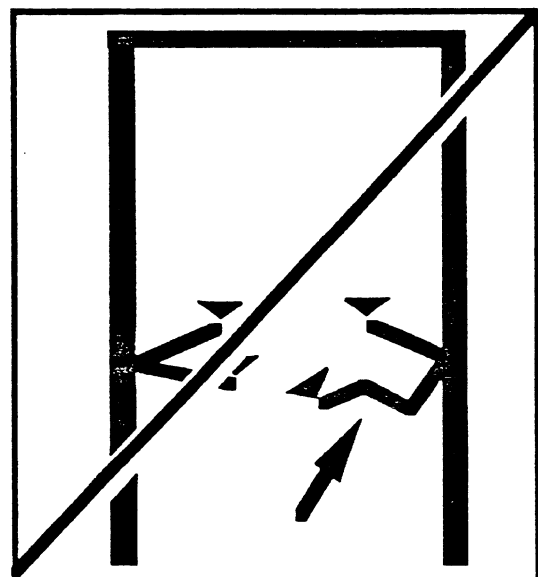
1=correct  
2=partially correct  
3=wrong  
4=no response

For this warning, all of the candidate symbols had poor correctness scores. However, symbol A was preferred by 30 out of the 50 participants even though its correctness score was not as good as symbol B. The differences in the preference task were statistically significant (Chi-Square=62,  $p < .001$ ). The difference from the naming task was significant as well (Kruskal-Wallis statistic=19,  $p < .001$ ).

Responses for symbol A generally varied from "Do not lift vehicle without all 4 arms" to "Do not use hoist with missing parts." These responses had the general idea, except that most participants drew their attention to the missing arm rather than a malfunctioning lift. For symbol B, participants responded with "Do not lift without all points in contact" or "Do not pick up car with hoist pad out of position." Again, the focus was on the broken arm rather than a damaged hoist. For symbol C, many interpreted the picture to indicate electrical problems as indicated by their responses, "Electrical hazard, Warning-may cause shock," "Do not use if hoist has electrical problems." Symbol A was modified to show all four arms so participants would interpret the warning as a lift with a broken arm rather than a missing part. Spacing around the slash was used to make the symbol clearer.



Recommended Choice



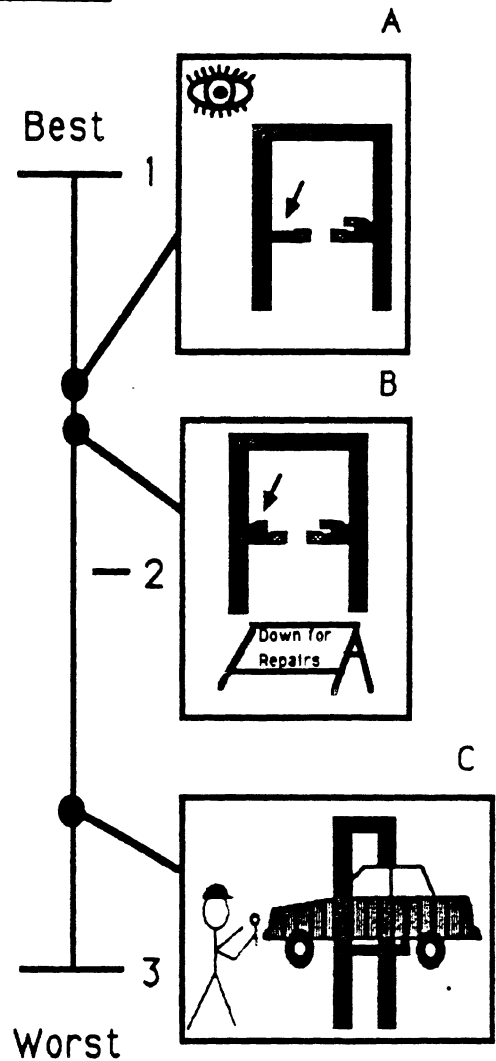
14. Periodic inspection required

Candidate	Preference					Performance					
	Rank			Missing	Mean					% Correct	Correctness Score
	Best	Worst	1			2	3	4			
A	24	22	4	0	1.60	18	10	17	5	40	1.18
B	23	20	7	0	1.68	3	24	22	1	6	2.39
C	3	8	39	0	2.72	1	2	29	18	3	2.87

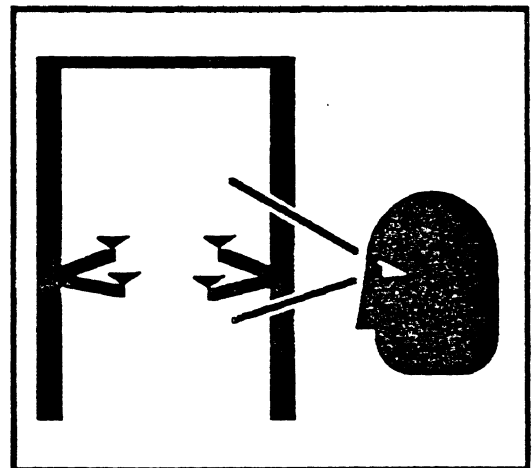
1=correct  
 2=partially correct  
 3=wrong  
 4=no response

Symbol A was the best candidate in both the ranking task, and the naming task. The differences between symbols were statistically significant (Chi-Square value=69, p<.001). However, the percent correct was not 50%. Perhaps the rather poor correct responses were due to the general nature of these warnings. The differences were statistically significant (Kruskal-Wallis statistic=21, p<.001).

In warnings 12-14, it was difficult for the authors to graphically represent "inspection required, make sure components are in working order, and read the manual." Responses for symbol A varied from "Look out for broken pieces" and "Watch what you are doing" to "Watch arms for eye damage." Because of the eye shown in the symbol, most of the participants wrote their message in the context of watch, look, visual inspection. There were several responses that were correct, such as "Inspect lift for problems and maintenance" and "Give visual inspection of hoist before using." Symbol B seemed to indicate damaged lift more than periodic inspection required. Some example responses were, "Damaged equipment," "Do not use broken hoist," "Make sure you use a sign when hoist is broken." Very few people wrote the correct response for symbol C. Most participants (29 out of the 50) wrote responses such as "Wear a hard hat" or "Use proper safety equipment." Modifications for symbol A included replacing the eye with the more standard profile shown in the FMC manual, and using all four arms to avoid the interpretation of "missing parts."



Recommended Choice





- Experiment 2, Selection of Symbols and Text -

## TEXT RANKINGS

The preferred text is shown in italic print in the box. Shown with warnings #1, 4, 6, 10, and 12 are the responses in the selection task (the fourth part of Experiment 2), where participants chose their preferred words from a series of columns to create their own warning text. In bold print are the number of participants out of the 50 that chose that particular word.

### Warning #1 Description

Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for a vehicle to fall off a hoist and injure someone.

Candidate	Rank			Missing	Mean
	Best →		Worst		
	1	2	3		
A	37	9	4	0	1.34
B	8	30	12	0	2.08
C	5	11	34	0	2.58

Chi-Square=83, p<.001

### Alternative texts

- A. *Always secure vehicle with proper jack stands when removing or installing large components.*
- B. Always use jack stands when removing heavy objects from vehicle.
- C. Use jack stands when removing large components.

### Selection Task

34	50	18	49	23	33
(Always)	use	jack stands	when removing	large components	from vehicle
		safety stands		heavy objects	
		32		26	

Message=Always use safety stands when removing heavy objects from vehicle.

The overwhelming majority chose message A, even though it was the longest warning text. This may seem strange except that the warning chosen also happened to give the most pertinent instructions. Although the warning is long, the message it conveys is the most descriptive and accurate based on the warning description given. The instructions for this portion of Experiment 2 state to rank according to which text best describes the warning given, not which one is the shortest. Symbol A was modified to reflect the preference as stated in the selection task of safety stands over jack stands, and the word heavy rather than large components because the warning deals with a weight problem rather than a size problem. Finally, "use" was chosen as the verb to be consistent with other warnings.

### Recommended Choice

*Always use safety stands when removing or installing heavy components.*

**Warning #2 Description**

Always use proper vehicle spotting and manufacturer's recommended pickup points. If the proper places are not used, the vehicle will not be securely placed on the hoist and it could fall and cause serious injury. This is especially true for above-ground hoists where it is tempting to place the vehicle too far forward so the doors will clear the posts.

Candidate	Rank			Missing	Mean
	Best → Worst				
	1	2	3		
A	28	7	15	0	1.74
B	8	32	10	0	2.04
C	14	11	25	0	2.22

Chi-Square=41, p<.001

Again participants chose text A, the longest message, as the preferred choice by a statistically significant margin. However, as mentioned for warning #1 description, the information is more accurate than the others. Rather than simply stating designated pickup points or proper lift points, which can be vague, the preferred phrasing from text choice A was "manufacturer lift points." This information is critical to proper lifting procedures. Finally, since the intent was for the lift point to be used and not just examined, the verb "use" was substituted for "check."

**Alternative Texts**

- A. *Check vehicle manufacturer lift points before using hoist.*
- B. Lift vehicle using only designated pickup points.
- C. Raise vehicle at proper lift points.

**Recommended Choice**

*Use vehicle manufacturer's lift points.*

### Warning #3 Description

Do not stand under the hoist while it is raising or lowering the vehicle.  
If it falls, it could cause serious injury or death.

Candidate	Rank			Missing	Mean
	Best → Worst				
	1	2	3		
A	24	18	8	0	1.68
B	23	13	14	0	1.82
C	3	19	28	0	2.50

Chi-Square=31, p<.001

### Alternative Texts

- A. *Remain clear of hoist while raising or lowering vehicle.*
- B. Stay clear of hoist when operating.
- C. Don't stand under hoist while raising or lowering.

Symbol A was again chosen as the preferred text by almost half of the participants, and the difference was statistically significant. This warning is the longest, but similar to the preferred text for warnings #1&2, the information is more specific. The phrase "remain clear" is more specific and accurate than "Don't stand under" which only specifies a limited region of the lift. Likewise, the phrase "while raising or lowering vehicle" is more accurate than "when operating" because these are the specified times to remain clear. If the mechanic stayed clear when operating he would never get under the lift. As was the case for several warnings, "lift" was substituted for "hoist" to provide a more accurate description of the equipment.

### Recommended Choice

*Remain clear of lift while raising or lowering vehicle.*

**Warning #4 Description**

Do not excessively shake the vehicle while it is on the hoist. It might fall and injure someone.

Candidate	Rank			Missing	Mean
	Best → Worst				
	1	2	3		
A	21	20	9	0	1.76
B	12	21	17	0	2.10
C	17	9	24	0	2.14

Chi-Square=14, p<.006

**Alternative Texts**

- A. *Do not shake vehicle in raised position.*
- B. Never rock vehicle while up on hoist.
- C. Keep vehicle stable when raised on hoist.

**Selection Task**

9	Don't		31	rock(ing)		44	vehicle		46	while on hoist
14	Never		17	shake(ing)		5	car			
27	Avoid (excessive)		1	jolt(ing)						
			1	jounce(ing)						

**Message**=Avoid excessive rocking of vehicle while on hoist.

Although alternative text A was chosen as the preferred text, the results from the selection task summarized above conflict with the wording of A. Notice the verb "shake" in alternative text A, while the term preferred above was "rock." It is important to include the term "excessive" because some rocking may be needed to check lift point engagement. However, the three alternative texts in the ranking task do not correspond very well with the word choices given in the selection task. Therefore, comparing the word selections when the phrasing and context is different between the two tasks is very difficult. However, for the recommended choice from the selection task, the phrase rock indicates a more serious condition than shake, which could be no more than normal vibrations that occur while working on a vehicle. Thus, the recommended choice is the preferred choice from the selection task.

**Recommended Choice**

*Avoid excessive rocking of vehicle while on lift.*

- Experiment 2, Selection of Symbols and Text -

Warning #5 Description

If the vehicle starts to fall, run away to avoid being struck by it.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	27	12	11	0	1.68
B	16	16	18	0	2.04
C	7	22	21	0	2.28

Chi-Square=18, p<.001

Alternative Texts

- A. *Clear area if vehicle is in danger of falling.*
- B. Run away if vehicle starts to fall.
- C. Leave area immediately should vehicle start to fall.

Alternative text A was preferred by an overwhelming margin and the difference between choices were statistically significant. The phrase "clear area" is more specific than text B's phrase "run away." The phrase "in danger of falling" for text A is more appropriate than "if vehicle starts to fall" or "should vehicle start to fall" because it gives the warned user time to react. When a vehicle is already falling it may be too late.

Recommended Choice

*Clear area if vehicle is in danger of falling.*

- Experiment 2, Selection of Symbols and Text -

**Warning #6 Description**

Keep feet from underneath the hoist while the hoist is being lowered so they will not be crushed.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	19	22	9	0	1.80
B	23	9	18	0	1.90
C	8	19	23	0	2.30

Chi-Square=19, p<.001

**Alternative Texts**

- A. *Keep feet clear of hoist while lowering.*
- B. Stand clear of vehicle when it is being lowered.
- C. Keep feet from under hoist frame when lowering vehicle.

**Selection Task**

28		15		13
Keep		feet clear of hoist		while moving
Stand		clear		while lowering
22		35		36

**Message=Keep clear while lowering.**

The preferred alternative text A corresponded well with the preferred text in the matching task. Although "keep feet clear" is more specific than simply "keep clear" or "stand clear" it reflects the intended message of the warning description. Therefore, no changes were made to the preferred text choice.

**Recommended Choice**

*Keep feet clear of lift while lowering.*

- Experiment 2, Selection of Symbols and Text -

Warning #7 Description

Unauthorized people are not allowed in the hoist area. They could get hurt.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	34	9	6	1	1.43
B	9	20	20	1	2.22
C	6	20	23	1	2.35

Chi-Square=44, p<.001

Alternative Texts

- A. *Authorized personnel only.*
- B. Customers not allowed in service area.
- C. Unauthorized persons please stay clear.

The preferred choice, text A, was chosen by 34 out of the 50 participants. This strong preference coupled with a concise and accurate message made it the recommended choice as well.

Recommended Choice

*Authorized personnel only.*

**- Experiment 2, Selection of Symbols and Text -**

**Warning #8 Description**

No one other than the trained operator should operate the hoist.  
Someone who is inexperienced might get hurt.

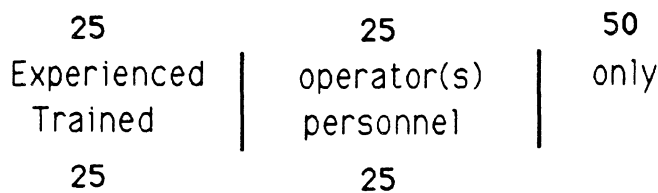
Candidate	Rank			Missing	Mean
	Best →		Worst		
	1	2	3		
A	33	7	9	1	1.51
B	11	17	21	1	2.20
C	5	25	19	1	2.29

Chi-Square=42, p<.001

**Alternative Texts**

- A. *Hoist to be used by authorized personnel only.*
- B. Trained personnel only.
- C. Experienced personnel only.

**Selection Task**



Message=Experienced operator only.

Alternative text A was the preferred text by a large percentage (33 out of 50), and the differences between alternatives were statistically significant. Note, however, that the selection task choices corresponding to B and C in the alternative texts were not well represented in the ranking task. In comparison to the previous warning description (#7), the texts sound very similar. It should be noted that the critical difference between these two warnings is that in warning #7 unauthorized people are not allowed in the area, while in warning #8 unauthorized people (or inexperienced) are not allowed to use the lift. To avoid confusion, the term "trained operator" was chosen. Also, the beginning of alternative text A "Hoist to be used" is essential for the meaning of the message. As previously noted, "lift" was substituted for "hoist" to improve accuracy.

**Recommended Choice**

*Lift to be used by trained operator only.*



- Experiment 2, Selection of Symbols and Text -

Warning #9 Description

Use of auxiliary adapters may affect the capacity of the hoist, so that it will not be able to lift as much. If the vehicle with adapters attached exceeds the weight capacity of the hoist, the vehicle could fall.

Candidate	Rank			Missing	Mean
	Best →		Worst		
	1	2	3		
A	20	15	14	1	1.88
B	20	14	15	1	1.90
C	9	20	20	1	2.22

Chi-Square=7, p<.113

Alternative Texts

- A. *Auxiliary adapters may affect load capacity.*
- B. Check lift capacity when adapters are in use.
- C. Do not overload hoist auxiliary adapters.

Alternative text A was chosen by a slim margin. The Chi-Square statistic was not significant. However, alternative A does state clearly and concisely the intended message of the warning description. Therefore the recommended choice, alternative text A, is shown with no modifications.

Recommended Choice

*Auxiliary adapters may affect load capacity.*

**- Experiment 2, Selection of Symbols and Text -**

**Warning #10 Description**

Some vehicles may require use of extenders for proper lifting. If extenders are not used the car would not be securely placed on the lift, and could fall off.

Candidate	Rank			Missing	Mean
	Best →		Worst		
	1	2	3		
A	24	6	20	0	1.92
B	17	15	18	0	2.02
C	9	29	12	0	2.06

Chi-Square=25, p<.001

**Alternative Texts**

- A. *Extenders must be used on vehicles requiring them to ensure safety.*
- B. Use extenders when required.
- C. Use extenders when necessary to stabilize vehicle on hoist.

**Selection Task**

50 Use	10 extenders 7 extentions 33 adapters	12 if 38 when	21 required 29 necessary
--------	---	------------------	-----------------------------

**Message=**Use adapters when necessary.

While the alternative texts A and B were very close in their mean ranks, the differences between candidates were statistically significant. However, when looking at the preferred message from the selection task, the language corresponds much more closely to text B. Notice the strong word selection "adapters" instead of "extenders." Although extenders and adapters are different apparatuses used for different purposes, many of the participants seemed to get them confused and would often interchange the meanings in warning #9 and #10. (Adding the word "height" should reduce the confusion.) The authors used the word adapters in the selection task to see how many participants would make that choice even though it is incorrect. The recommended choice was modified from texts A and B incorporating the preferred word choice "necessary" for "required."

**Recommended Choice**

*Use height extenders when necessary to ensure good contact.*

- Experiment 2, Selection of Symbols and Text -

Warning #11 Description

Do not exceed the weight capacity of the hoist. If the hoist is overloaded it could fail unexpectedly and injure someone.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	24	19	7	0	1.66
B	14	19	17	0	2.06
C	12	12	26	0	2.28

Chi-Square=18, p<.001

Alternative Texts

- A. *Do not exceed weight capacity.*
- B. Do not overload hoist.
- C. Check lift capacity before lifting.

Alternative A was the preferred choice in the ranking task, and the differences between choices were statistically significant. Because of its high ranking and concise message, no modifications were made to the recommended choice.

Recommended Choice

*Do not exceed weight capacity.*

- Experiment 2, Selection of Symbols and Text -

Warning #12 Description

Read the Automotive Lift Institute safety manual, the safety tips card, and all other lift-related printed material before operating the hoist.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	22	16	12	0	1.80
B	19	21	10	0	1.82
C	9	13	28	0	2.38

Chi-Square=19, p<.001

Alternative Texts

- A. *Follow instructions in ALL safety manual when operating hoist.*
- B. Read safety manual before operating lift.
- C. Know all proper lifting methods before using this equipment.

Selection Task

50	18	36	50	33
Read	safety	manual	before	use(ing)
	operating	instructions		hoist operation
	34	14		17

Message=Read operating manual before using.

The rankings for alternative text A and B were very close, though there were statistically significant differences between all three. In the selection task, strong preferences are indicated for "operating" instead of "safety" and "manual" instead of "instructions." Also, "using" was preferred over "operating." Finally, because the operating and safety manuals are quite distinct, both were listed. Also, the word "lift" was substituted for "hoist" for accuracy. Alternative text B was modified accordingly to give the recommended choice as shown.

Recommended Choice

*Read operating and safety manuals before using lift.*

Warning #13 Description

Do not operate the hoist if any part is not working properly.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	27	7	16	0	1.78
B	19	22	9	0	1.80
C	4	21	25	0	2.42

Alternative Texts

- A. *Hoist and components must be in proper working order before using.*
- B. Do not operate a damaged hoist.
- C. Do not use faulty equipment.

Chi-Square=33, p<.001

The alternative texts A and B were very close in the ranking task. Either one could be used as an acceptable warning message. Text A shows the positive side of the message by stating "must be in proper working order," while text B uses "Do not" indicating a negative message. Because the symbol corresponding to this warning (developed independently) indicates a negative message by the slash through a broken lift, the corresponding message should be negative as well. Therefore alternative text B is the recommended choice for this warning, though modified (substituting "lift" for "hoist") to be more accurate.

Recommended Choice

*Do not operate a damaged lift.*

Warning #14 Description

Periodic inspection and maintenance of this hoist is required. If this is not followed the hoist could malfunction. Consult the owner's manual for proper maintenance procedures.

Candidate	Rank			Missing	Mean
	Best	→	Worst		
	1	2	3		
A	24	8	18	0	1.88
B	12	23	15	0	2.06
C	14	19	17	0	2.06

Chi-Square=13, p<.014

Alternative Texts

- A. *Proper maintenance and inspection necessary for safe operation.*
- B. Periodic inspection is required.
- C. Service hoist regularly.

Alternative text A was the preferred choice by a statistically significant margin, almost 2:1 over the second choice. Although it was the longest text of the alternatives it was the only one that included "maintenance and inspection" in the phrasing. Both of these are essential to the meaning of the warning. Thus, the alternative text A was chosen as the recommended choice with no modifications.

Recommended Choice

*Proper maintenance and inspection necessary for safe operation.*

## CONCLUSIONS

Although the recommended texts and symbols were described in the results section previously, those recommendations are incomplete. Also needed are recommendations for the size of the warning symbols and the letters, graphical improvements, location, and the positioning and grouping of the warning elements. The authors do not recommend that the warnings be cut directly out of this report and plastered over garages around the country, but that some thought be given to their placement and grouping.

### What Symbols and Text Are Recommended?

The warning messages closely follow standard industry practice in format as outlined in the FMC manual. By using these guidelines, warning signs containing three parts were developed. The top part of each sign was the signal word (Warning, Caution, Notice) based on the severity of the implications.

Underneath the signal word was a symbol. The recommended symbol for each warning was usually the first choice in both the response and ranking tasks. In Experiment #2, only 3 of the 14 warnings had recommended symbols that were not #1 in both tasks (Warnings #4, 9, & 13). This suggests that most participants agreed on which symbols they preferred and which they didn't. It is very important that the symbols be shown with the text because understanding of the symbols by themselves is poor (e.g., Warning #8-trained operator only) because some ideas are difficult to represent graphically.

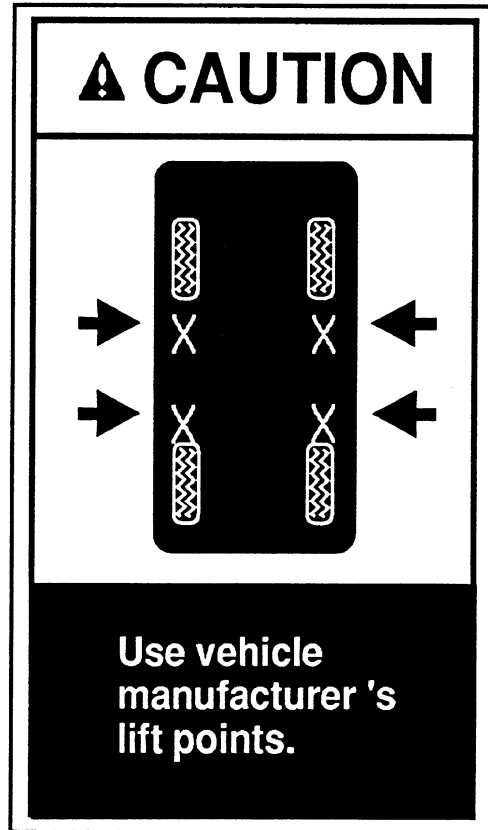
The text messages chosen by the participants were usually the longest ones in the list, contrary to what is usually recommended (ANSI Z35.1, Westinghouse Product Safety Handbook, FMC manual), as discussed in the results section of Experiment 2. However, these sources do say that the messages should contain the action or preventionary measures needed to avoid the hazard so making a warning message shorter does not necessarily mean better. Modifications were made to warnings #1-Use jack stands, 10-Use extenders when necessary, 12-Read manual, and 13-Lift must be in proper working order before using, in order to clarify and simplify the language as based on the data from the participants' responses and the recommendations from the literature.

Warnings can be either vertical or horizontal in format, with the selection of format depending mainly on the space available. For example, it makes the most sense to use a horizontal layout on a horizontal cross member of an above-ground lift.

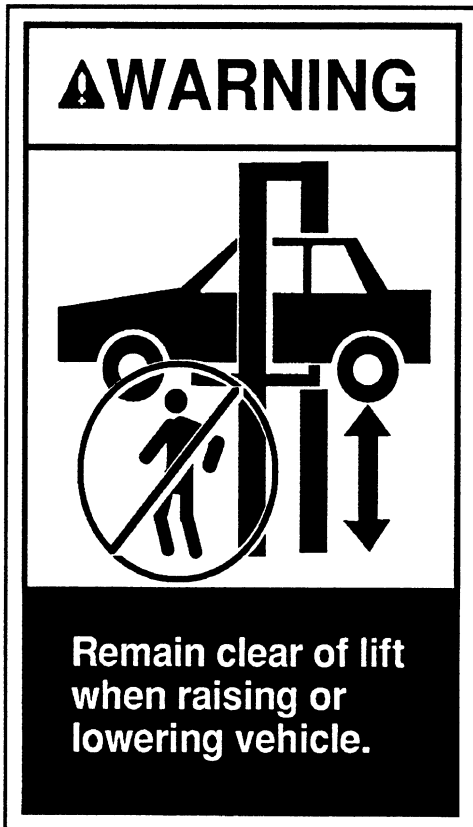
The recommended symbols and texts are as follows:



Warning #1



Warning #2



Warning #3

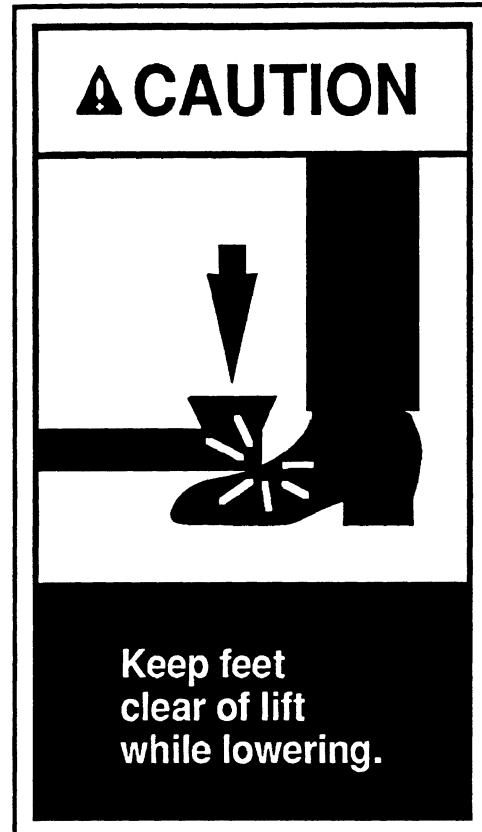


Warning #4





Warning #5



Warning #6



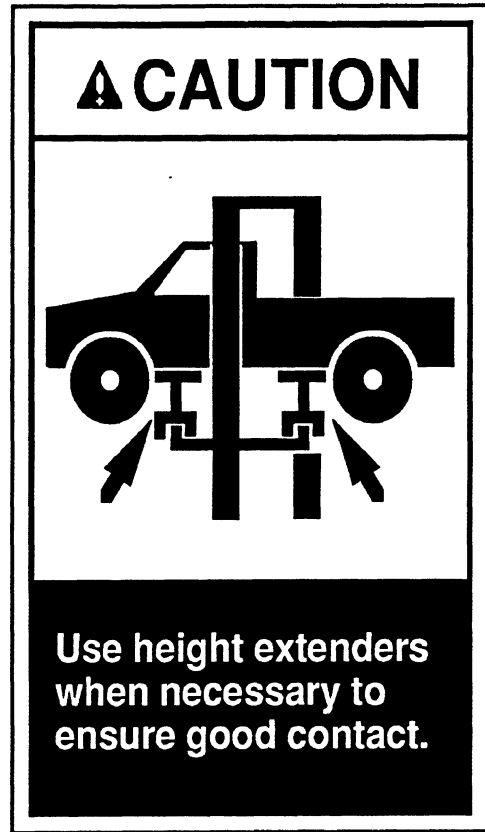
Warning #7



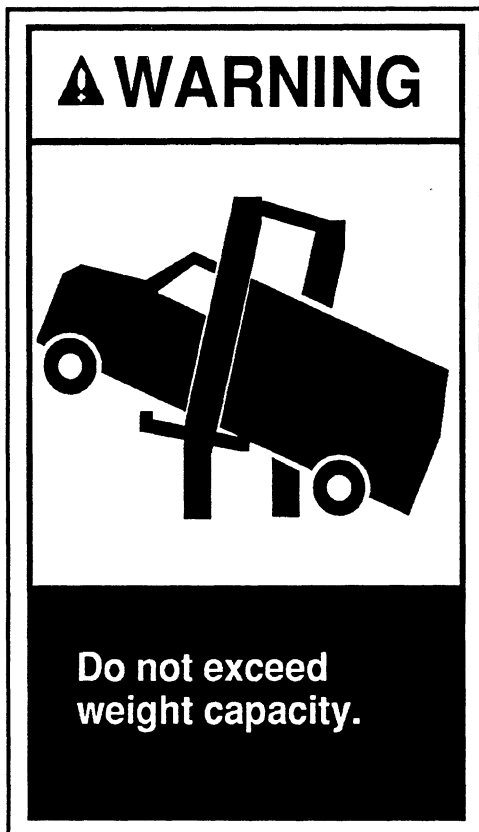
Warning #8



Warning #9



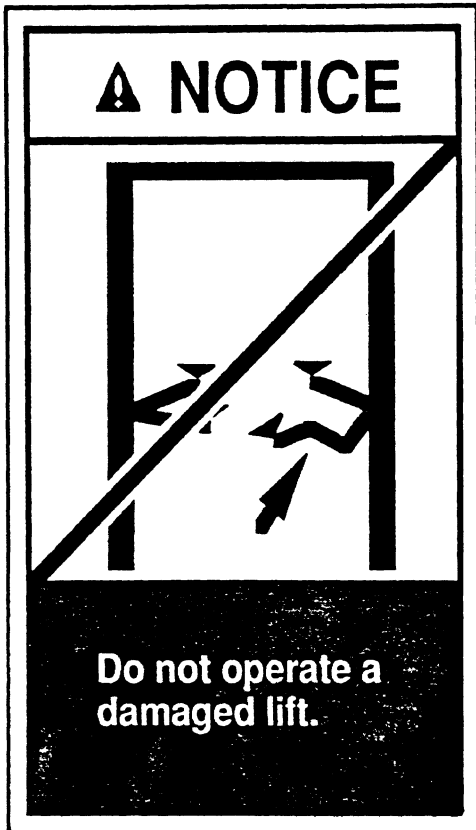
Warning #10



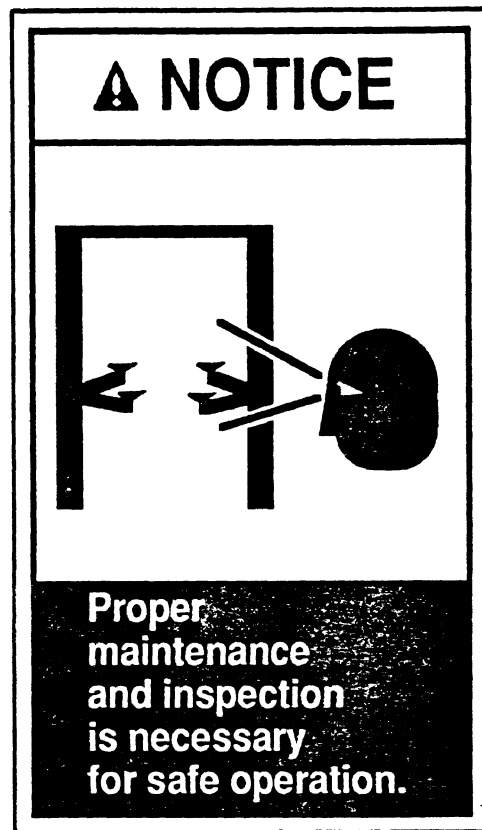
Warning #11



Warning #12



Warning #13



Warning #14

### How Big Should the Warnings Be?

The FMC manual gives standard label proportions based on the size of the symbol. All of the signal words are shown in Helvetica Bold type, 36 point, a very legible font. The messages are also in Helvetica Bold type, 18 point. (Note: One point is about 1/72 of an inch, so 18 point corresponds to 1/4 inch.) The text is written white-on-black and left-justified, as that has proven to be the easiest to read (FMC, 1985; Westinghouse Product Safety Label Handbook).

These recommendations lead to the following sign sizes:

**Table 2. Size Recommendations from FMC Manual**

#### Vertical Format

total warning size-	3"x5"
signal word panel-	3"x1"
symbol panel-	3"x2.75"
message panel-	3"x1.25"

The size required should be based on the viewing distance. Shown in Table 3 are the likely locations for each warning, where the warning must be seen from, a worst case viewing distance, and a recommended size based on the James Bond Rule (Smith, 1979). The Bond Rule is a well accepted rule of thumb for determining character sizes. In brief, it states that the height of a character divided by its viewing distance should be greater than or equal to .007, the identification code for the fictitious agent. That is:

$$\frac{\text{Height}}{\text{Viewing Distance}} \geq .007$$

This rule is quite conservative, generating character size recommendations that are often much larger than other procedures. In this case, it is better to err in the direction of characters that are larger than the absolute minimum.

**Table 3. Character Size and Location Recommendations**

Message	Location	Viewing Distance	Size	Type
1. Jack Stands	control panel	28 in	.2 in	Caution
2. Pick Up Points	control panel	28 in	.2 in	Caution
3. Don't Stand Under	control panel	28 in	.2 in	Warning
4. Don't Shake	control panel	28 in	.2 in	Warning
5. Run Away	control panel	28 in	.2 in	Warning
6. Keep Feet Clear	control panel	28 in	.2 in	Caution
7. Unauthorized	control panel	28 in	.2 in	Caution
8. Trained Oper Only	control panel	28 in	.2 in	Caution
9. Use Adapters	control panel	28 in	.2 in	Caution
10. Use Extenders	control panel	28 in	.2 in	Caution
11. Don't Overload	control panel	28 in	.2 in	Warning
12. Read Manual	control panel	28 in	.2 in	Notice
13. Don't Op If Broken	control panel	28 in	.2 in	Notice
14. Periodic Inspection	control panel	28 in	.2 in	Notice

The key to coming up with size recommendations is deciding where the sign will be and the worst case location for the observer. All of the messages need to be seen by a worker using a lift. (While message 7 could be intended for the customer, here the message is for the lift operators.) But finding a location where they can be seen (and properly illuminated) while underneath a lift is quite difficult. Rather, it is more appropriate to put the warning at a location where the worker would be when planning a lift, at the control box. If one assumes the worker operates the controls from the standard instrument panel viewing distance, 28 inches, the required height for characters is about .2 inches (actually .196 inches according to the Bond Rule). (Most likely, the worker will stand closer.) Thus, meeting the FMC size requirements will also cause the Bond Rule requirements to be met.

Warning placement was an issue raised by participants. Many felt that warnings placed directly on the lift would either be painted over, wear off with use, or become unrecognizable with dirt and film residue. A few expressed concern over the number of warnings provided in the experiment. They said too many warnings plastered everywhere would not be as beneficial as a few strategically placed.

While messages 12-14 are not used during a particular phase of lift use, placing them on the control panel is appropriate for them as well since they are likely to be seen there. Thus the size recommendations for messages 8-14 are the same as those for 1-6.

With regard to grouping, messages can be displayed singly or, space permitting, could be combined into four placards. They are: a Caution placard on the

- Conclusions -

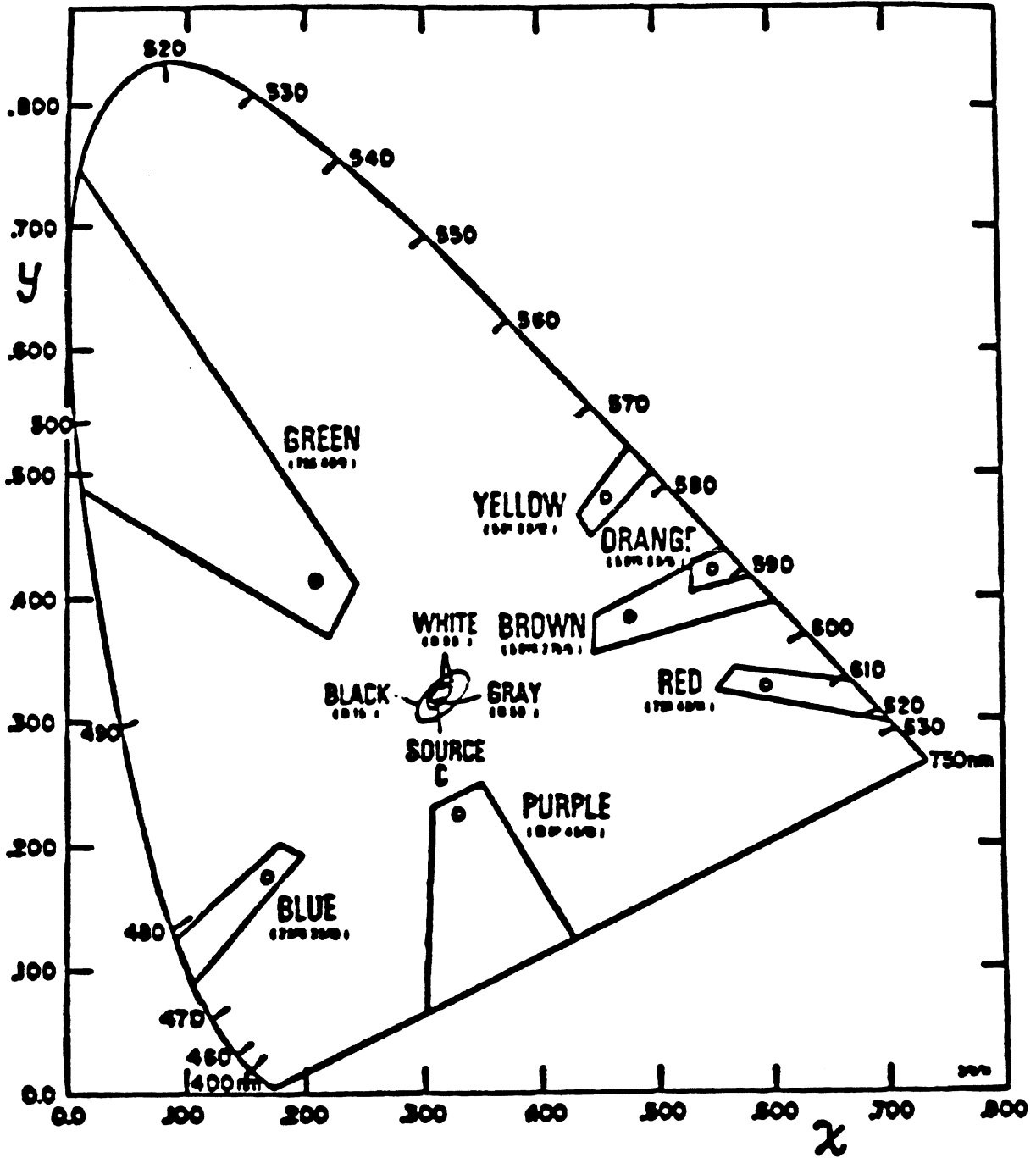
control panel (jack stands, keep feet clear, trained operator only, use adapters, use extenders), a Notice placard on the control panel (pick up points, read manual, don't operate if broken, periodic inspection), a Warning placard on the control panel, (don't stand underneath, don't shake, run away, don't overload), and a Caution placard either overhead or on the posts (unauthorized).

**What Colors Should the Signs Be?**

Each warning should have a signal word in black lettering on a color-coded background. These colors should correspond to the signal word, orange-Warning, yellow-Caution, blue-Notice. According to ANSI Z535.1 the colors should be as shown in Table 4 and Figure 8. The symbols should be black on a white background, the text warning white on black. Those colors are also given in Table 3 and Figure 3.

**Table 4. Colors Defined by ANSI Z535.1**

Color	Boundary with	Equation in CIE 1931 Chromaticity Diagram
Safety Orange	Red	$y = .2678 + .2545x$
	White	$x = .5331$
	Yellow	$y = 0.3722x + .2301$
Safety Yellow	Orange	$y = 0.9837 + 0.0112x$
	White	$y = 1.1007 + 1.4631x$
	Green	$y = 1.2183x - 0.0615$
Safety Blue	Green	$y = 0.8725x + 0.0457$
	White	$y = 0.2852 - 0.4696x$
	Purple	$y = -1.1134x - 0.0290$
Safety White		see Figure
Safety Black		see Figure



NOTE: The small circles identify the chromaticities of the standard colors.

Figure 8. CIE 1931 Chromaticity Diagram Showing Color Codes

## **Closing Thoughts**

This report demonstrates how one should go about developing and evaluating a set of text and symbolic messages. One begins by trying to identify who the users are and what they do. Subsequently, one then probes the users for specific suggestions for warning text and symbols using the population stereotype method. At that point, candidate messages are developed and tested for their appropriateness and understandability using empirical tests with real users. Finally, based on those tests, warnings are modified where necessary and standard messages are developed.

If the authors were to do this study again, there are two aspects they would give greater emphasis. First, the skills of an illustrator should be brought into play after the population stereotype study, not after the field evaluation as was done here. Second, the authors would rely much more on the "build-a-message" procedure for identifying the most appropriate text message for selecting a recommended message rather than giving people a limited set from which to select. The build-a-message task was an experimental procedure that was thought to be too difficult for people to do. It was not, but should be, a contributing factor for determining text message appropriateness in future studies.

- Conclusions -



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## **APPENDIX A FOCUS GROUP**

This appendix contains the subject consent form that was used for the focus group session. It also contains a list of the questions that were used to guide the focus group discussion. The subject consent form is normally printed on UMTRI letterhead paper.

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INTERVIEW OF AUTOMOTIVE LIFT USERS ABOUT WARNING LABELS  
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**SUBJECT CONSENT FORM**

The purpose of this research is to develop warning messages for automotive lifts (service-station car hoists), and then test these messages to verify that automotive lift users understand them.

As part of the project we will interview a few typical users such as yourselves to get a better understanding of who the users are. We are interested in any information you can tell us about warnings that already exist for automotive lifts and also, if you know of anyone who has been in an accident involving an automotive lift. Your responses will be kept confidential.

We will need to audiotape a few people participating in this experiment. If this is asked of me, I do/do not (circle one) consent to my being audio-taped during this experiment.

-----  
I have read and understand the information above.

\_\_\_\_\_  
print your name

\_\_\_\_\_  
date

\_\_\_\_\_  
sign your name

\_\_\_\_\_  
witness (experimenter)





## DEVELOPMENT AND TEST OF WARNING LABELS FOR AUTOMOTIVE LIFTS

### Interview questions for the potential users of automotive lifts.

Start the conversation with introductions. Ask them their names and what they are doing now. Keep the conversation informal. Assure the operators that their employers will not get any information we discuss. Let them know we will be taping the discussion. Dress casually, and interact on their level. Try to avoid flowery language.

An example of the conversation starter could be as follows:

Hi, my name is Julie Eberhard, and I am a student at the University of Michigan (other introductions). After introductions, we could ask: "What do you do now?" Try to get a feel for their daily/weekly routine. After we get a sense of their background we can start the questions. Depending on their answers, elaborate or switch questions as appropriate.

#### OPERATORS

1. How long have you been using garage hoists?
2. How did you learn how to use a hoist?
3. Is safety an important factor in your work?  
If so, how much? (Very important, moderately important, of little or no importance)-personal and corporate
4. Are you supposed to wear safety equipment on the job?  
What kind?
5. Have you ever been hurt using hoists? If yes, please describe.
6. Do you know of anyone who has been hurt using a hoist?  
What happened?
7. What kinds of injuries are likely to result from using hoists?

#### WARNINGS

8. Have you noticed any warnings on the hoists you use?  
What did they say?
9. When did you first see the warnings? What grabbed your attention?
10. What type of warnings do you feel are easiest to understand; words, pictures, color, etc.?

**LIFT DESIGN**

11. Who showed you how to use the hoist you currently use most often?  
How did you get your training?
12. What did they say about safety?
13. Have you ever seen or read the operating instructions?
14. What could be done to improve the design of hoists?
15. What kinds of problems do you have using them?
16. Who makes the best hoists? the worst? What makes them the best or worst?
17. How often does the hoist need repair?
18. What do you do? How often do you use the hoist?
19. What kind of hoists do you use? above ground or below?

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## **APPENDIX B EXPERIMENT 1**

This appendix contains the subject consent form and biographical data form that were used for the first experiment. The subject consent form is normally printed on UMTRI letterhead paper. The same biographical data form was used for both the first and second experiments. This appendix also contains the data sheets used by subjects to record their responses. Finally, this appendix contains the raw symbols and text warnings produced by subjects.

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DEVELOPMENT OF WARNING LABELS FOR AUTOMOTIVE LIFTS

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**SUBJECT CONSENT FORM**

The purpose of this research is to develop warning messages for automotive lifts (garage hoists), and then test these messages to verify that users understand them. Since you and your colleagues are the kinds of people these warnings are being designed for, it is important we get your input.

You will be given a general description of 14 warnings and then asked to restate each warning in your own words. In addition, you will be asked to draw a picture to represent each warning. You will also be asked to fill out a biographical data sheet (name, age, etc.).

This will take about 30-45 minutes. You can withdraw from this experiment at any time. We cannot think of any hazards you might be exposed to in this experiment.

---

I have read and understand the information above.

\_\_\_\_\_

print your name

\_\_\_\_\_

date

\_\_\_\_\_

sign your name

\_\_\_\_\_

witness (experimenter)



**BIOGRAPHICAL DATA SHEET  
WARNING LABELS FOR GARAGE HOISTS**

Subject # \_\_\_\_\_  
Experimenter \_\_\_\_\_  
Date&Time \_\_\_\_\_  
Site \_\_\_\_\_  
# \_\_\_\_\_

1. Name: \_\_\_\_\_
2. Sex: *male*    *female*    (circle one)
3. Occupation: \_\_\_\_\_
4. Age: \_\_\_\_\_
5. Did you graduate from:  
    (circle the highest level completed)  
  
    *grade school*    *junior high*    *high school*  
    *trade school*    *college*
6. How long have you operated a lift? (yrs) \_\_\_\_\_
7. What type of garage hoist do you currently use?  
    (circle all that apply)  
  
    *in ground -*            *axle-engaging (fore-aft post)*  
                              *frame-engaging (side-by-side or 1 post)*  
                              *runway (drive-on, single post)*  
                              *rocker panel (pad)*  
  
    *above ground -*        *two-column drive-through*  
                              *four-column (runway)*  
                              *short-rise*
8. Describe any injuries relating to hoists, you have had on the job:  
\_\_\_\_\_  
\_\_\_\_\_
9. Describe any injuries that you know others have had:  
\_\_\_\_\_  
\_\_\_\_\_
10. How did you learn to operate the lift you currently use? (circle all that apply)  
  
*lift service personnel*    *manual*    *experienced operator*    *friend*    *other*  
If other, please explain: \_\_\_\_\_
11. Are there any warning labels on the hoist you use most often? If so, what do they say: \_\_\_\_\_
12. What does ALI stand for? \_\_\_\_\_
13. Comments: \_\_\_\_\_





# DEVELOPMENT AND TEST OF WARNING LABELS FOR GARAGE HOISTS

## INSTRUCTIONS

This experiment is concerned with developing warning signs and symbols that will be used for above ground garage hoists. It is critical that the warning signs and symbols on them be legible and understandable. Since you use hoists, your input is very important.

On the following pages are general and specific warnings related to hoists. For each warning, write down what you think the sign should say. Be brief. Also, draw a picture that represents the warning. Keep the drawings simple, and avoid using words or letters that are language specific. Don't worry if your drawings are crude.

### Example:

**The message is:** Do not mix together substances marked as flammable.

**The sign should say:**

**Explosive if combined**

**The picture should look like:**





## Specific Warnings

1. **The message is:** Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for the vehicle to fall off a hoist and injure someone.

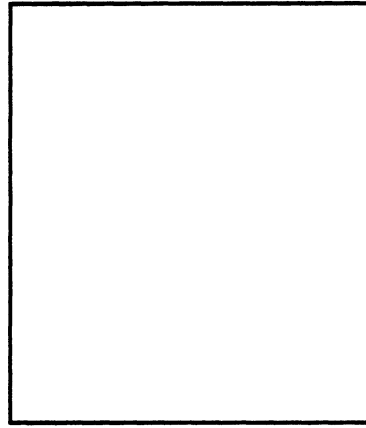
**The sign should say:**  
(in your own words, be brief!)

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**The picture should look like:**



2. **The message is:** Always use proper vehicle spotting and manufacturer's recommended pickup points. If the proper places are not used, the vehicle will not be securely placed on the hoist and it could fall and cause serious injury. This is especially true for above ground hoists where it is tempting to place the vehicle too far forward so the doors will clear the posts.

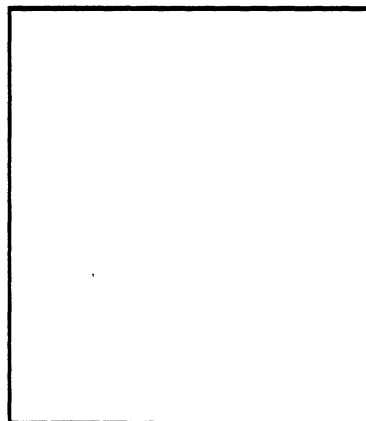
**The sign should say:**

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**The picture should look like:**



3. **The message is:** Do not stand under the hoist while it is raising or lowering the vehicle. If it falls, it could cause serious injury or death.

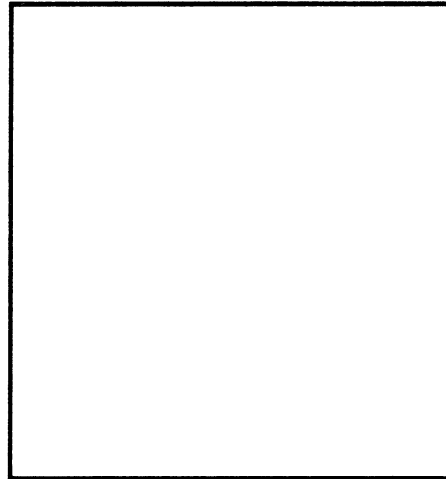
**The sign should say:**

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**The picture should look like:**



4. **The message is:** Do not excessively shake the vehicle while it is on the hoist. It might fall and injure someone.

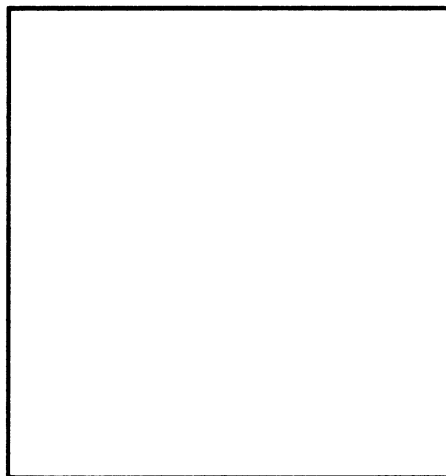
**The sign should say:**

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**The picture should look like:**



5. **The message is:** If the vehicle starts to fall, run away to avoid being struck by it.

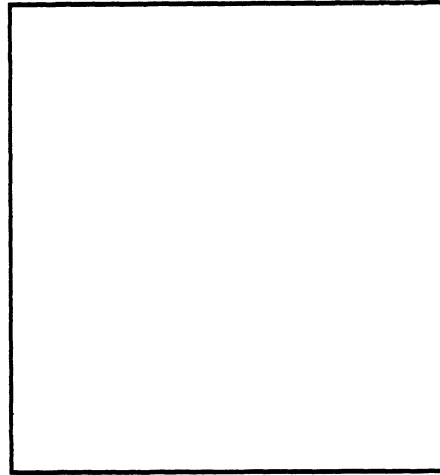
**The sign should say:**

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**The picture should look like:**



6. **The message is:** Keep feet from underneath the hoist while the hoist is being lowered so they will not be crushed.

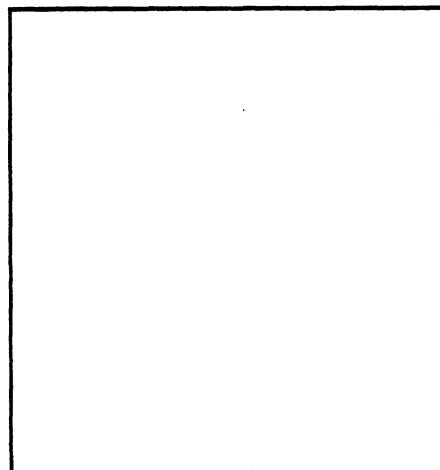
**The sign should say:**

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**The picture should look like:**



7. **The message is:** Unauthorized people are not allowed in the hoist area.  
They could get hurt.

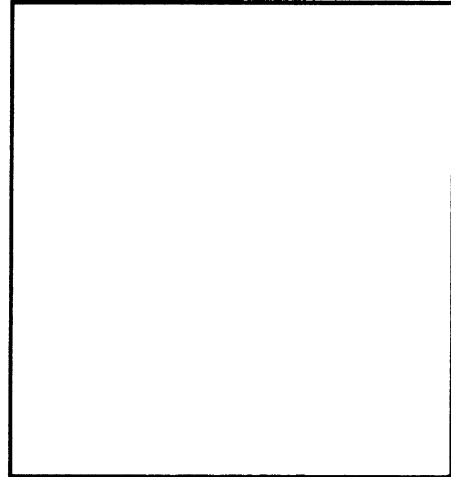
**The sign should say:**

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**The picture should look like:**



8. **The message is:** No one other than the trained operator should operate the hoist. Someone who is inexperienced might get hurt.

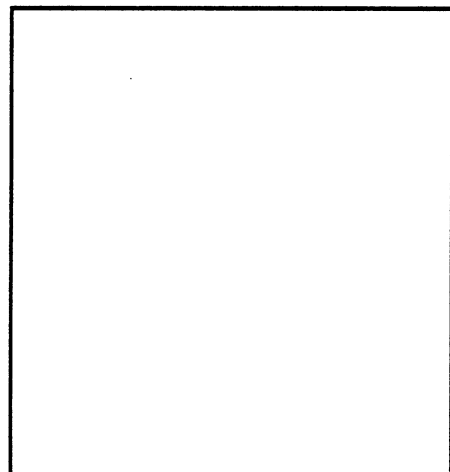
**The sign should say:**

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**The picture should look like:**



9. **The message is:** Use of auxiliary adapters may affect the capacity of the hoist, so that it will not be able to lift as much. If the vehicle with adapters attached exceeds the weight capacity of the hoist, the vehicle could fall.

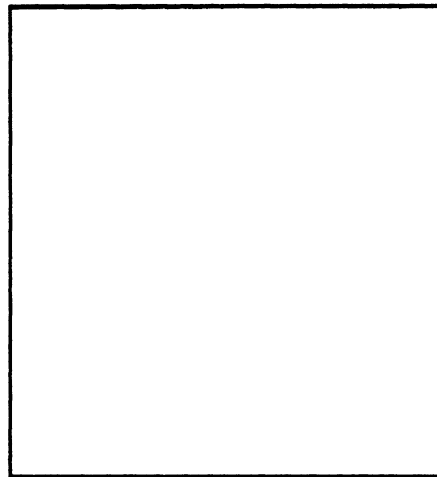
**The sign should say:**

---

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**The picture should look like:**



10. **The message is:** Some vehicles may require use of extenders for proper lifting. If extenders are not used the car would not be securely placed on the lift, and could fall off.

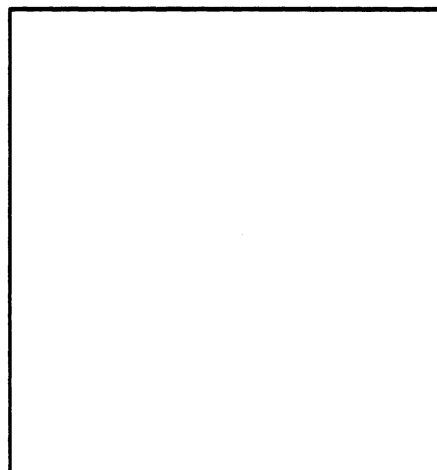
**The sign should say:**

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---

---

**The picture should look like:**



**11. The message is:** Do not exceed the weight capacity of the hoist. If the hoist is overloaded it could fail unexpectedly and injure someone.

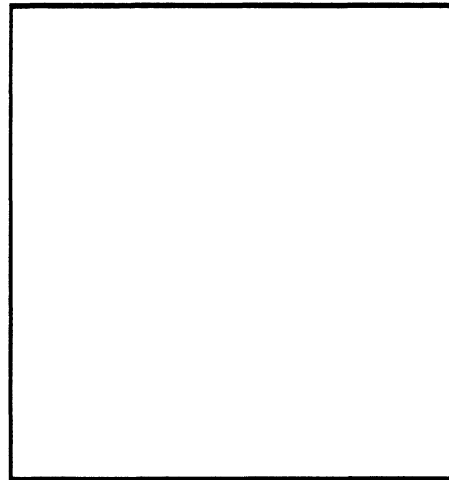
**The sign should say:**

---

---

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**The picture should look like:**





## General Warnings

12. **The message is:** Read the Automotive Lift Institute safety manual, the safety tips card, and all other lift-related printed material before operating the hoist.

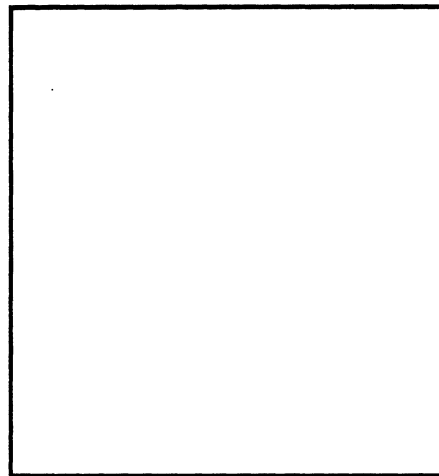
**The sign should say:**

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**The picture should look like:**



13. **The message is:** Do not operate the hoist if any part is not working properly.

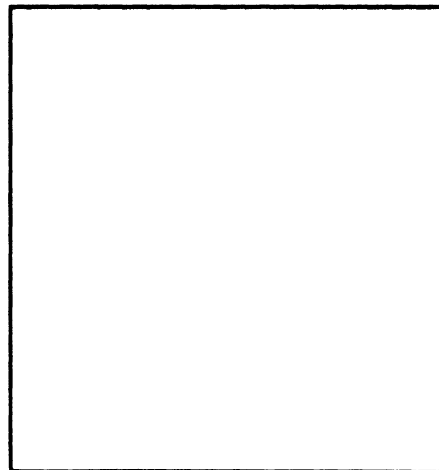
**The sign should say:**

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**The picture should look like:**



14. **The message is:** Periodic inspection and maintenance of this hoist is required. If this is not followed the hoist could malfunction. Consult the owner's manual for proper maintenance procedures.

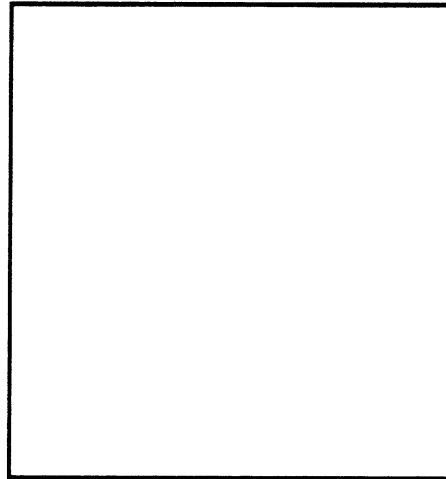
**The sign should say:**

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**The picture should look like:**



- Appendix B - Experiment 1 -

Are there other warnings that should be present?  
What should it say, and what should the picture look like

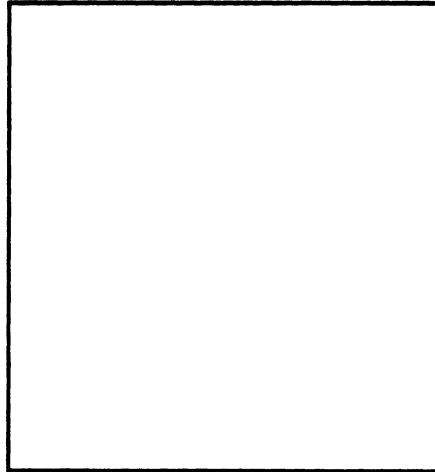
**The sign should say:**

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**The picture should look like:**



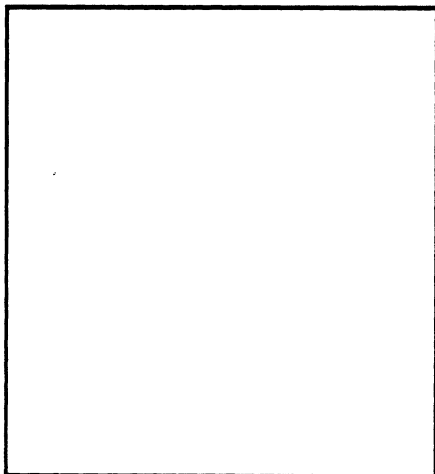
**The sign should say:**

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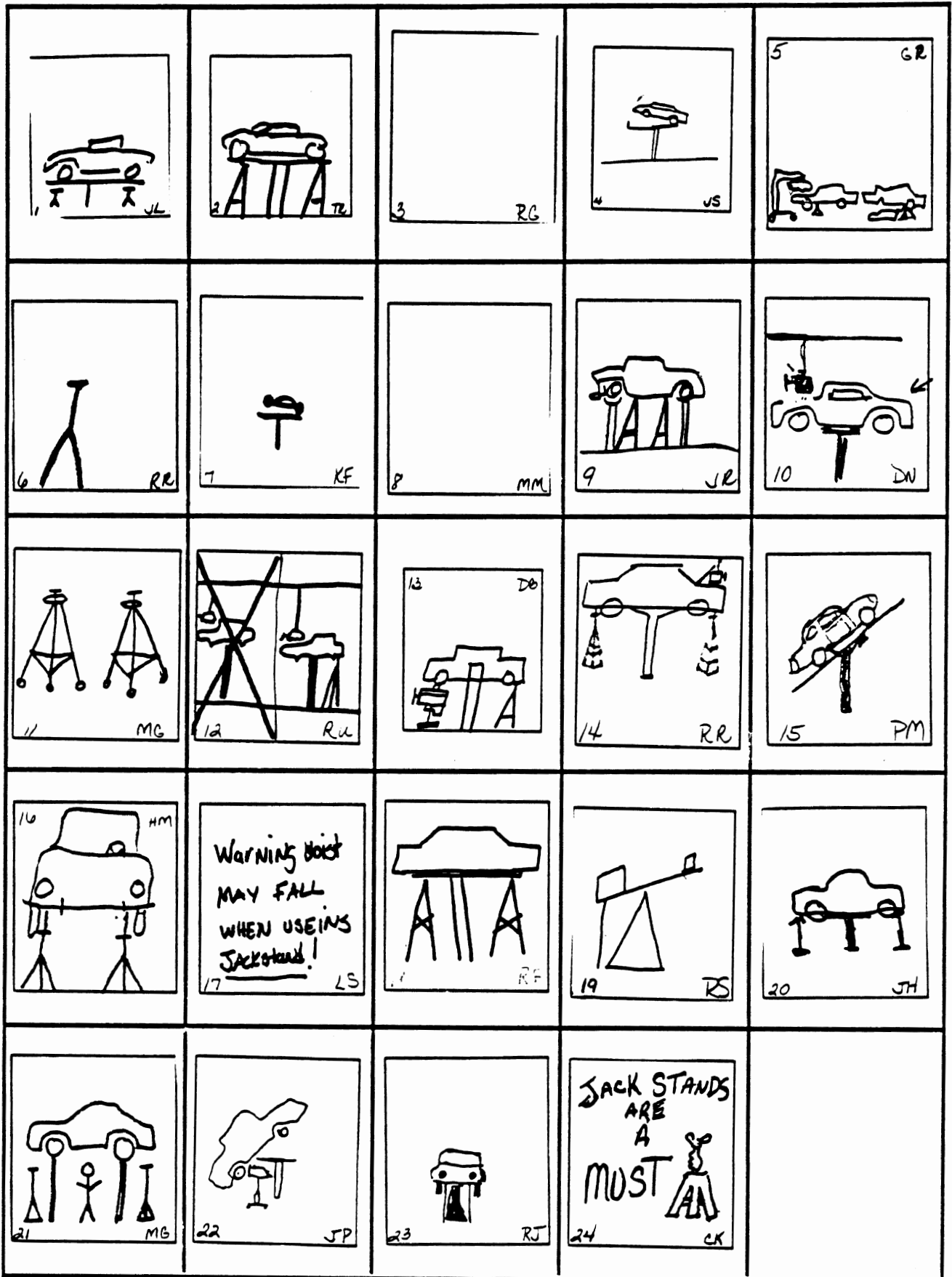
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**The picture should look like:**

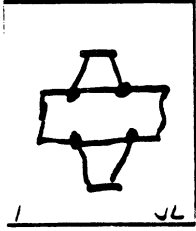
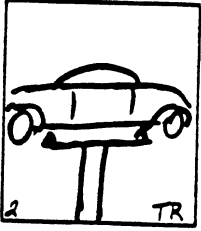
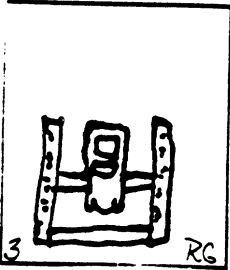
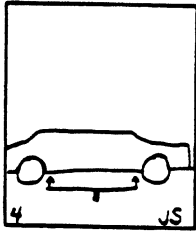
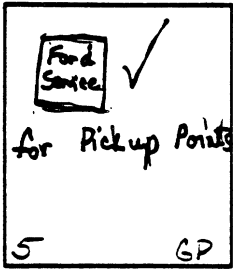
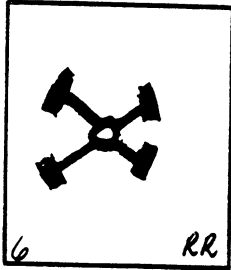
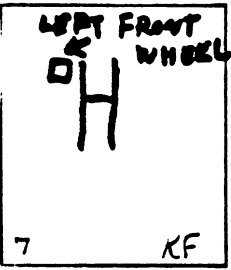
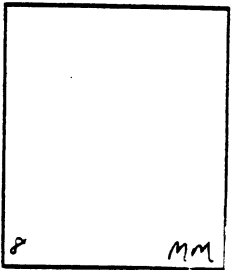
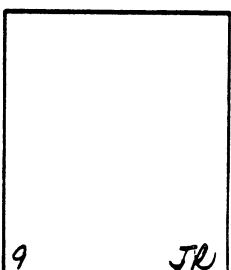
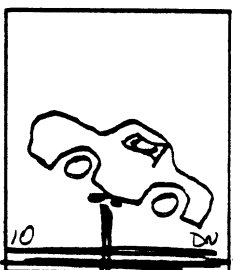
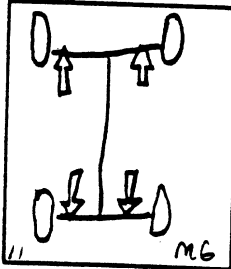
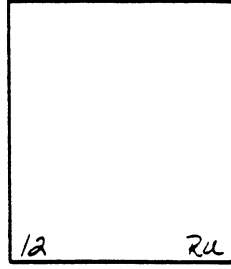
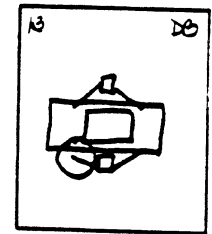
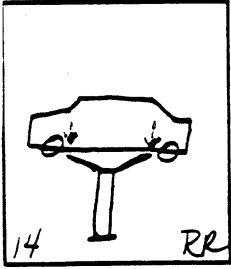
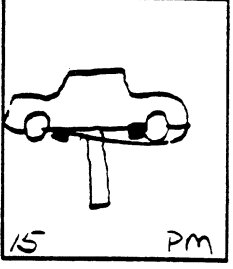
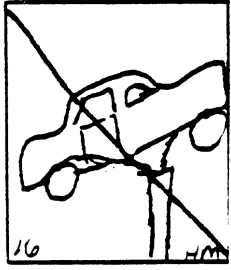
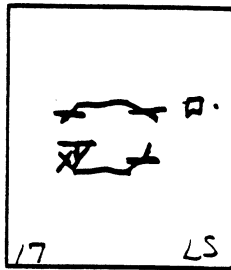
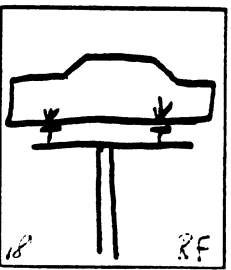
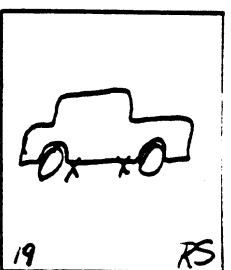
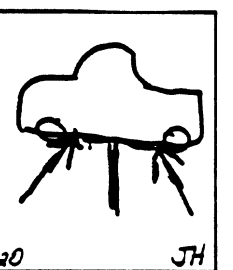
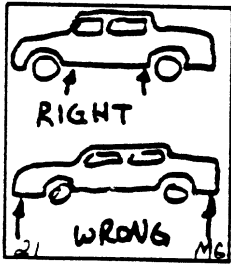
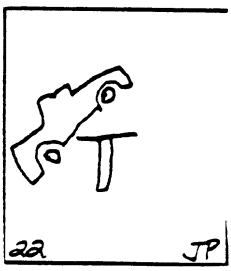
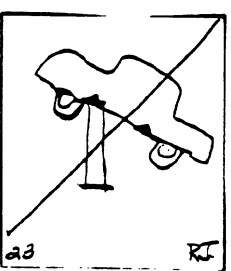
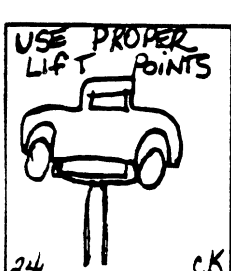




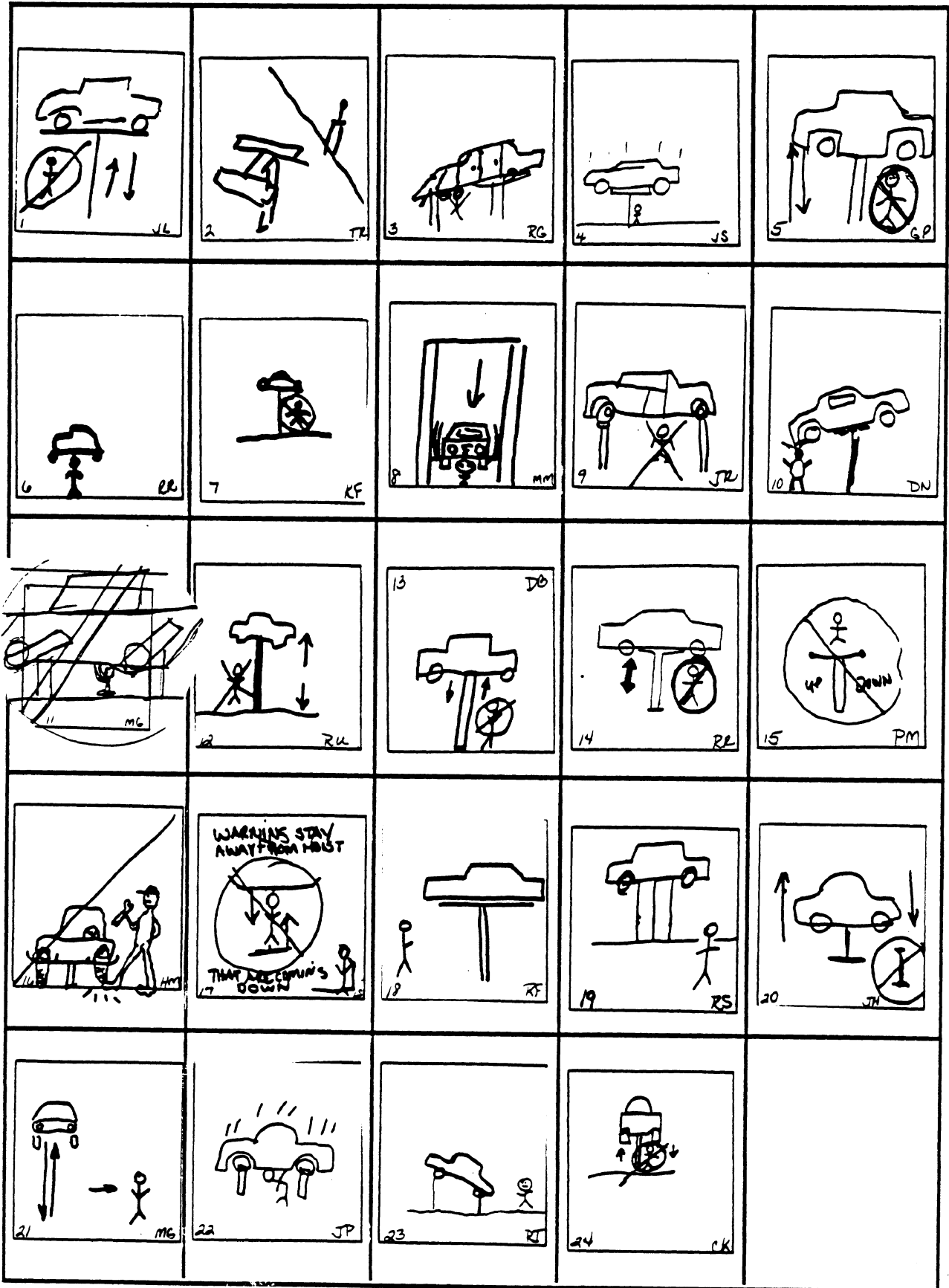
# 1. Use Jack Stands



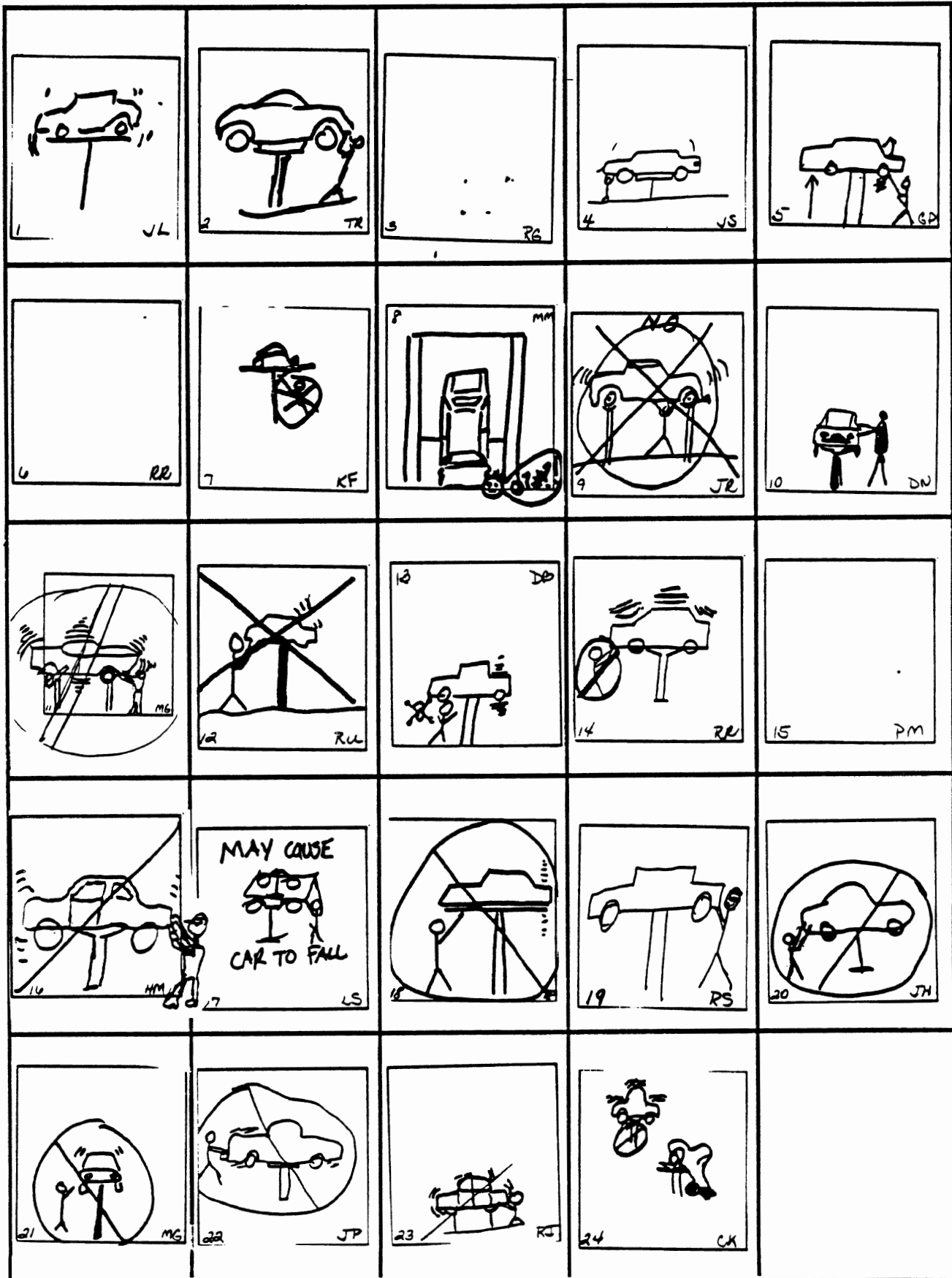
## 2. Vehicle pickup points

 <p>1 JL</p>	 <p>2 TR</p>	 <p>3 RG</p>	 <p>4 JS</p>	 <p>5 GP</p>
 <p>6 RR</p>	 <p>7 KF</p>	 <p>8 MM</p>	 <p>9 JR</p>	 <p>10 BR</p>
 <p>11 MG</p>	 <p>12 RL</p>	 <p>13 DB</p>	 <p>14 RL</p>	 <p>15 PM</p>
 <p>16 HM</p>	 <p>17 LS</p>	 <p>18 RF</p>	 <p>19 RS</p>	 <p>20 JH</p>
 <p>21 MG</p>	 <p>22 JP</p>	 <p>23 RI</p>	 <p>24 CK</p>	

### 3. Don't stand under hoist while it's moving

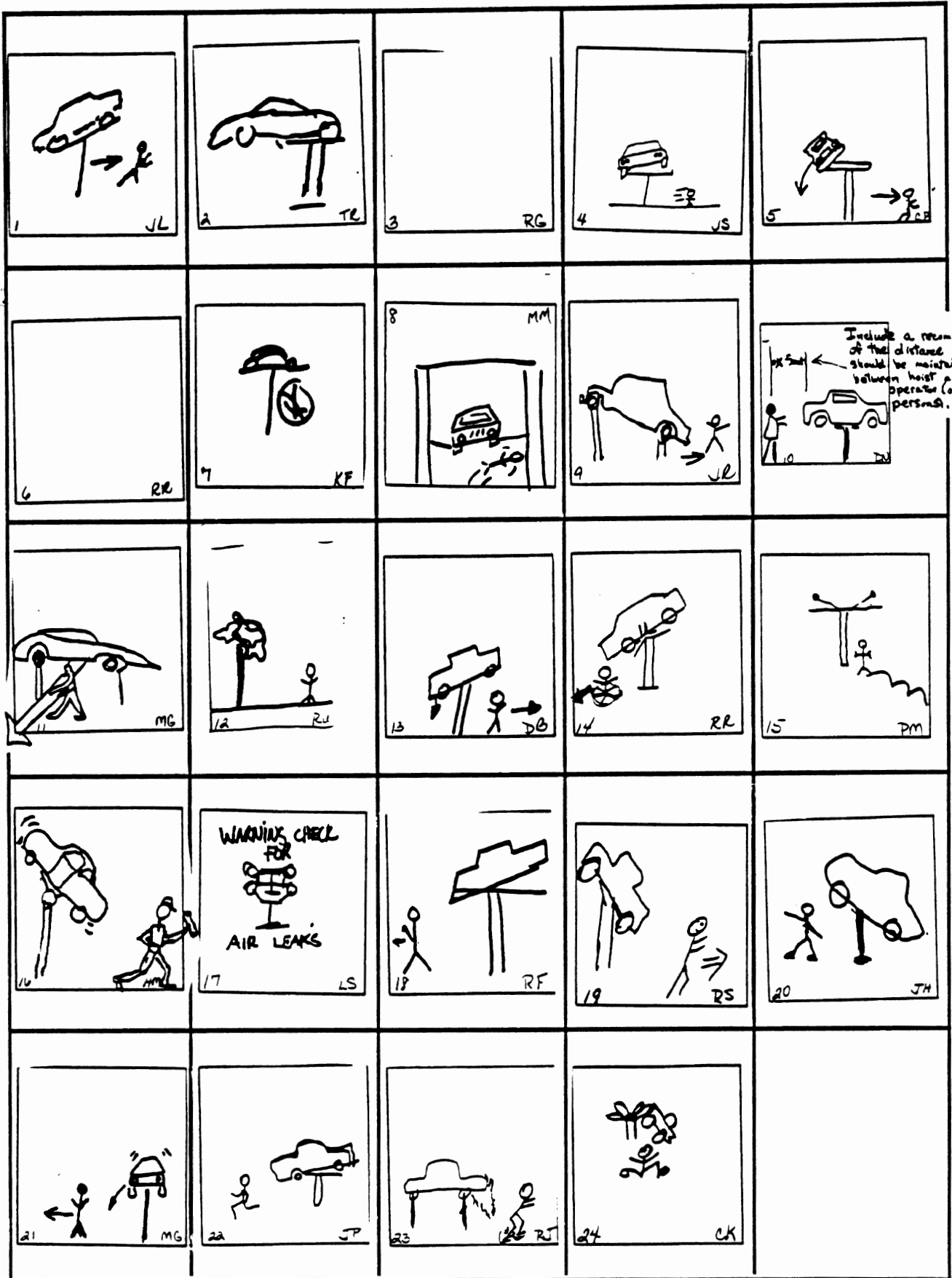


# 4. Don't excessively shake vehicle

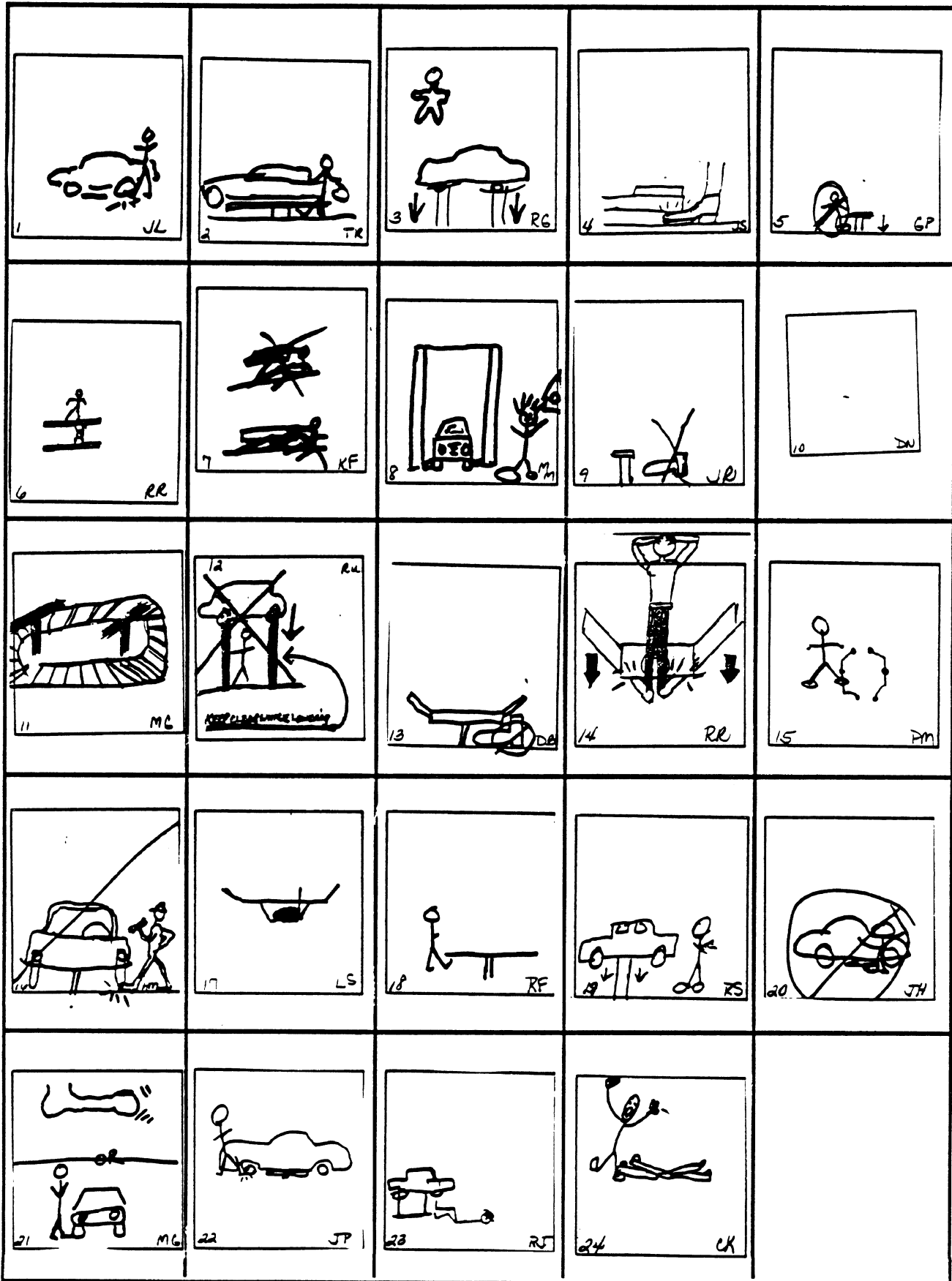




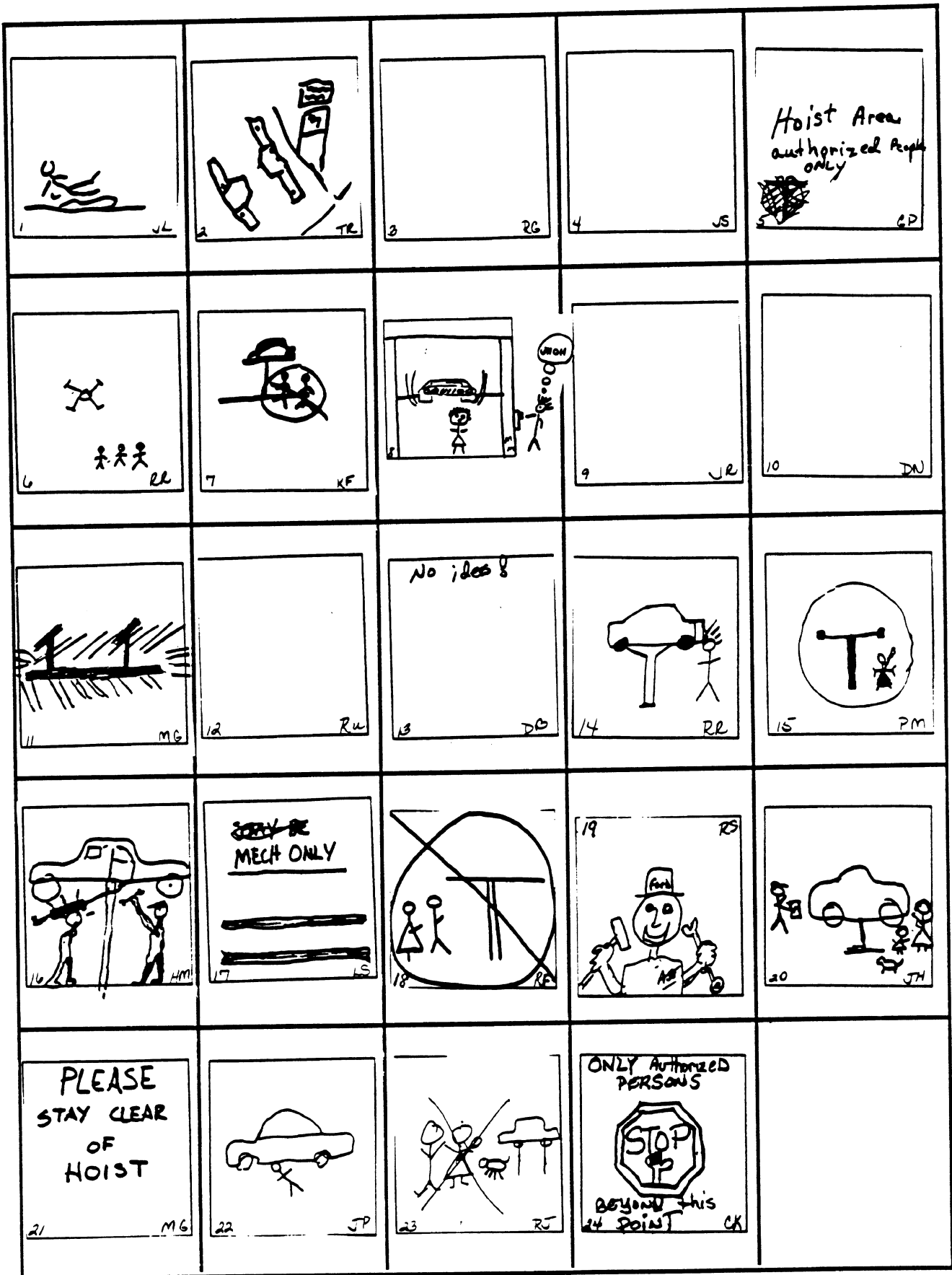
# 5. Run away if vehicle starts to fall



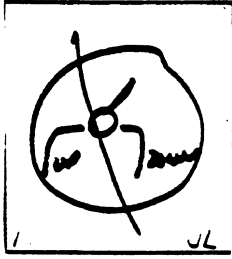
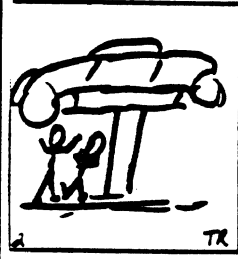
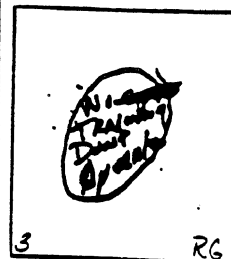
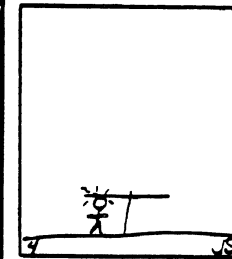

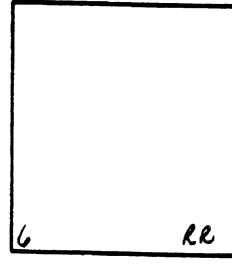
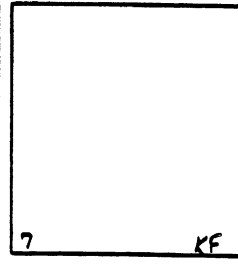
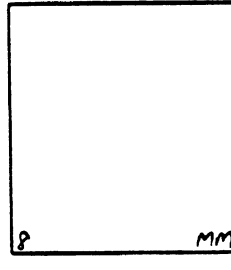
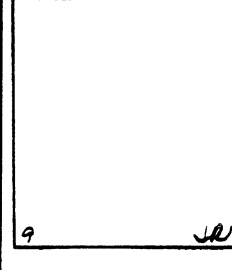
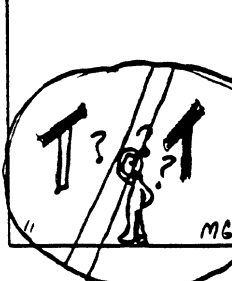
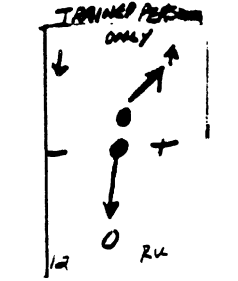
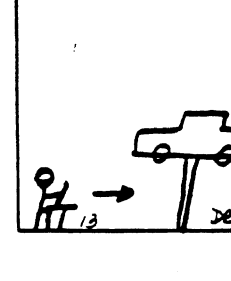
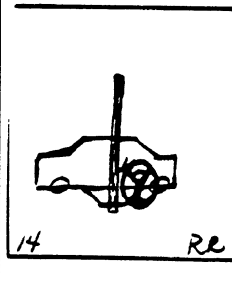
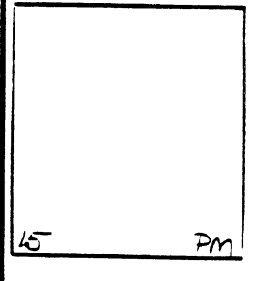
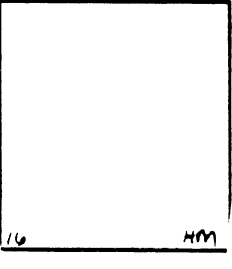
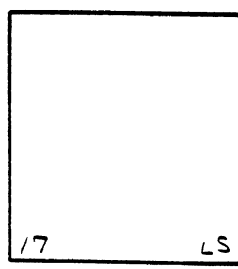
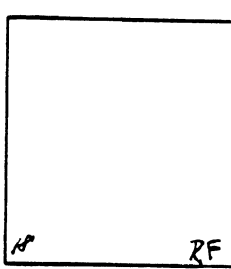
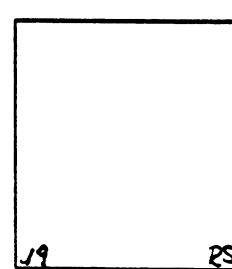

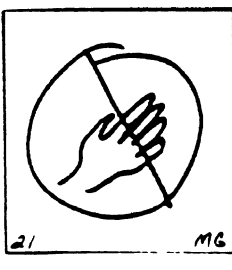
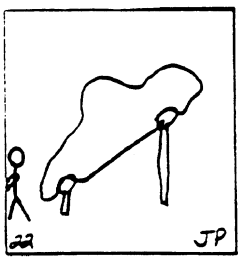
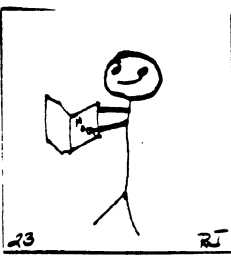
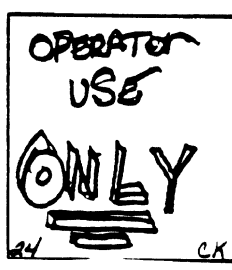

# 6. Keep feet clear of hoist



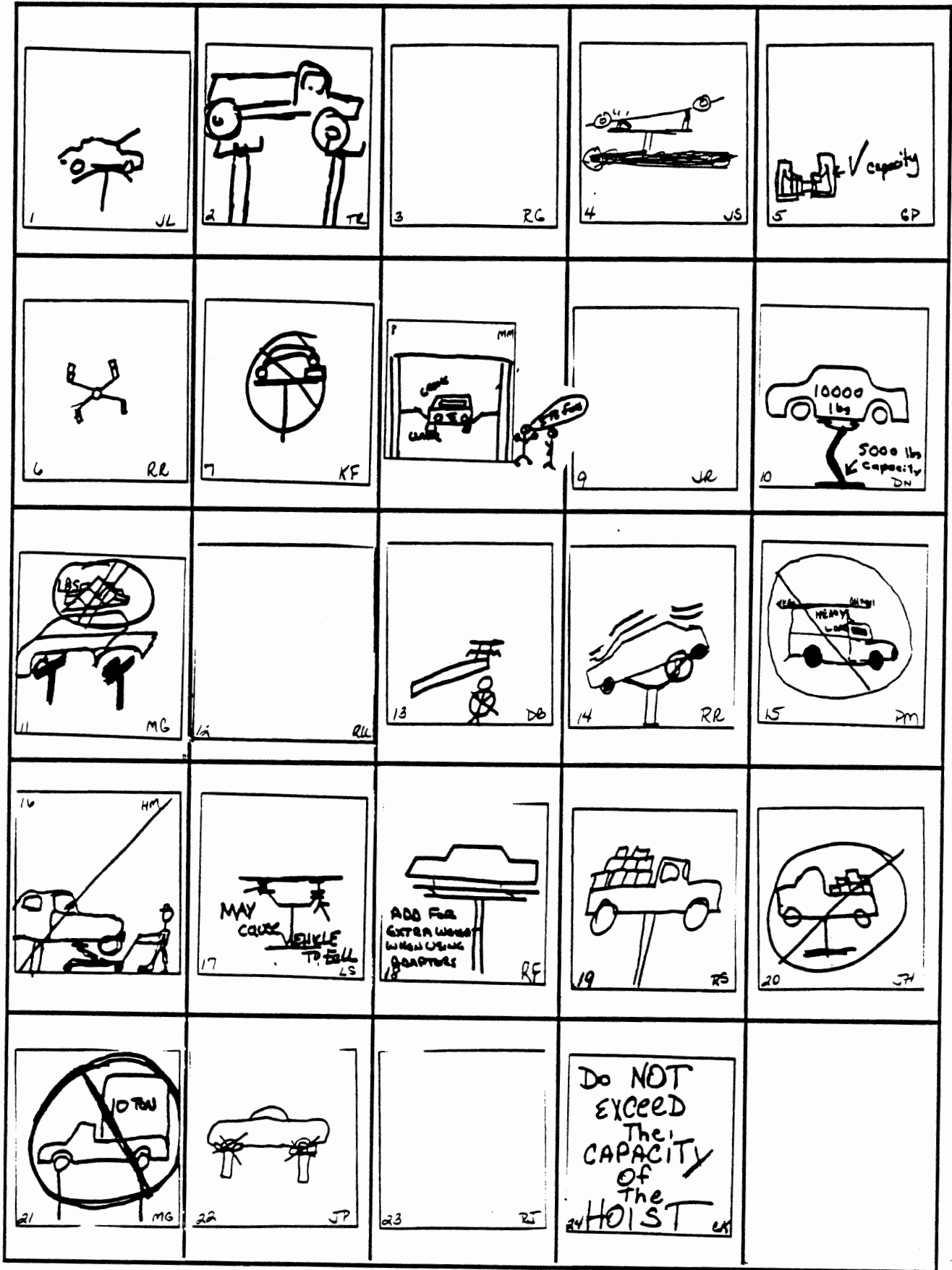
# 7. Unauthorized people stay out



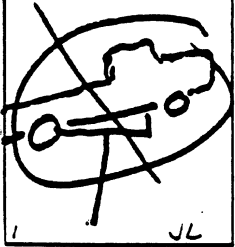
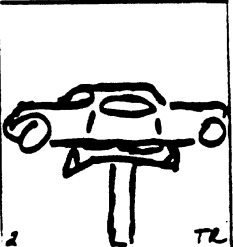
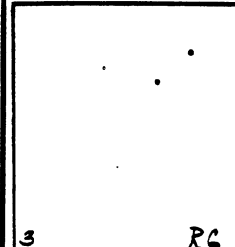
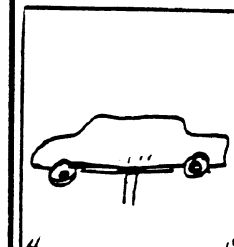
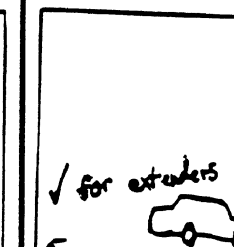
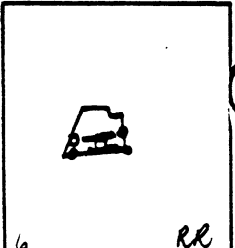
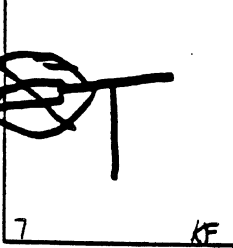
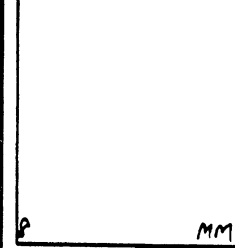
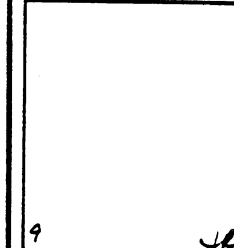
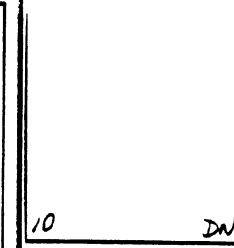
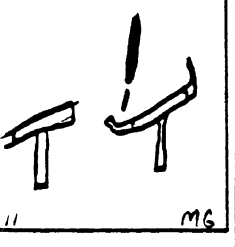
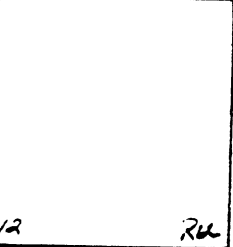
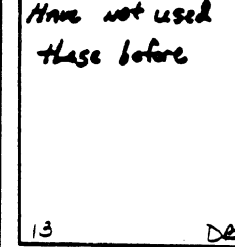
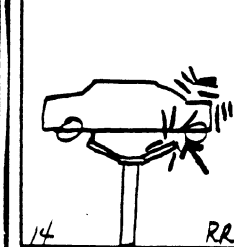
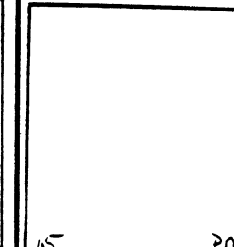
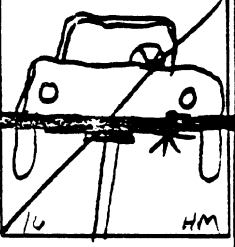
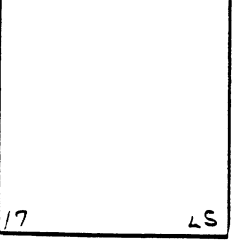
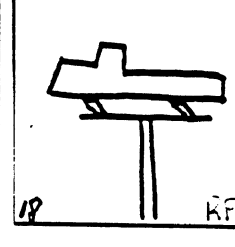
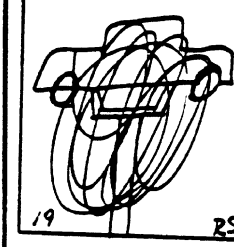
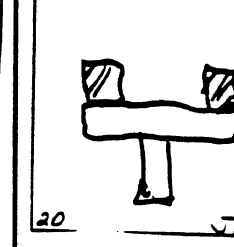
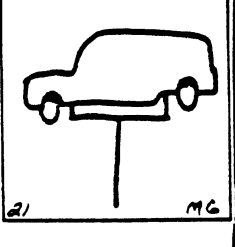
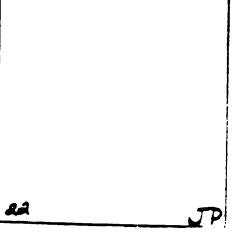
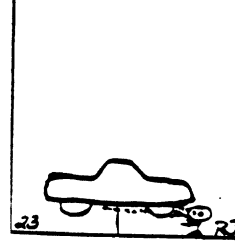
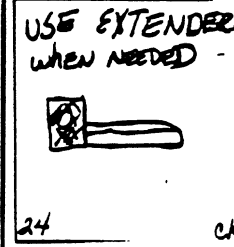
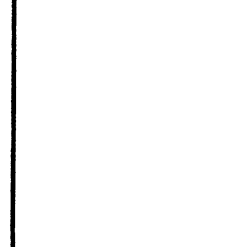
# 8. Only trained operator allowed

 <p>1 JL</p>	 <p>2 TR</p>	 <p>3 RG</p>	 <p>4 JS</p>	 <p>5 GP</p>
 <p>6 RR</p>	 <p>7 KF</p>	 <p>8 MM</p>	 <p>9 JR</p>	<p>Position the above warning next to or on the hoist control</p> <p>10 DW</p>
 <p>11 MG</p>	 <p>12 RU</p>	 <p>13 DB</p>	 <p>14 RL</p>	 <p>15 PM</p>
 <p>16 HM</p>	 <p>17 LS</p>	 <p>18 RF</p>	 <p>19 RS</p>	 <p>20 JH</p>
 <p>21 MG</p>	 <p>22 JP</p>	 <p>23 RI</p>	<p>OPERATOR USE ONLY</p>  <p>24 CK</p>	

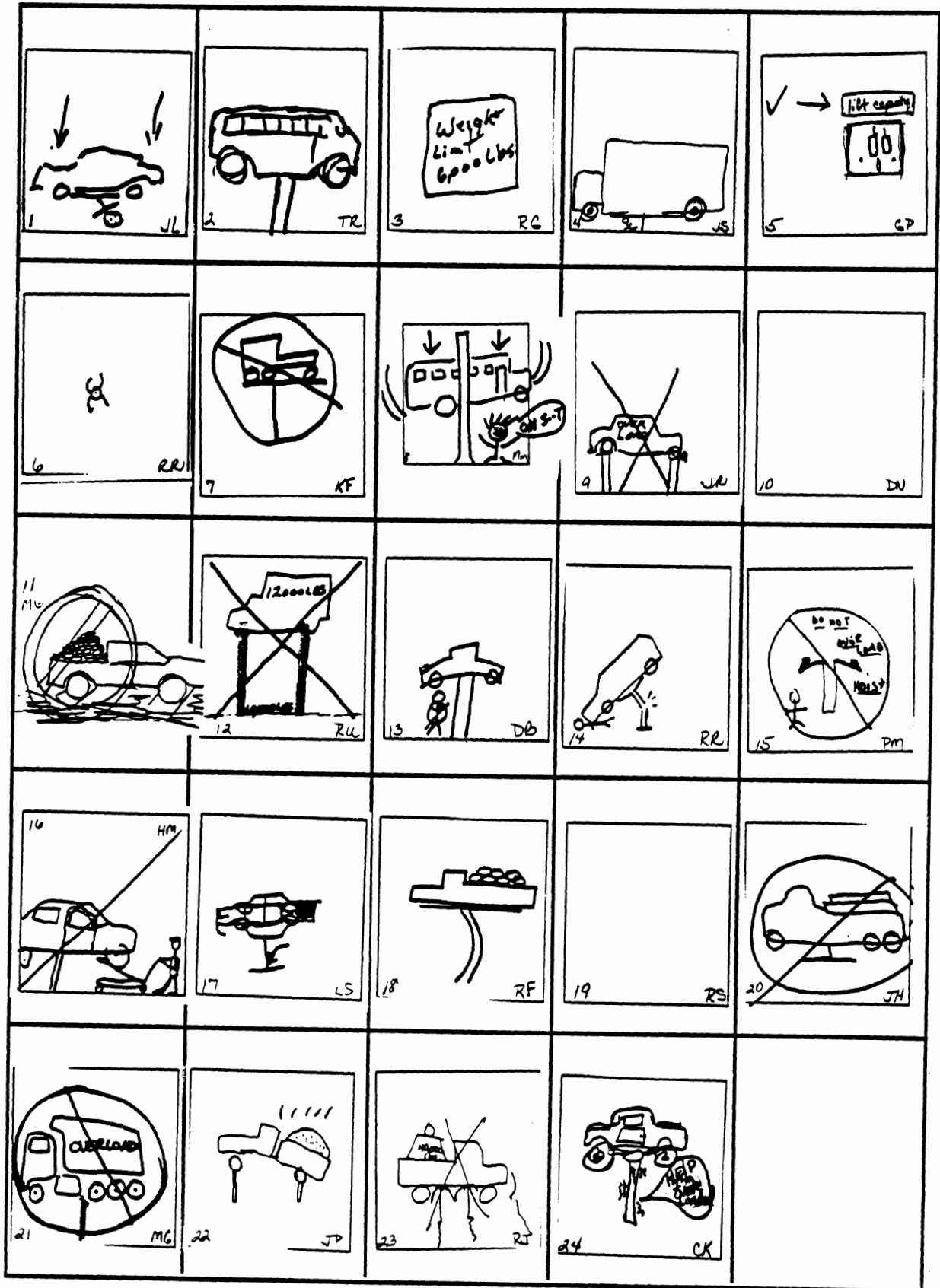
# 9. Use auxiliary adapters



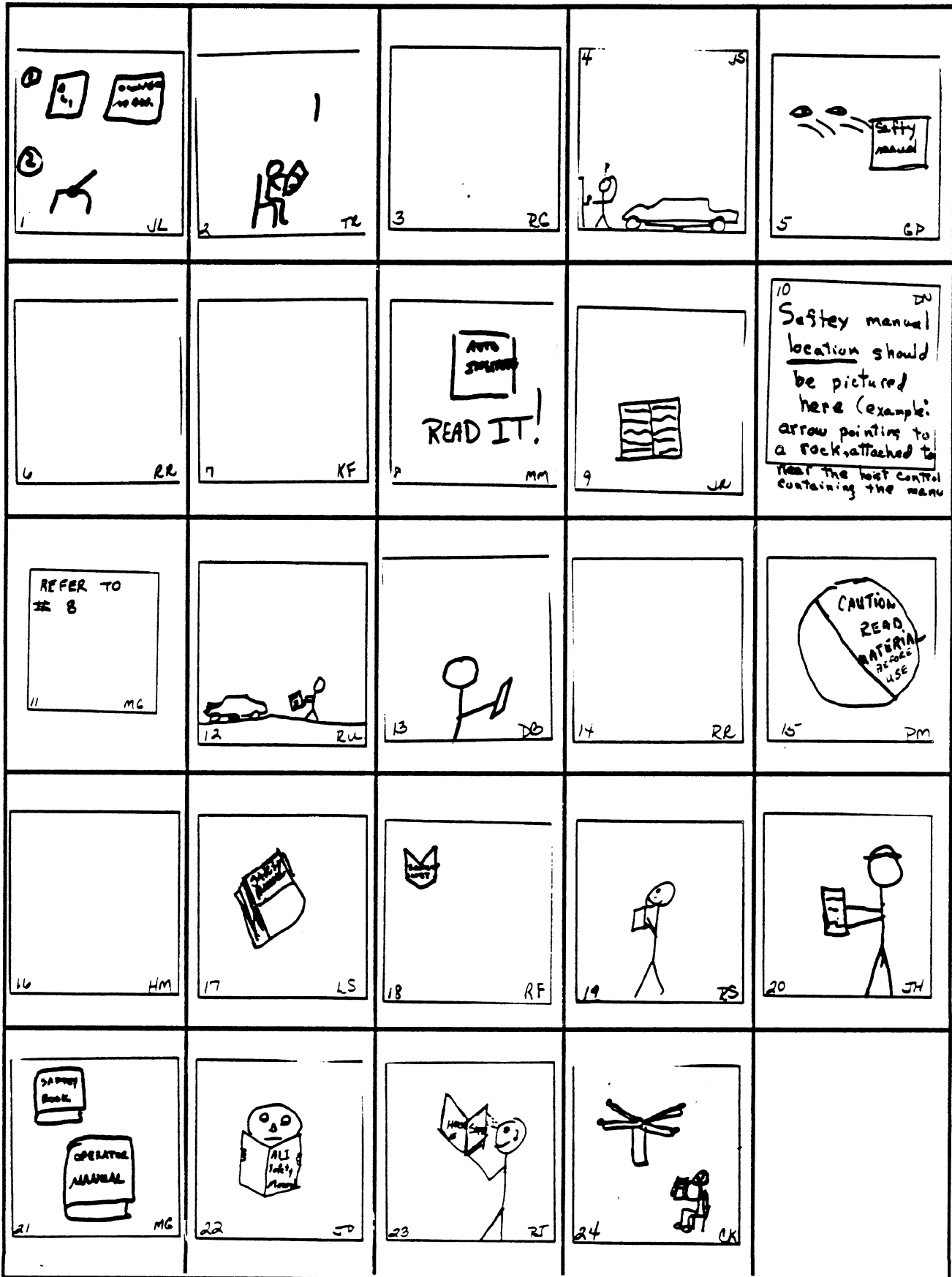
# 10. Use extenders when necessary

 <p>1 JL</p>	 <p>2 TR</p>	 <p>3 RG</p>	 <p>4 JS</p>	<p>✓ for extenders</p>  <p>5</p>
 <p>6 RR</p>	 <p>7 KF</p>	 <p>8 MM</p>	 <p>9 JL</p>	 <p>10 DN</p>
 <p>11 MG</p>	 <p>12 RL</p>	<p>Have not used these before</p>  <p>13 DB</p>	 <p>14 RR</p>	 <p>15 PM</p>
 <p>16 HM</p>	 <p>17 LS</p>	 <p>18 KF</p>	 <p>19 RS</p>	 <p>20 JH</p>
 <p>21 MG</p>	 <p>22 JP</p>	 <p>23 RJ</p>	<p>USE EXTENDERS WHEN NEEDED -</p>  <p>24 CK</p>	

# 11. Don't exceed weight capacity

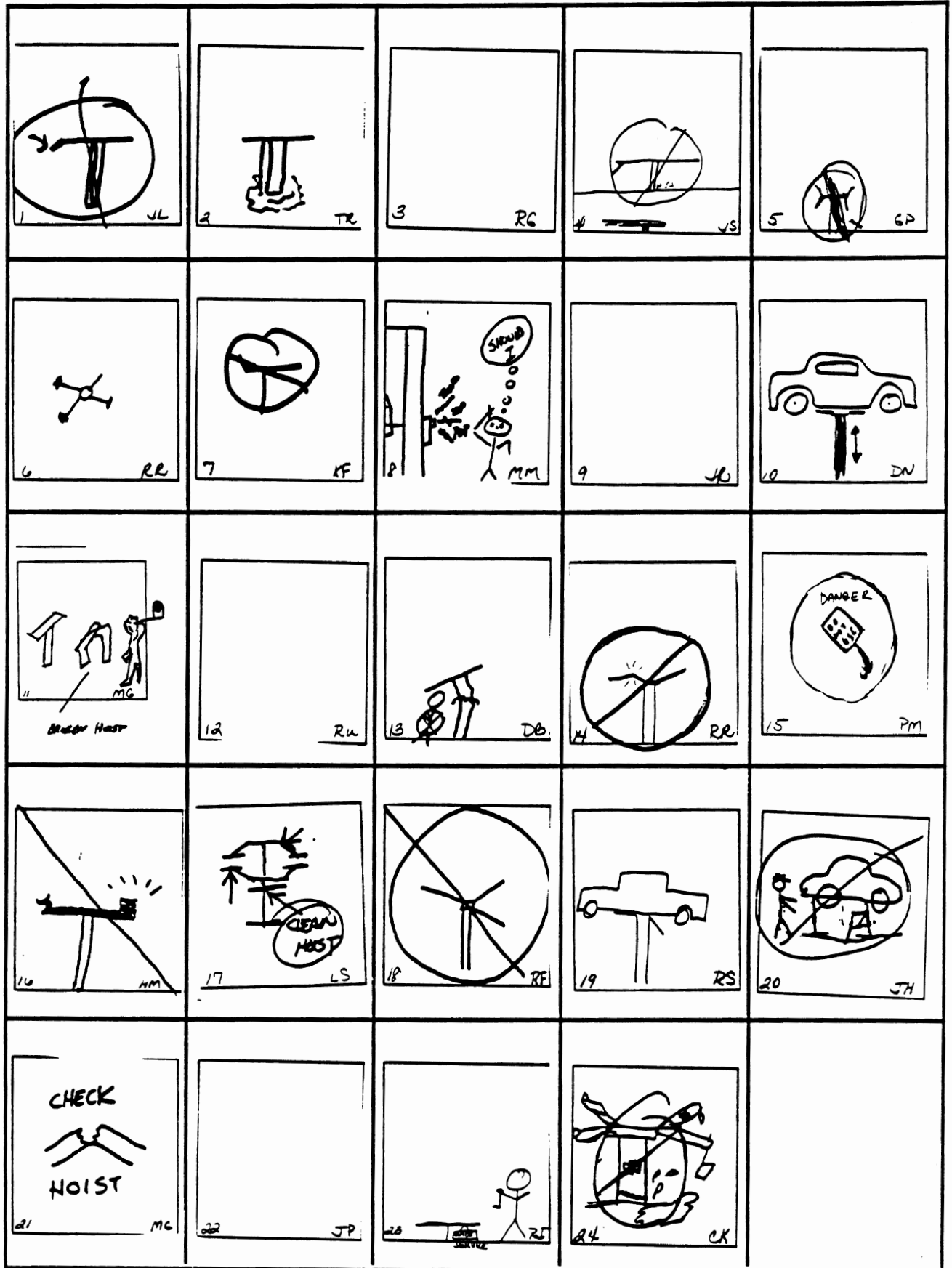


# 12. Read ALI manual


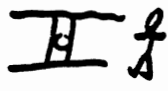


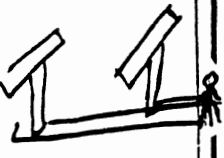
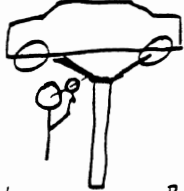
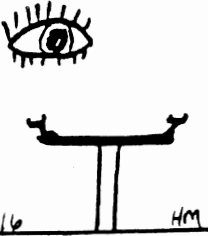

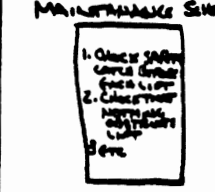


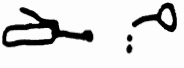

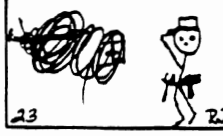





# 13. Don't operate if malfunctioning



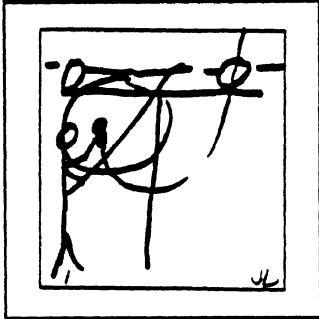
# 14. Periodic Inspection Required

 <p>1 Down for repairs JL</p>	 <p>2 TR</p>	<p>3 RG</p>	<p>4 JS</p>	<p>PM The Hoist</p>  <p>5 GP</p>										
<p>MAN WITH GREEN GUN</p>  <p>6 RR</p>	<p>7 KF</p>	<p>8 MM</p>	<p>9 JK</p>	<p>Table containing dates for scheduled maintenance, and initials or name of maintenance person who performed work should be on or near hoist control</p> <p>Example: DN</p> <p>Maintenance Schedule</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Performed By</th> </tr> </thead> <tbody> <tr> <td>10-2-89</td> <td>DDJ</td> </tr> <tr> <td>4-2-90</td> <td>DDJ</td> </tr> <tr> <td>10-2-90</td> <td></td> </tr> <tr> <td>4-2-91</td> <td></td> </tr> </tbody> </table>	Date	Performed By	10-2-89	DDJ	4-2-90	DDJ	10-2-90		4-2-91	
Date	Performed By													
10-2-89	DDJ													
4-2-90	DDJ													
10-2-90														
4-2-91														
 <p>11 MG</p>	<p>12 R4</p>	<p>13 DB</p>	 <p>14 RR</p>	<p>15 PM</p>										
 <p>16 HM</p>	 <p>17 LS</p>	<p>MAINTENANCE SIGN</p>  <p>18 FOLLOW INSTRUCTIONS BEFORE OPERATING</p>	 <p>19 RS</p>	 <p>20 JH</p>										
 <p>21 MG</p>	 <p>22 JP</p>	 <p>23 RJ</p>	 <p>24 CK</p>											

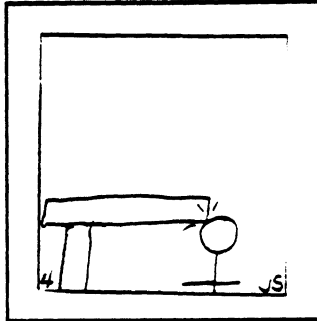
# Miscellaneous Warnings

(Developed by the subjects)

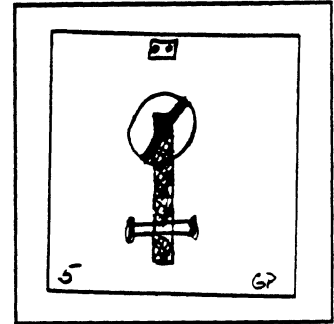
Drop lights not for under vehicle use



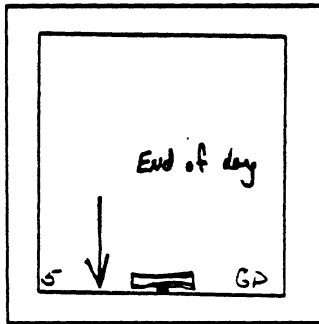
Caution- Low projection Head injury may result



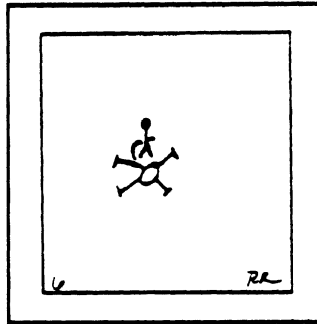
Never leave pit open



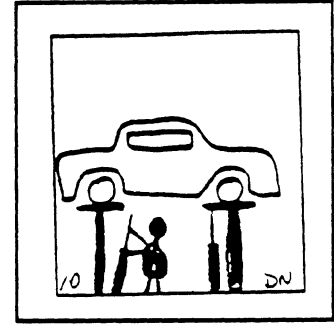
Never leave hoist up over night



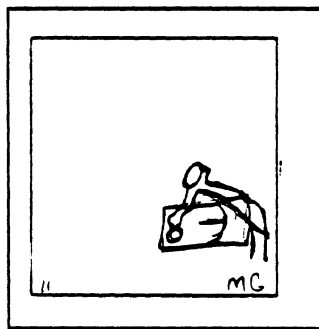
Be sure safety is on



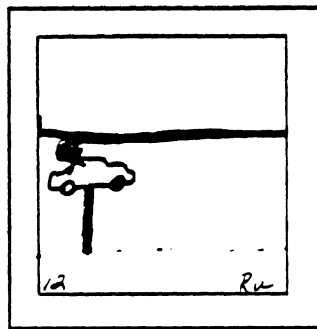
Always use safety stands



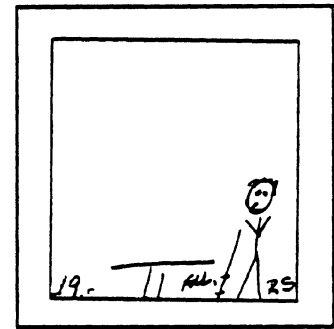
Disengage safety stop before lowering hoist



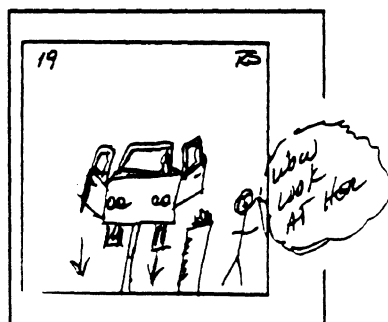
See that overhead is clear when raising



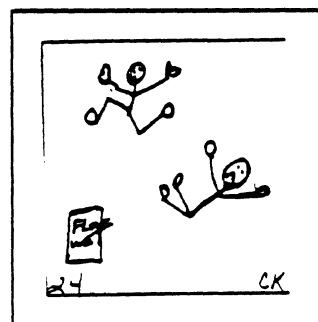
Check level weekly (hydraulic hoist)



Keep doors closed



Use common sense in your work place





## SUBJECT RESPONSES FOR WARNING LABELS (unedited)

1. Message - Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for a vehicle to fall off a hoist and injure someone.

<u>Subject #</u>	<u>Warning Label</u>
1	Use jack stands for stability
2	Jack stands should be used if car is to be used awile
3	Incomplete
4	Caution- Unstable load on hoist
5	Use jack stands after removing engine or transmission
6	Stands must be used
7	Caution- Use jack stands
8	Incomplete
9	Jack stands needed
10	Part removal may result in vehicle imbalance. Use jack stands.
11	Warning- Jack stands required
12	Use jack stands
13	Use jack stands when removing large components
14	Always use stands when removing heavy objects from vehicle
15	Caution use jack stands if needed
16	Use safety stands when removing drive line components
17	Warning when useing hoist with jack stand vehicle may fall
18	Support vehicle when removing large assemblies
19	Support heavy end
20	Use stands as needed
21	Use safty stands when working under vehicle
22	Caution: Always secure vehicle with proper jack stands when removing or installing large components
23	Take time use jack stands where needed
24	Always use jack stands when lifting vehicles

- Appendix B - Experiment 1 -

2. Message- Always use proper vehicle spotting and manufacturer's recommended pickup points. If the proper places are not used, the vehicle will not be securely placed on the hoist and it could fall and cause serious injury. This is especially true for above ground hoists where it is tempting to place the vehicle too far forward so the doors will clear the posts.

<u>Subject #</u>	<u>Warning Label</u>
1	Support vehicle at proper lift points
2	Always use frame or proper pickup points
3	(Beware) Don't place car too far forward This could cause injury
4	Caution- Set hoist at proper pick up point
5	Always pick vehicle up at recommended points
6	Warning: Check lift pads
7	Position vehicle on wheel chock
8	Incomplete
9	Center vehicle on hoist
10	Lift vehicle only on manufacturer recommended pickup points
11	Caution- Use proper lifting locations
12	Use proper pickup points
13	Use proper jack points
14	Use lifting points recommended by manufacturer
15	Caution- Raise vehicle at proper lift points
16	Check manufacturer's recommended pickup points
17	Use recommended pick up when picking up hoist
18	Lift vehicle using only designated lift points
19	Use recommended lift points
20	Use only recommended pickup points
21	Lift vehicle at proper pickup points
22	Caution: To avoid serious injury or damage to vehicle, vehicle must be raised by proper pickup points
23	Check vehicle mfg. lift points before using lift
24	Use proper lift points

- Appendix B - Experiment 1 -

3. Message- Do not stand under the hoist while it is raising or lowering the vehicle. If it fell, it could cause serious injury or death.

<u>Subject #</u>	<u>Warning Label</u>
1	Do not stand under hoist when raising or lowering
2	Hoist control should be mounted in a safe place
3	Warning: Stand clear of hoist while under operations
4	Caution- No standing under hoist when raising or lower vehicle
5	Never stand under vehicle while it is going up or down
6	Don't stand under hoist while raising or lowering
7	Caution: stand clear while raising and lowering vehicle
8	Incomplete
9	Stand clear during hoist operation
10	Do not stand under hoist during hoist operation
11	No standing under hoist while raising or lowering
12	Keep clear when raising or lowering
13	Stay clear of hoist when moving- injury may occur
14	Don't stand under vehicle during hoist operation
15	Caution- Don't go under vehicle while hoist operates
16	Keep clear of hoist when operating
17	Warning Stay clear of hoist when coming down
18	Remain lclear of hoist while raising or lowering vehicle
19	Keep clear when in use
20	Use stands only when vehicle isn't in motion
21	Stand clear when in motion
22	Caution: Stand clear of hoist when raising or lowering vehicle
23	Stay clear when raising or lowering vehicles
24	Keep clear when lifting and lowering vehicles

4. Message- Do not excessively shake the vehicle while it is on the hoist. It might fall and injure someone.

<u>Subject #</u>	<u>Warning Label</u>
1	Keep vehicle stable when raised on hoist
2	Make sure vehicle is on hoist properly
3	Incomplete
4	Caution- no rocking of vehicle while on hoist
5	Never rock vehicle while up on hoist
6	Incomplete
7	Do not shake vehicle in raised position
8	Do not jolt car while on hoist due to possible injury
9	Avoid shaking vehicle
10	Excessive movement may cause vehicle to fall
11	Do not rock vehicle while on hoist
12	Do not shake
13	No excessive vehicle movement on hoist. Injury may occur.
14	Don't use excessive force on vehicle- It may fall!
15	Caution- Do not shake vehicle while hoist is up
16	Do not rock vehicle after hoisting
17	Do not try to move or shake car when on hoist
18	Do not jounce vehicle while lift is in the raised position
19	Do not shake excessively
20	Don't shak vehicle
21	Avoid shaking vehicle when lifted
22	Caution: To avoid injury Avoid
23	Minimize vehicle movement when raised
24	Use care with cars on hoist - No shaking on hoist

- Appendix B - Experiment 1 -

5. Message- If the vehicle starts to fall, run away to avoid being struck by it.

<u>Subject #</u>	<u>Warning Label</u>
1	Run in opposite direction of falling vehicles
2	Check vehicle on hoist before raising up completely
3	Incomplete
4	Caution- Keep feet out from under hoist
5	Run if vehicle should fall from hoist
6	Incomplete
7	Clear area if vehicle moves downward
8	If vehicle starts to fall MOVE!
9	Run clear of danger
10	Keep clear during hoist operation
11	If vehicle falls, stay clear
12	Stand clear if falling
13	Get clear of vehicle if it falls
14	If vehicle begins to fall- get away fast!
15	If vehicle starts to fall get away
16	Clear area if vehicle is in danger of falling
17	Always check hoist for loose control arm, hoist may fall
18	Leave area immediately should vehicle start to fall
19	Do not try to stop falling vehicles
20	Run if vehicle is unstable
21	Watch for falling vehicles: Seek shelter
22	Flee immediately if vehicle should start to fall
23	Move away if vehicle shifts
24	Do not save vehicle save yourself

6. Message- Keep feet from underneath the hoist while the hoist is being lowered so they will not be crushed.

<u>Subject #</u>	<u>Warning Label</u>
1	Stand clear of vehicle when it is being lowered
2	Be alert when lowering vehicle
3	Stand clear while lowering hoist
4	Caution- Keep feet out from under hoist
5	Never have feet near hoist as it is lowered
6	Warning Keep feet clear
7	Keep feet clear
8	Keep feet clear of hoist
9	Keep feet clear
10	Keep clear during hoist operation
11	Keep feet clear
12	Keep clear while lowering
13	Keep feet clear while operating hoist
14	Keep feet and hands clear during hoist operation
15	Caution keep feet clear while using hoist
16	Keep clear of hoist when lowering
17	Warning- stay 10/20 feet when hoist is in use
18	Keep feet clear of hoist while lowering
19	Keep feet clear
20	Keep feet from under hoist frame when lowering vehicle
21	Watch your toes
22	Stand clear when hoist is being lowered
23	Stand clear of vehicle when hoist is moving
24	Use care with hoists in motion



- Appendix B - Experiment 1 -

7. Message- Unauthorized people are not allowed in the hoist area. They could get hurt.

<u>Subject #</u>	<u>Warning Label</u>
1	Customers not allowed in service area
2	Employees only in garage area
3	Incomplete
4	Caution- Authorized personnel in lift area
5	Only authorized people in this area, others could be hurt
6	Unauthorized stay out of hoist area
7	Authorized personnel only in this area
8	Incomplete
9	Stay clear of hoist area
10	Keep clear during hoist operation
11	Authorized personnel only
12	Authorized people only
13	No usage by unauthorized people. Injury may occur
14	Authorized personnel only
15	No unauthorized people in work area
16	Unauthorized personnel stay clear of hoist area
17	Mechanic only in shop
18	No unauthorized personnel in vicinity of hoist
19	For professional use only
20	Unauthorized personal not allowed
21	Please stay clear of hoist area
22	Authorized personal only in hoist area
23	Unauthorized persons please stay clear
24	Only authorized persons beyond this point

8. Message- No one other than the trained operator should operate the hoist. Someone who is inexperienced might be hurt.

<u>Subject #</u>	<u>Warning Label</u>
1	Trained personnel only]
2	Teach new employee how to operate properly
3	Trained operators only
4	Caution- Hoist to be used by trained personnel only
5	Trained operators only untrained people may be hurt
6	Incomplete
7	Experienced operator only
8	Incomplete
9	Experienced operator only
10	Experienced operators only
11	Experienced operators only
12	Trained personnel only
13	Trained operator use only- injury may occur
14	Only authorized personnel permitted to operate
15	Caution- experienced operator only
16	Trained personnel only!!
17	Mechanic can only use hoist
18	To be operated by trained personnel only
19	For professional use only
20	Trained personal only
21	Please don't touch hoist controls
22	Hoist to be used by authorized only
23	Obtain preper training before use
24	Operator use only

- Appendix B - Experiment 1 -

9. Message- Use of auxiliary adapters may affect the capacity of the hoist, so that it will not be able to lift as much. If the vehicle with adapters attached exceeds the weight capacity of the hoist, the vehicle could fall.

<b><u>Subject #</u></b>	<b><u>Warning Label</u></b>
1	Do not exceed manufacturers maximum weight capacities
2	Don't exceed hoist capacity
3	Incomplete
4	Caution- Use only specified or correct adapters on this hoist
5	Run if vehicle should fall from hoist
6	Check lift capacity when adapters are in use
7	Use approved adapters only
8	Do not overload hoist aux. adapters
9	Use caution when adapters are used
10	Capacity of this hoist is _____. check vehicle weight before using.
11	Auxiliary adapters may affect load capacity
12	Use proper equipment
13	Adapters may affect lifting capacity
14	Only use hoist as it was designed
15	Caution- overloaded vehicle is dangerous
16	Do not assist lifting capacity of hoist
17	Warning auxiliary adapters may cause vehicle to fall
18	When adding adapters consider them when determining hoist lift capacity
19	Do not exceed weight limits
20	Check vehicle for added weight
21	Don't lift vehicles with heavy loads or attachments
22	Auxiliary adapters of any kind are not to be used with this hoist
23	Use adapters only as recommended by manufacturer
24	Do not exceed the capacity of the hoist

- Appendix B - Experiment 1 -

10. Message- Some vehicles may require use of extenders for proper lifting. If extenders are not used the car would not be securely placed on the lift, and could fall off.

<u>Subject #</u>	<u>Warning Label</u>
1	Use proper lift adapters to stabilize vehicle before lifting
2	Extenders are used for special clearance under car
3	Incomplete
4	Caution- Use extenders when necessary to stabilize vehicle on hoist
5	Before lifting check for use of extenders
6	Check to see if extenders are in place
7	Use proper extenders only
8	Incomplete
9	Some vehicles require extenders
10	Lift vehicle only on manufacturer recommended pickup points
11	Caution- Use extenders when needed (required)
12	Use extenders if required
13	Use extenders when required
14	Use hoist equipment properly
15	Caution Use proper equipment if needed
16	Do not use makeshift extensions
17	Warning when using extenders on vehicle Be careful
18	Use adapters where specifically required for vehicle
19	Incomplete
20	Use extensions as needed
21	Use proper lift pads
22	Extenders must be used on vehicles requiring them to ensure safety
23	CK for proper hoist contact before raising
24	If extenders are needed to properly raise a car use them

11. Message- Do not exceed the weight capacity of the hoist. If the hoist is overloaded it could fail unexpectedly and injure someone.

<u>Subject #</u>	<u>Warning Label</u>
1	Exceeding hoist max weight capacity could result in injury or death
2	Don't try to raise a truck on a car lift
3	Warning- This hoist weight limit is X amount of lbs.
4	Caution- Do not exceed lift weight capacity of the hoist
5	Check lift capacity before lifting
6	Check capacity
7	Do not exceed load limit
8	Do not overload hoist
9	Check hoist weight capacity
10	Capacity of this hoist is _____. Check vehicle weight before using.
11	Hoist capacity : 5000
12	Do not exceed capacity
13	Do not exceed weight capacity
14	Do not overload hoist
15	Caution - Is vehicle too heavy
16	Do not assist lifting capacity of hoist
17	Warning Do not over exceed hoist!
18	Do not overload hoist. Capacity of this hoist is _____
19	Do not exceed weight limits
20	Do not exceed weight capacity
21	Do not over load hoist with heavy vehicles
22	Do not exceed load capacity of hoist
23	Do not overload hoist
24	Help! I'm overloaded

- Appendix B - Experiment 1 -

12. Message- Read the Automotive Lift Institute safety manual, the safety tips card, and all other lift-related printed material before operating the hoist.

<u>Subject #</u>	<u>Warning Label</u>
1	Know all proper lifting methods before using this equipment
2	Know about your hoist before you use it
3	Incomplete
4	Caution- Read all instructions on proper use of this hoist
5	Read safety manual before operating lift
6	Incomplete
7	Read operators manual before useing
8	Read manuals before hoist operation
9	Read safety and operating material
10	Please read safety manuals before using
11	Do you know how this hoist operates
12	Reading of safety manual required
13	Read all related manuals before operating
14	Read manual before operation
15	Read safety material before useing
16	Incomplete
17	Check operating manuel befor use hoist
18	Follow instruction in ALI safety manual when operating hoist
19	Read instruction carefully
20	Read safety manual before operation
21	Read operater and saftey manuals before use
22	Be sure to read ALI safety manual and operators manual before operating hoist
23	Read all safety information before use
24	Become fommlar with a hoist before operation

13. Message- Do not operate the hoist if any part is not working properly.

<u>Subject #</u>	<u>Warning Label</u>
1	Not safe for use if any component is not fully functional
2	If hoist leaks or safety leg is broken have it repaired
3	Incomplete
4	Inspect hoist and do not use if all parts are not in working order
5	Never operate hoist if any parts have stopped working properly
6	Do not operate with parts broken or missing
7	Check all parts befor using
8	Do not operate a damaged hoist
9	Do not operate faulty hoist
10	Check and note hoist operation before using
11	If hoist is broken or damaged- Do not operate call the proper department
12	Incomplete
13	Do not oeprate defective hoist
14	Do not use faulty equipment
15	Danger If not working properly
16	Do not operate hoist if any part is defective
17	Check hoist daily
18	Do not operate hoist if any portion of system is not operating correctly
19	Keep all parts in proper condition
20	Don't operate with defective equipment
21	Check hoist before use
22	Hoist and components must be in proper working order before using lift
23	Check all operating parts before use
24	If hoist operation is not safe do not use

- Appendix B - Experiment 1 -

14. Message - Periodic inspection and maintenance of this hoist is required. If this is not followed the hoist could malfunction. Consult the owner's manual for proper maintenance procedures.

<u>Subject #</u>	<u>Warning Label</u>
1	Perform proper maintenance and have repairs performed by qualified personnel
2	Visual inspection monthly can save your life and equipment
3	Incomplete
4	Incomplete
5	PM is needed to keep hoist in good working order, check manual
6	Maintain hoist prevent accidents
7	Check proper maintenance record before using
8	Incomplete
9	Inspect hoist often
10	Do not use if this hoist is overdue for scheduled maintenance.
11	Perform routine maintenance when required
12	Periodic inspection required
13	Service hoist per owners manual
14	Inspection hoist periodically
15	Incomplete
16	Service and inspect hoist on timely schedule
17	Check maintenance on hoist Daily!
18	Follow maintenance procedures as prescribed by manufacturer
19	Inspect weekly for operation
20	Check for periodic inspection of equipment
21	Service hoist regularly
22	Periodic maintenance and inspection required every _____.
	Consult operators manual for procedure.
23	Proper maintenance & inspection necc. for safe operation
24	Incomplete



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## **APPENDIX C EXPERIMENT 2**

This appendix contains the subject consent forms that were used for the second experiment. The second consent form was used for the subjects from the General Motors Proving Grounds, since those subjects were not paid for their participation. The subject consent form is normally printed on UMTRI letterhead paper. Since the same biographical data form was used for both experiments, the form appears at the beginning of Appendix B only. Appendix C also contains the data sheets used by subjects to record their responses. Finally, this appendix contains the raw warnings produced by subjects.

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TEST OF WARNING LABELS FOR AUTOMOTIVE LIFTS  
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**SUBJECT CONSENT FORM**

The purpose of this research is to develop warning messages for above ground automotive lifts (service-station car hoists), and then test to verify that automotive lift users, such as yourselves, understand these messages.

You will be shown various pictorial warnings and asked what each picture represents. Also you will rank the pictures for each warning and alternative wordings. In the last section of the experiment, you will be shown various combinations of texts, and asked to pick the one you like the best. The experiment will take about an hour. \$10 in cash will be paid upon completion.

We will need to videotape a few people participating in this experiment as well. If this is asked of me, I do/do not (circle one) consent to my being video-taped during this experiment.

-----  
I have read and understand the information above.

\_\_\_\_\_  
print your name

\_\_\_\_\_  
date

\_\_\_\_\_  
sign your name

\_\_\_\_\_  
witness (experimenter)

-----  
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-----

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The purpose of this research is to develop warning messages for above ground automotive lifts (service-station car hoists), and then test to verify that automotive lift users, such as yourselves, understand these messages.

You will be shown various pictorial warnings and asked what each picture represents. Also you will rank the pictures for each warning and alternative wordings. In the last section of the experiment, you will be shown various combinations of texts, and asked to pick the one you like the best. The experiment will take between 45 minutes to an hour.

-----  
I have read and understand the information above.

\_\_\_\_\_  
print your name

\_\_\_\_\_  
date

\_\_\_\_\_  
sign your name

\_\_\_\_\_  
witness (experimenter)

## Rating Candidate Symbols and their Texts for Automotive Hoist Warning Labels

### Instructions

You will be shown several candidate symbols representing 14 different warnings for above ground garage hoists. Write down what you think each picture means (the warning message). Be as specific as possible. There will be more than one picture for each warning (but usually on different pages) so you can use the same text more than once. Two examples are shown below.

No Smoking

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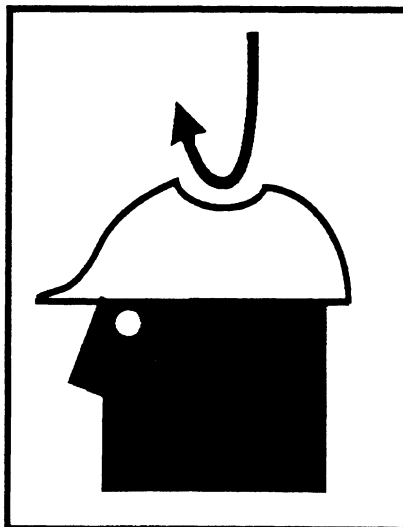
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Watch for falling  
objects: Wear a hard  
hat at all times



- Appendix C - Experiment 2 -

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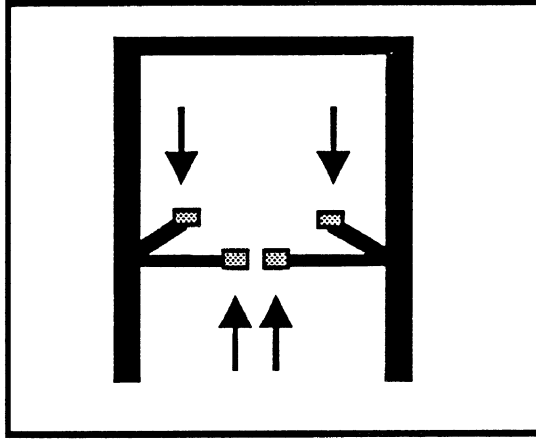
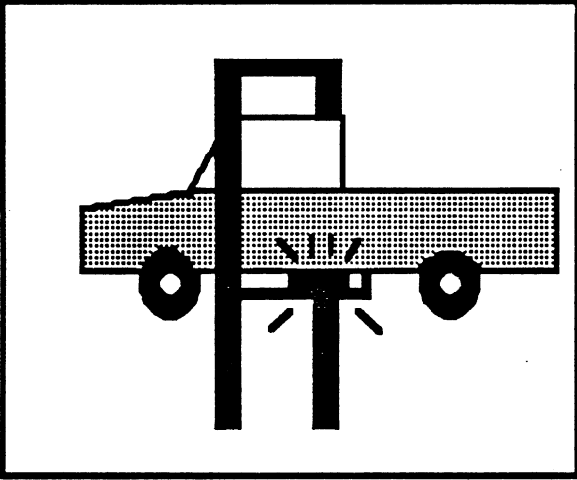
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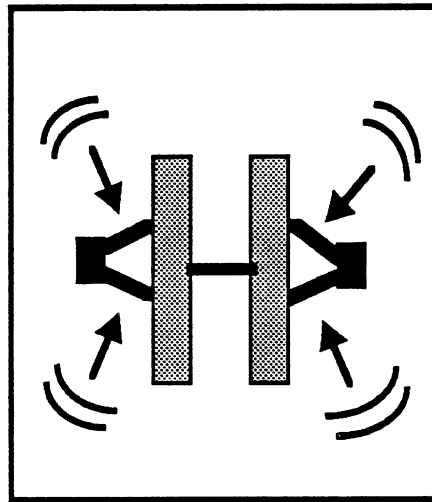
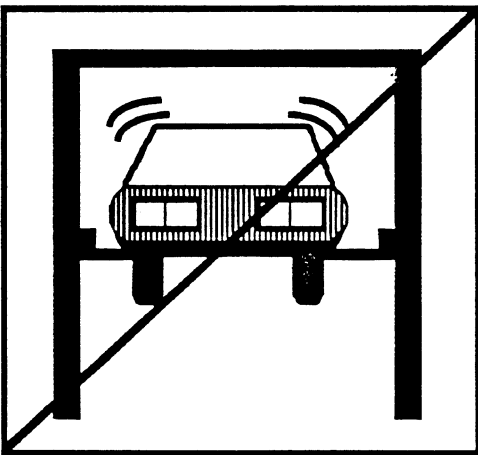
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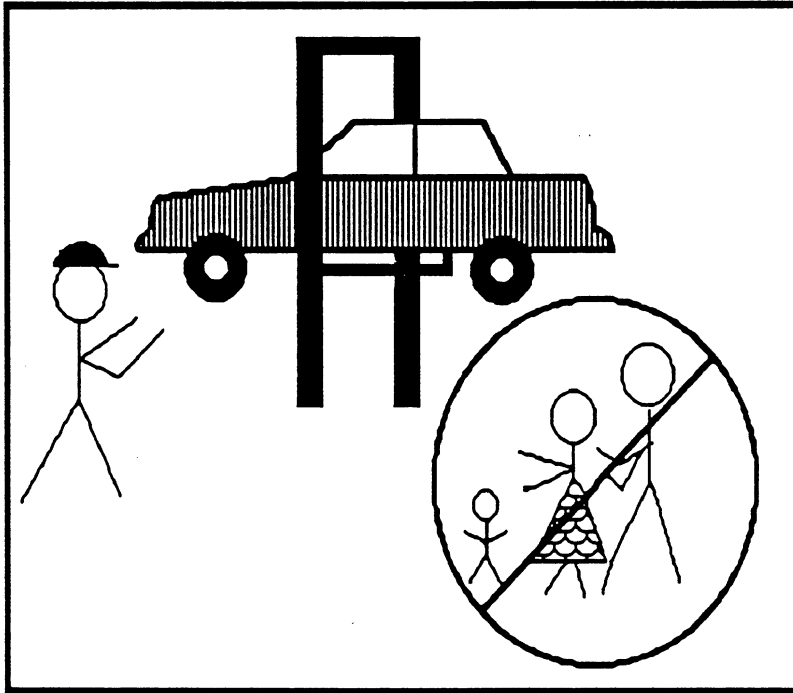
- Appendix C - Experiment 2 -

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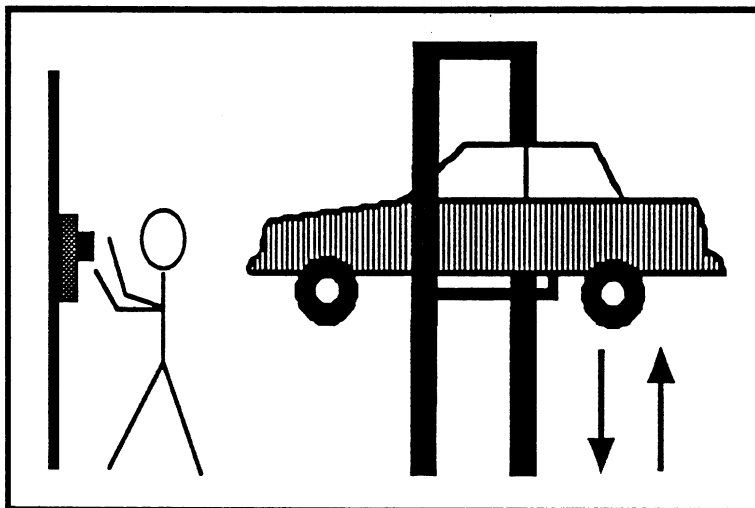


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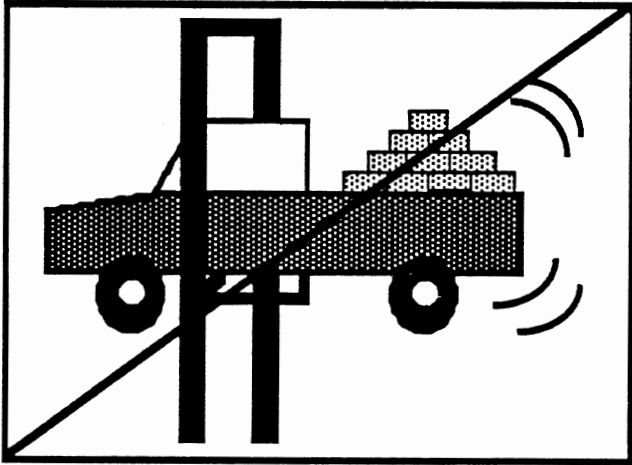


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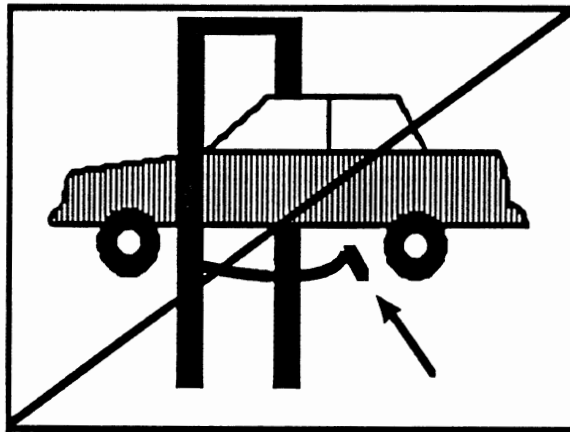


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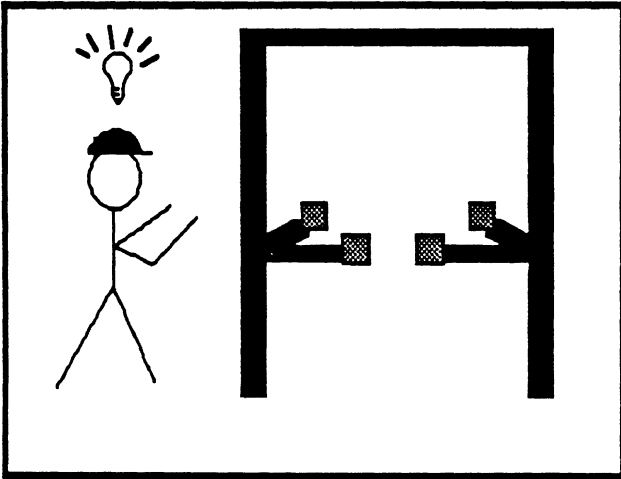


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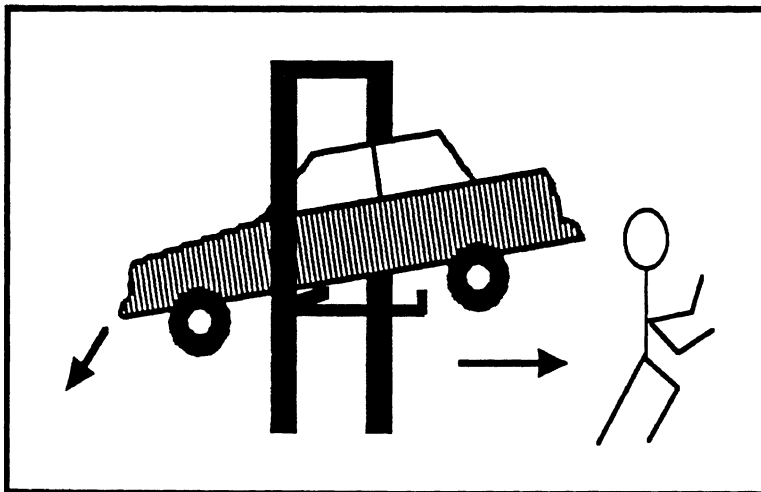


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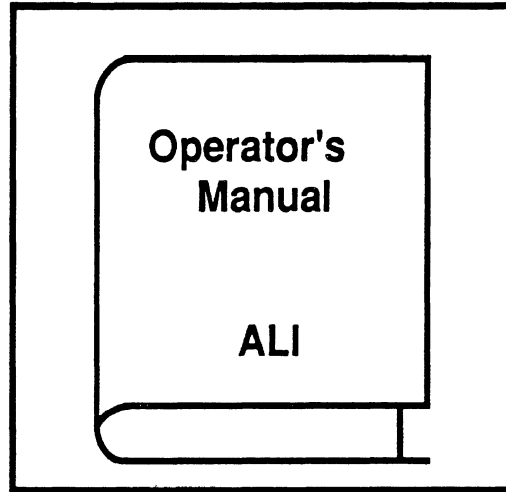
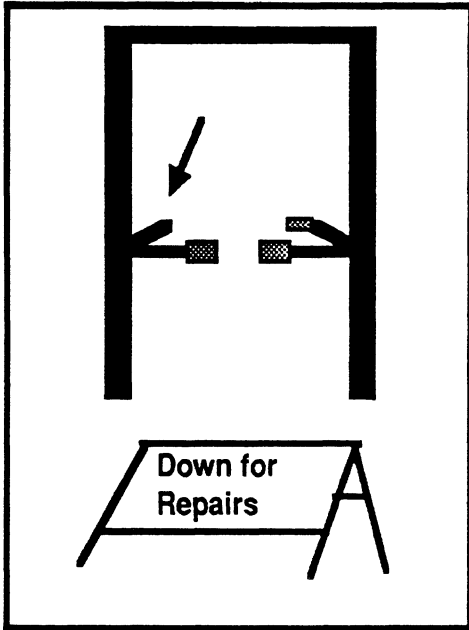
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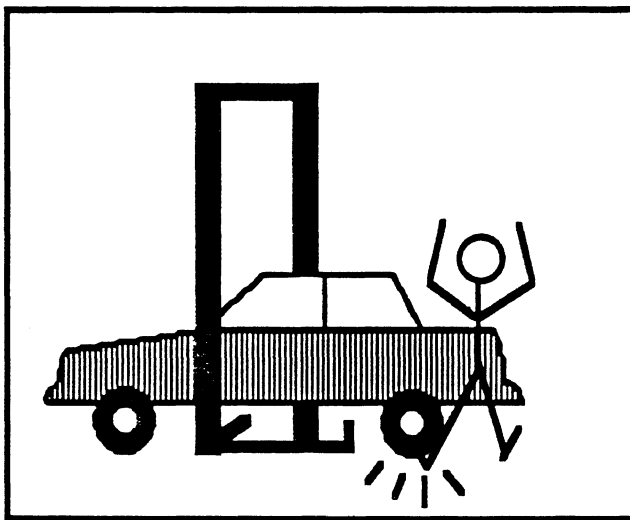


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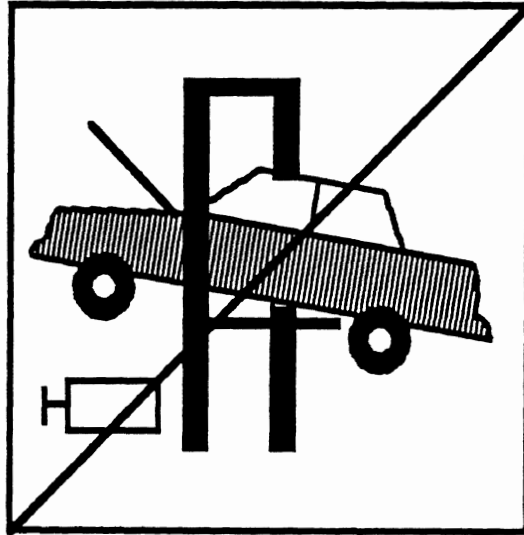
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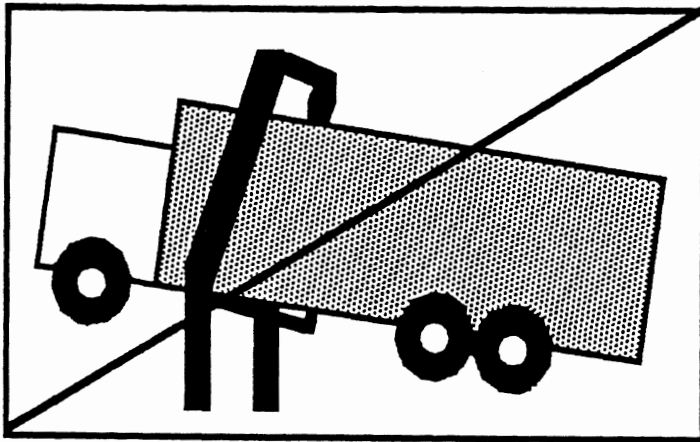


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- Appendix C - Experiment 2 -

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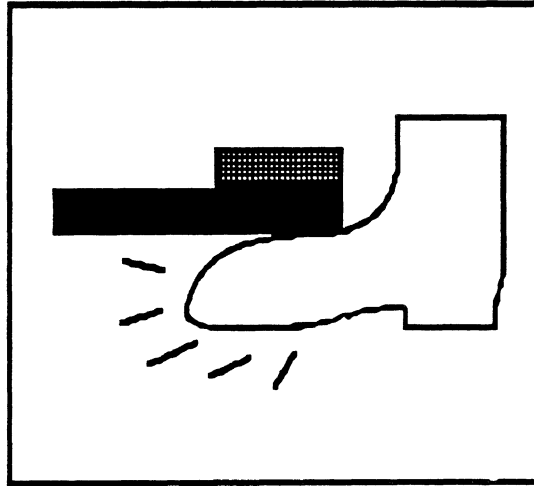
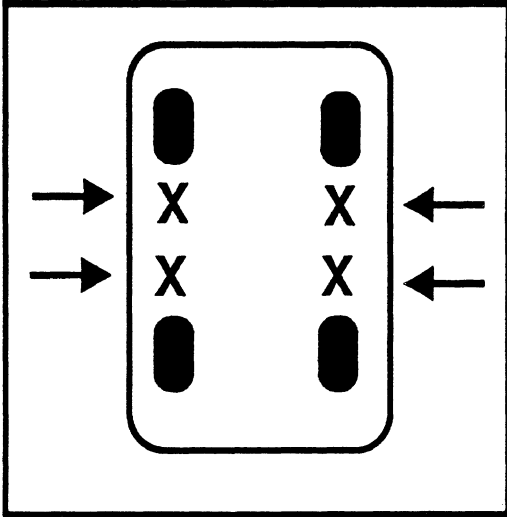
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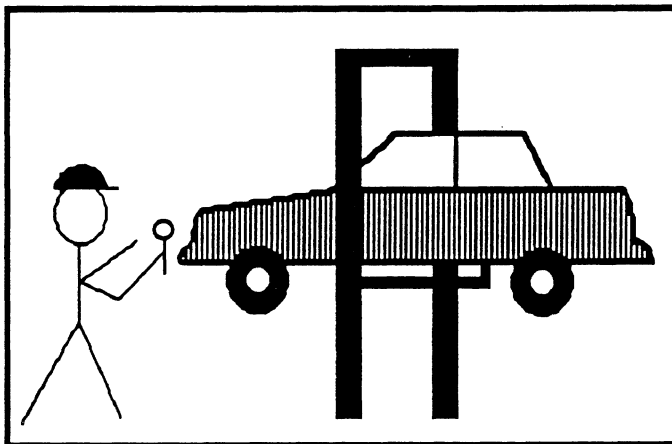


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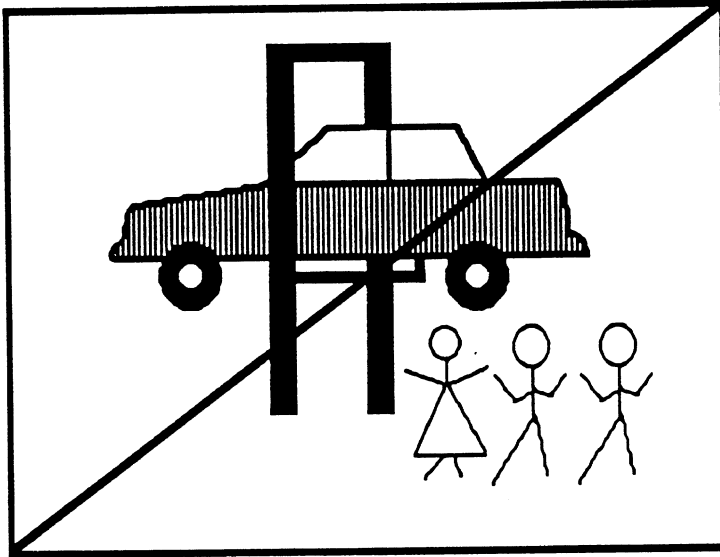
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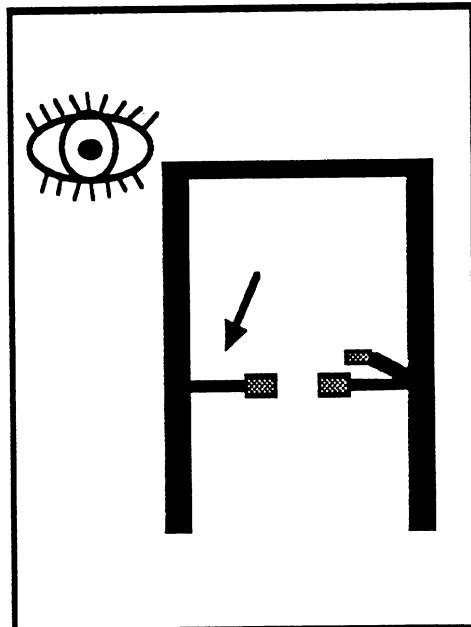
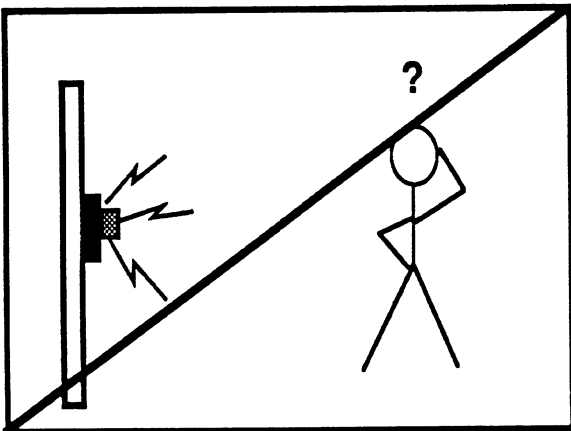
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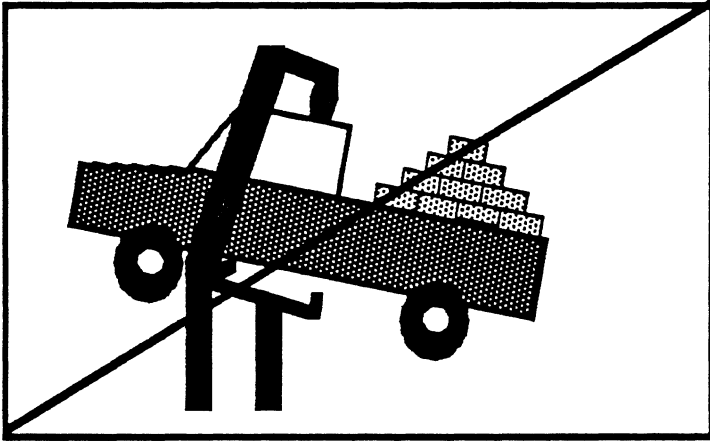
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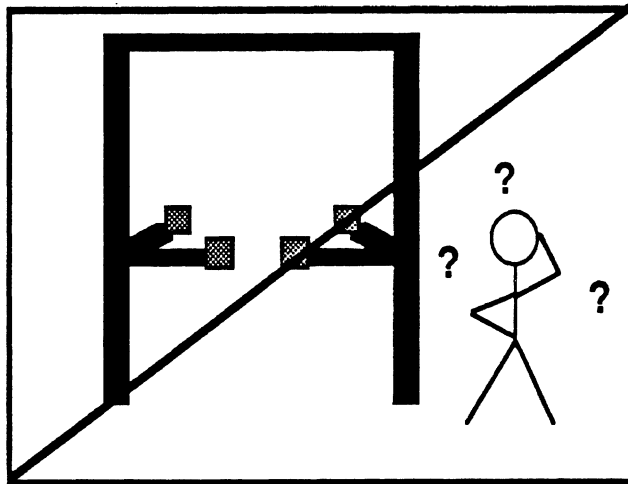


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- Appendix C - Experiment 2 -

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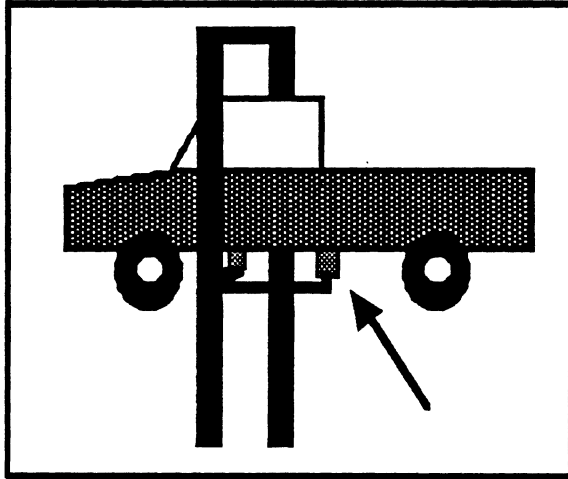
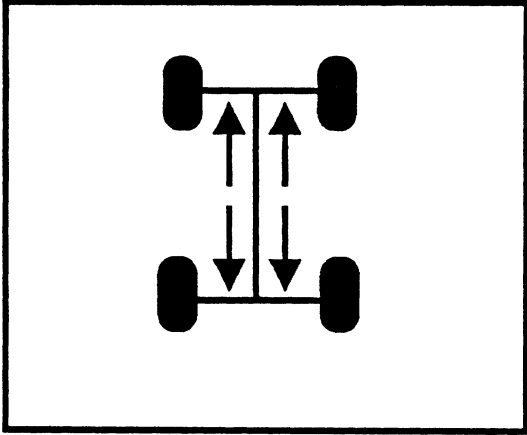
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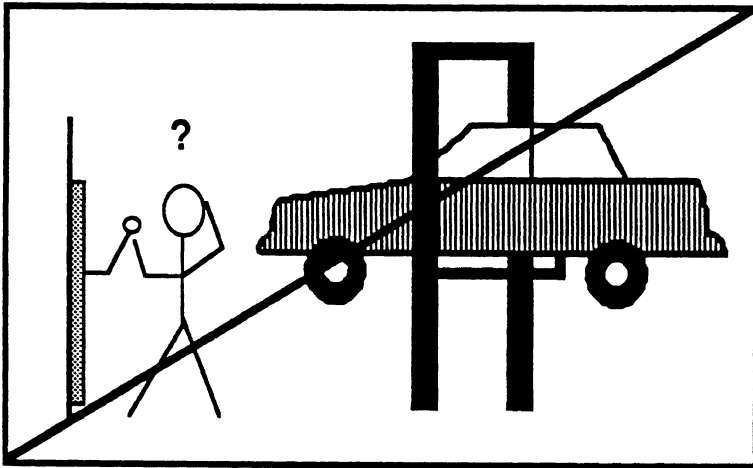


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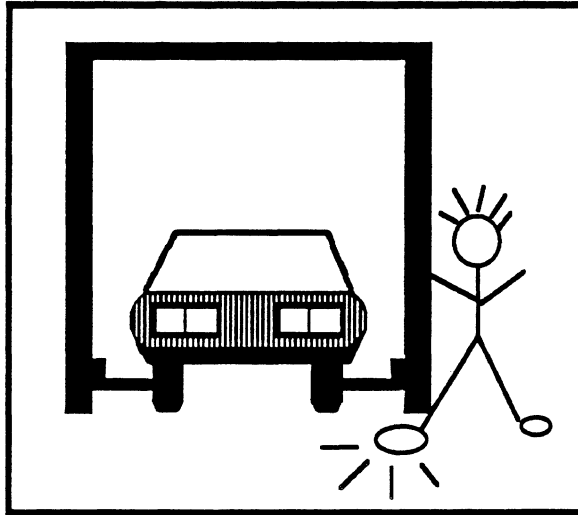
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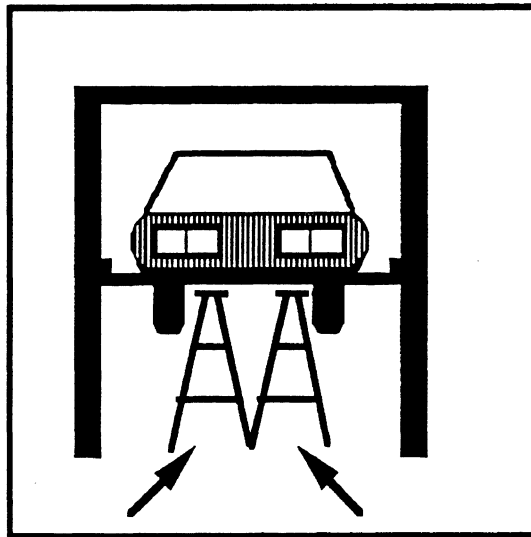
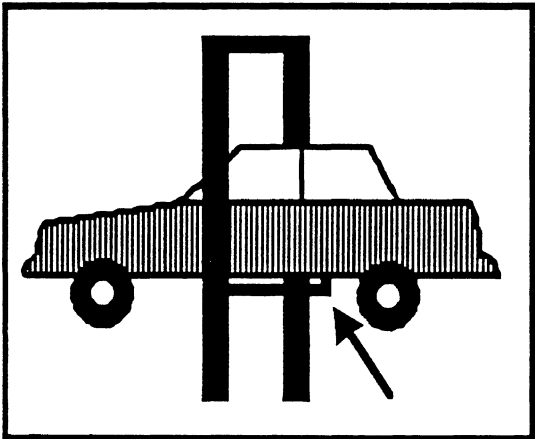
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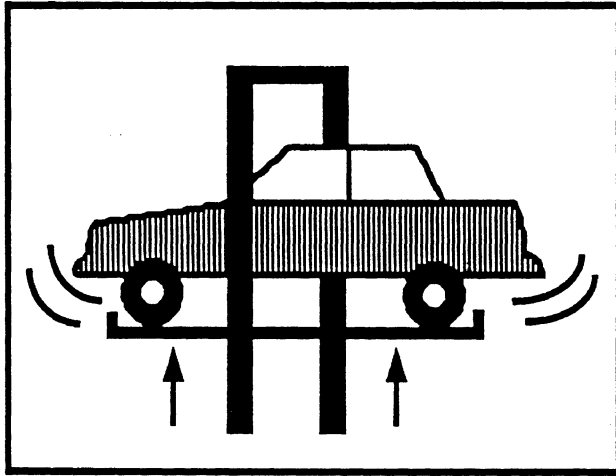
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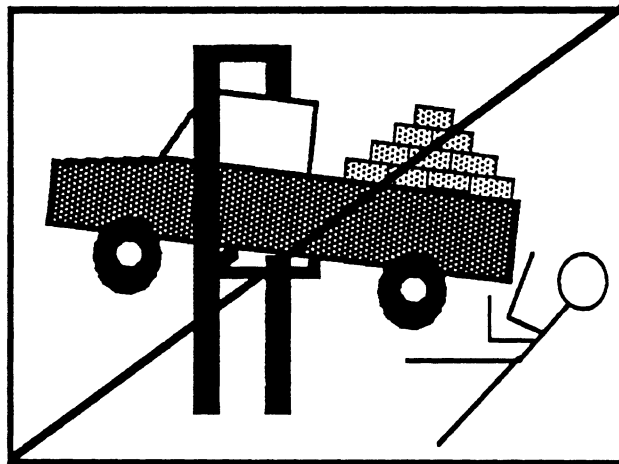


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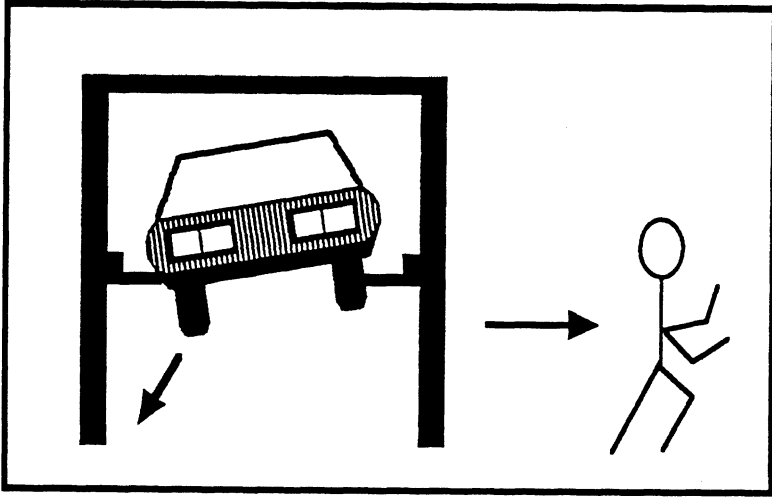
- Appendix C - Experiment 2 -

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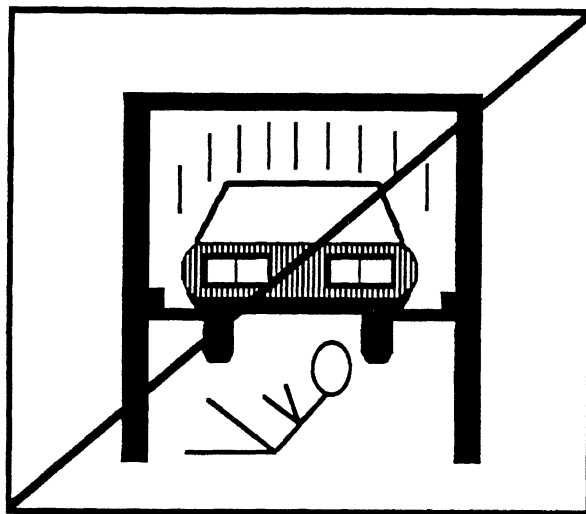


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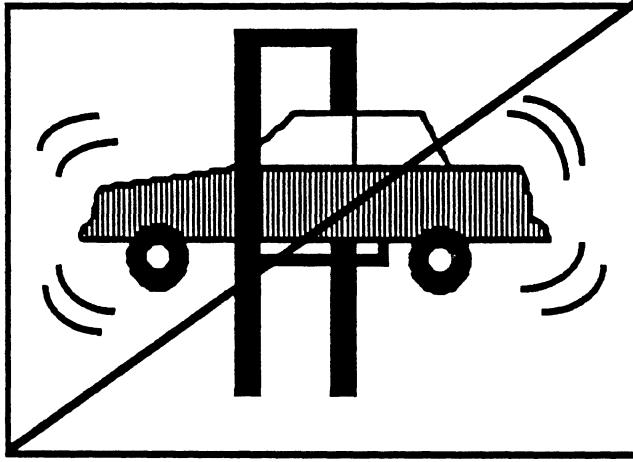


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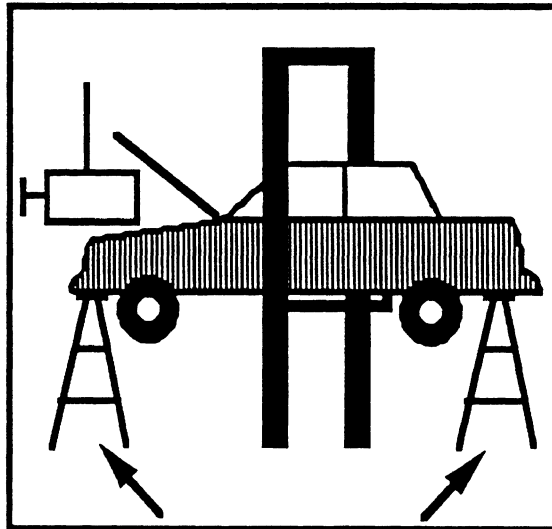
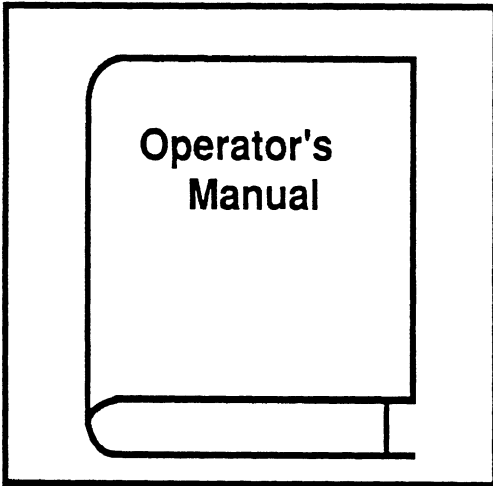
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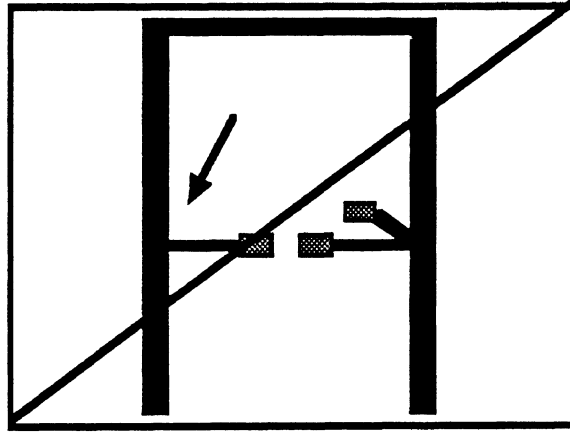
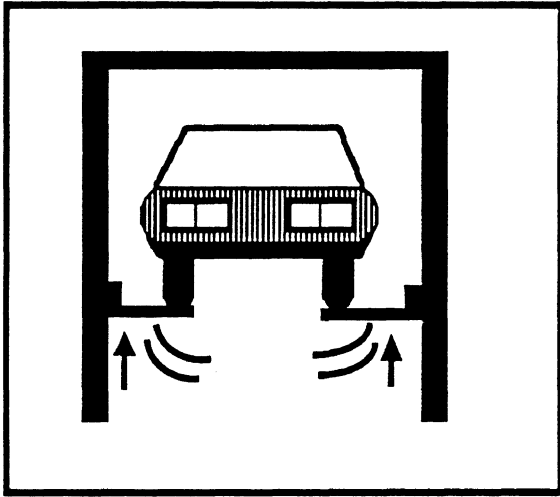
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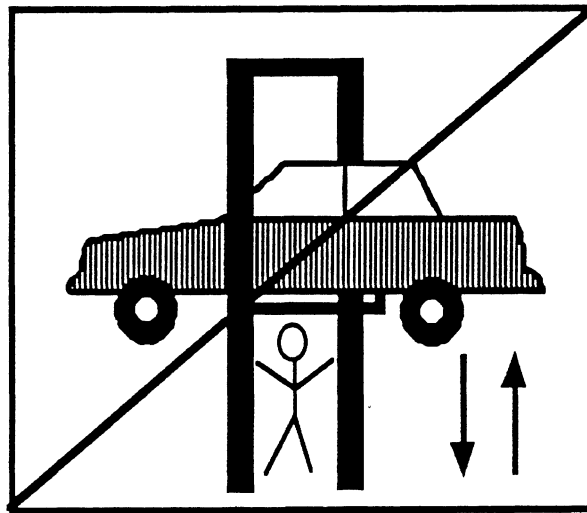
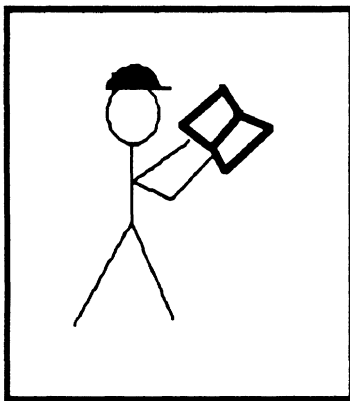
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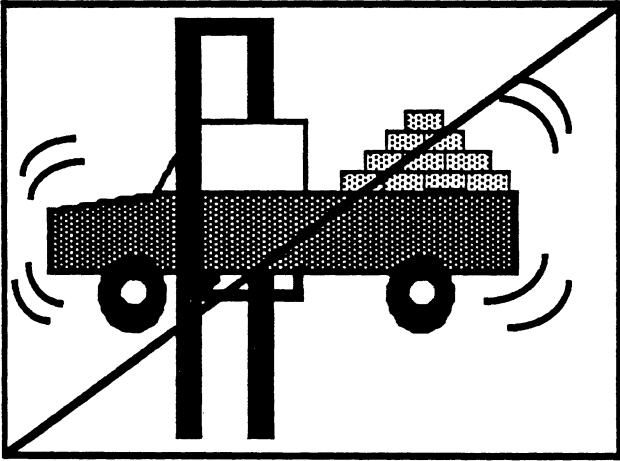
- Appendix C - Experiment 2 -

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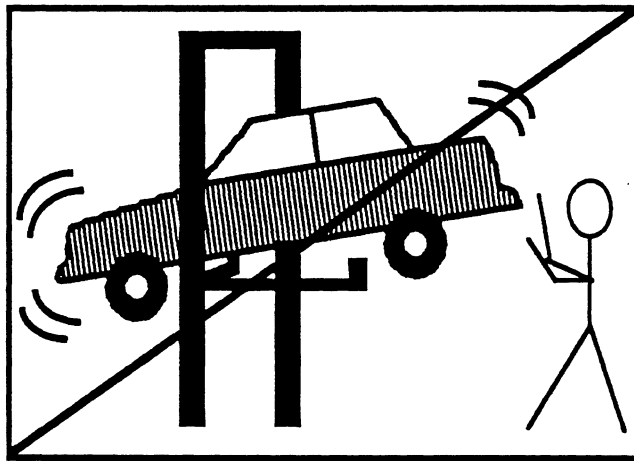


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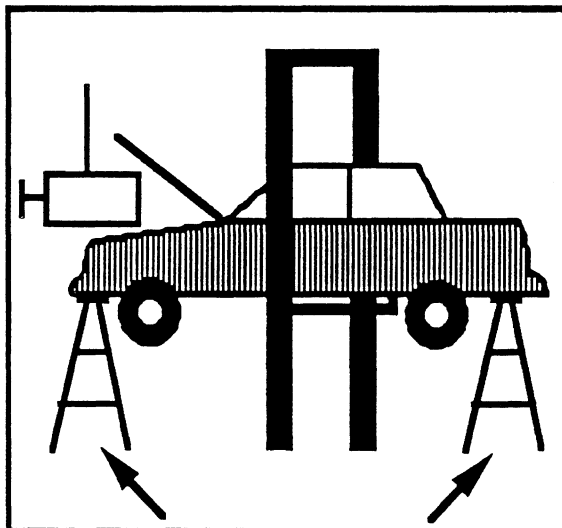
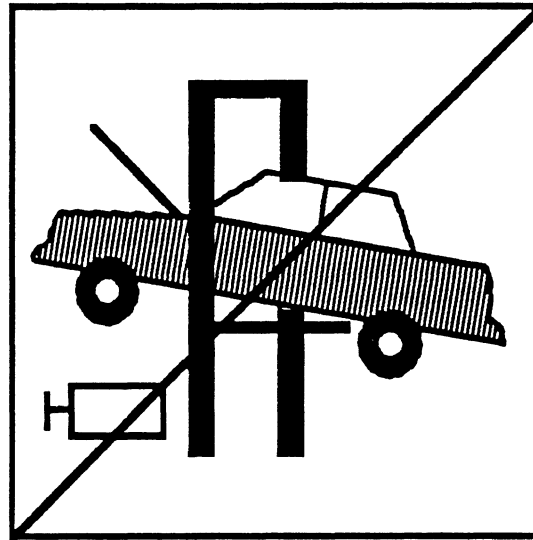
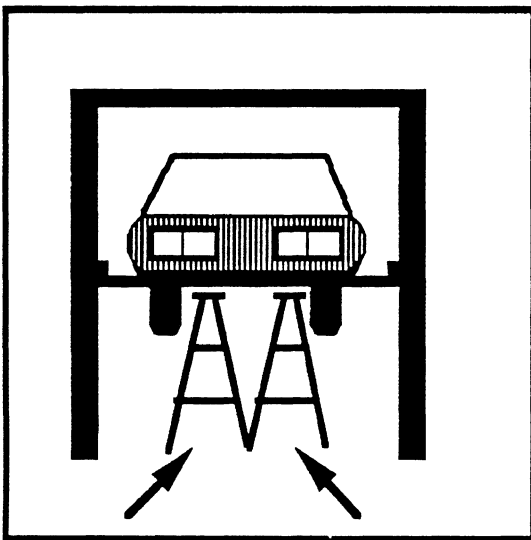
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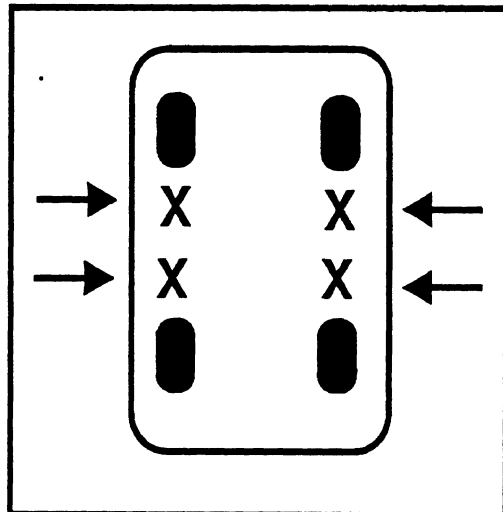
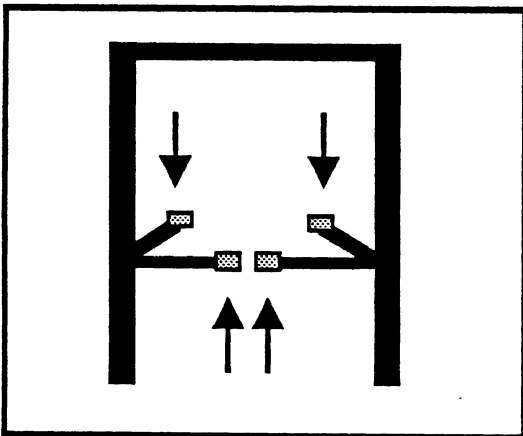
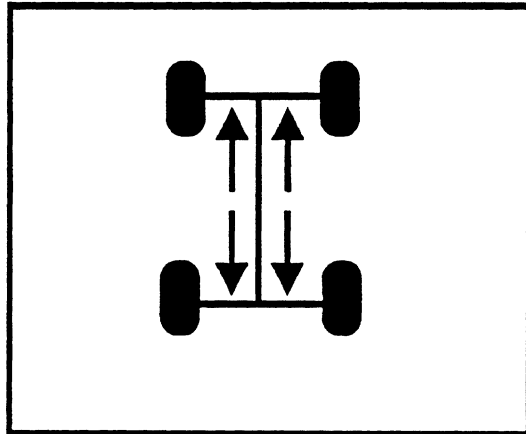
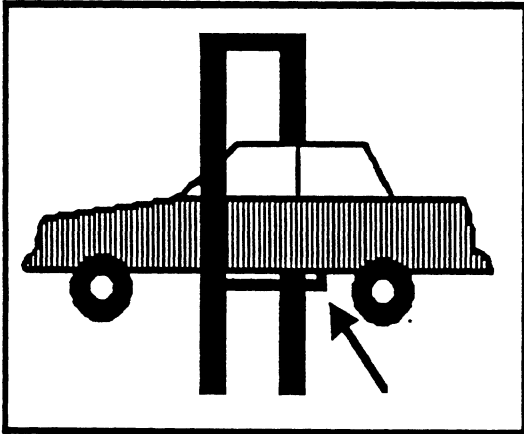
The next section of this survey shows the 14 warning descriptions with their corresponding candidate symbols. On the following pages, rank the symbol based on how well each picture describes the warning given. Label the best picture with a number 1, and the second best with the number 2 (etc.) until all possible choices have been ranked. Place your ranking in the upper lefthand corner of the picture on the space provided.

1. Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for a vehicle to fall off a hoist and injure someone. ( 1=best, 2=2nd best, etc.)

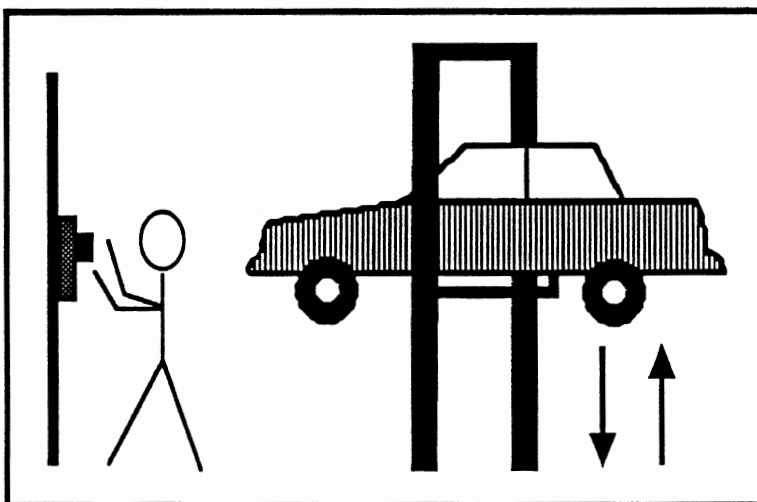
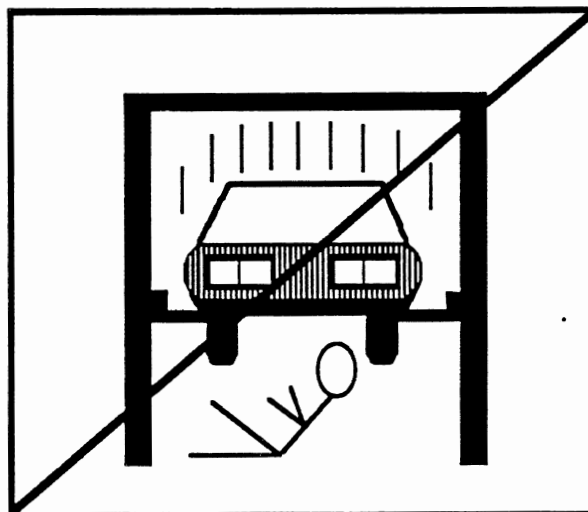
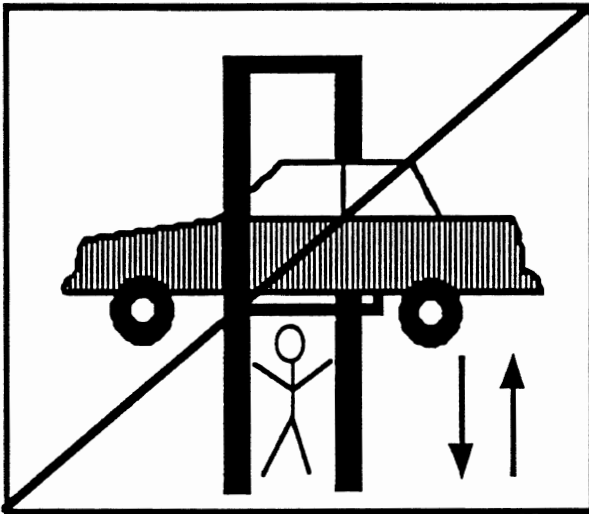


- Appendix C - Experiment 2 -

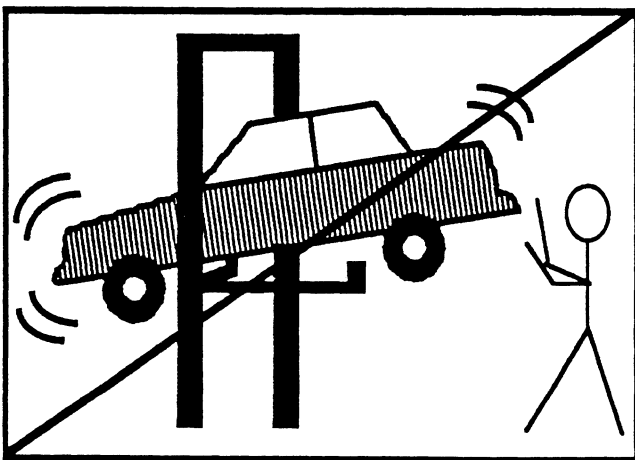
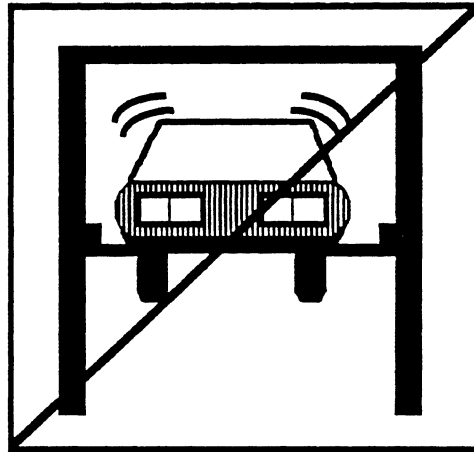
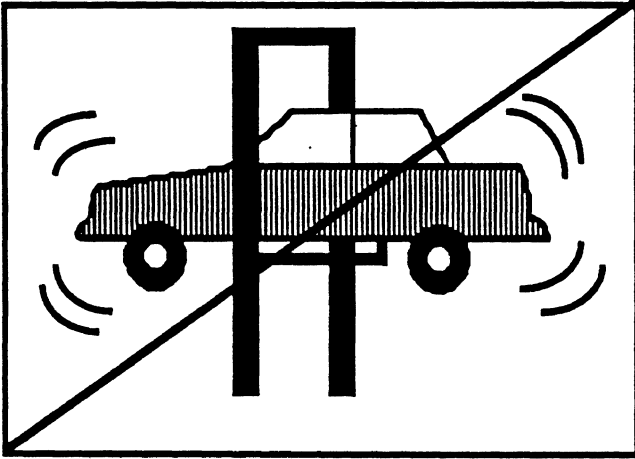
2. Always use proper vehicle spotting and manufacturer's recommended pickup points. If the proper places are not used, the vehicle will not be securely placed on the hoist and it could fall and cause serious injury. This is especially true for above ground hoists where it is tempting to place the vehicle too far forward so the doors will clear the posts.



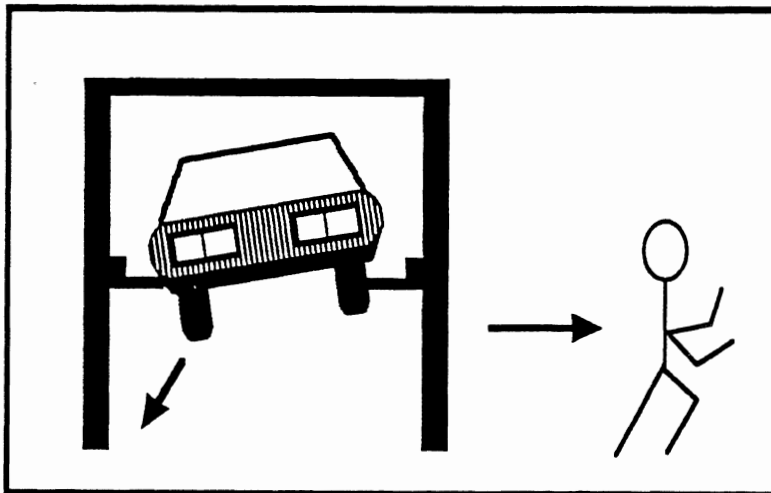
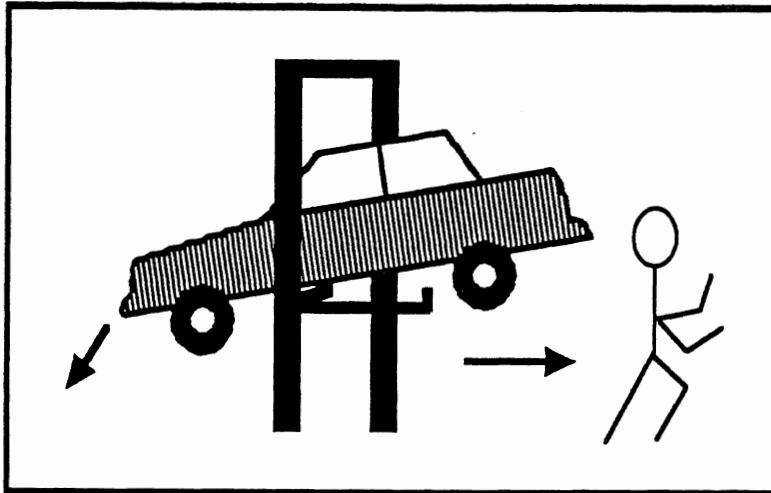
3. Do not stand under the hoist while it is raising or lowering the vehicle. If it falls, it could cause serious injury or death.



4. Do not excessively shake the vehicle while it is on the hoist. It might fall and injure someone.



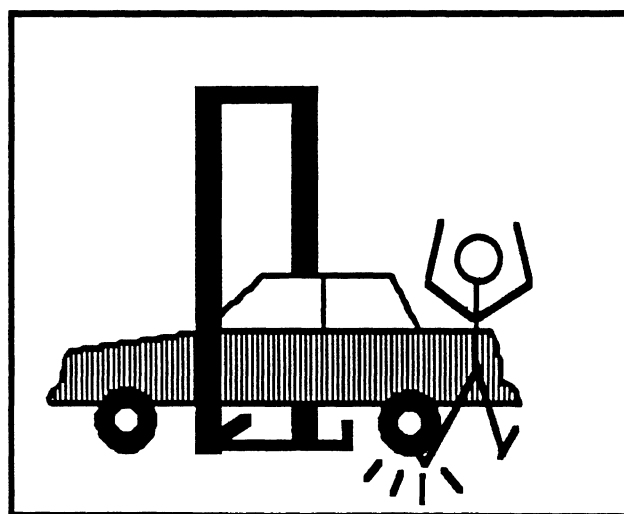
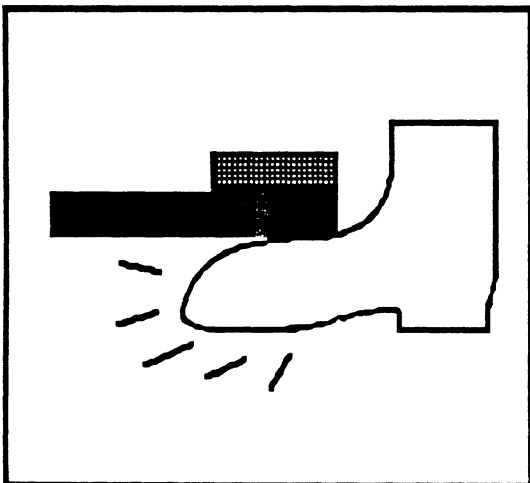
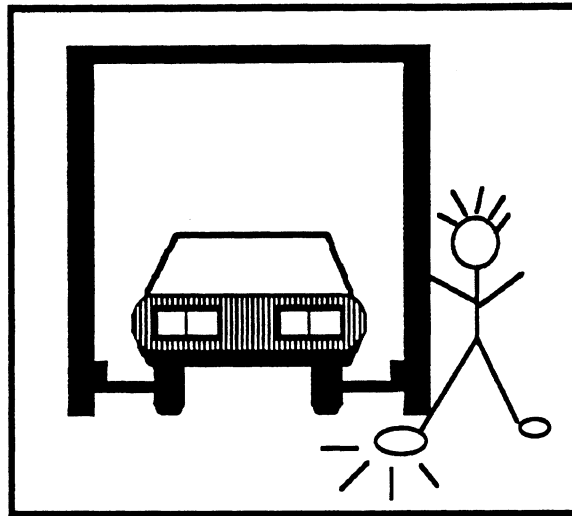
5. If the vehicle starts to fall, run away to avoid being struck by it.



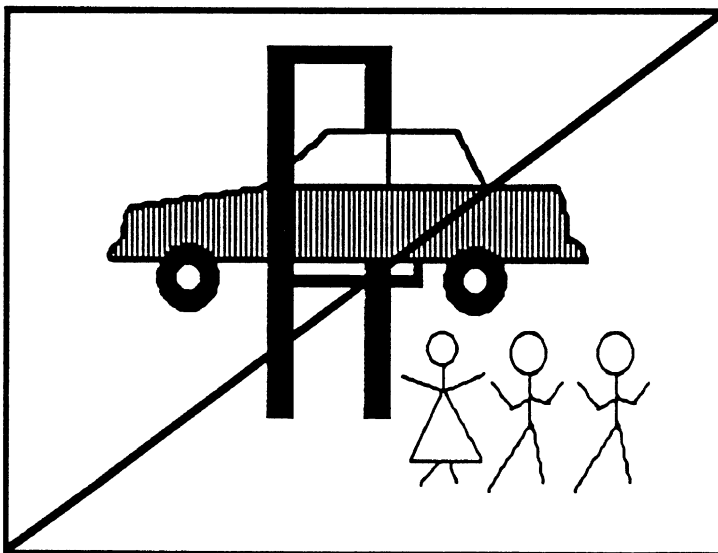
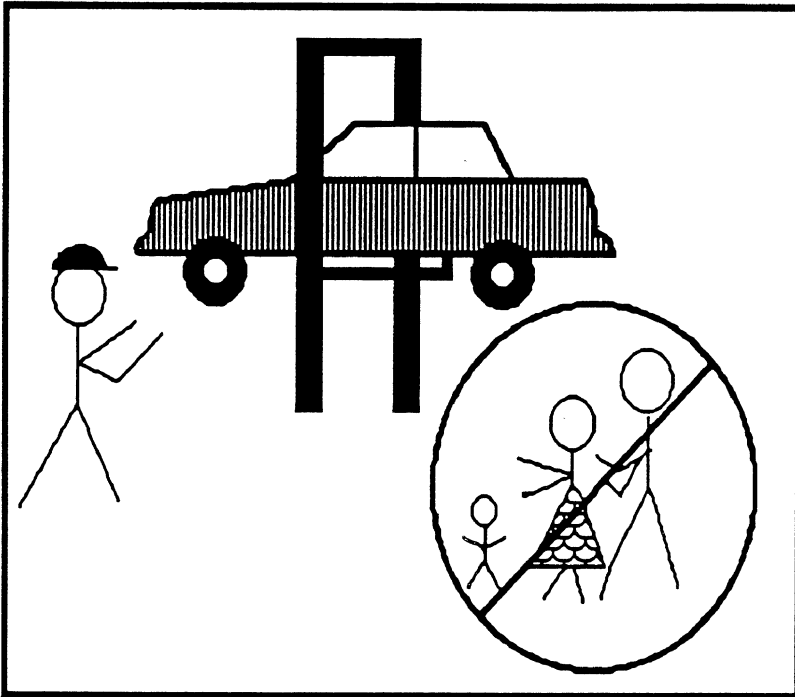


- Appendix C - Experiment 2 -

6. Keep feet from underneath the hoist while the hoist is being lowered so they will not be crushed.

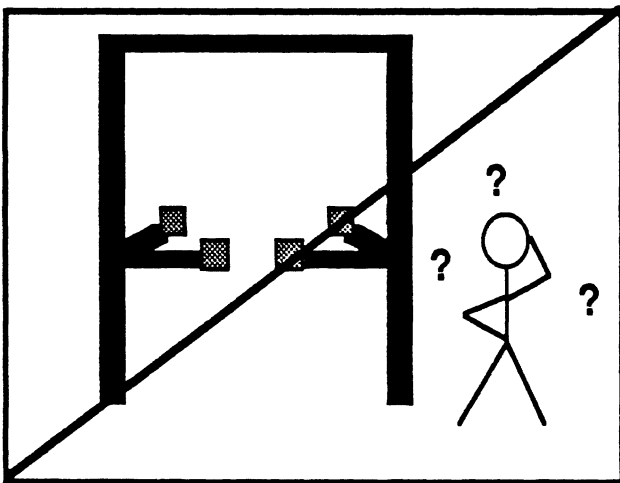
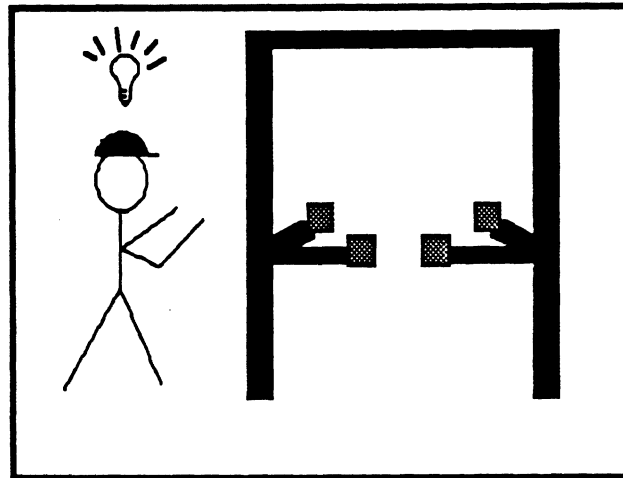


7. Unauthorized people are not allowed in the hoist area. They could get hurt.

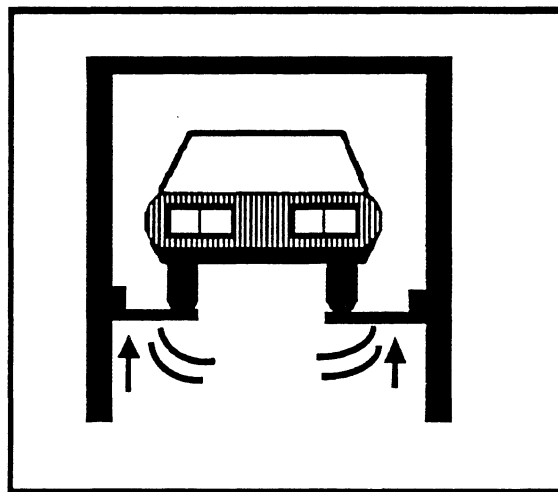
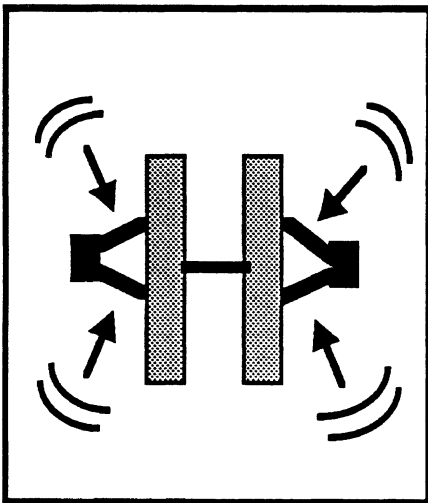
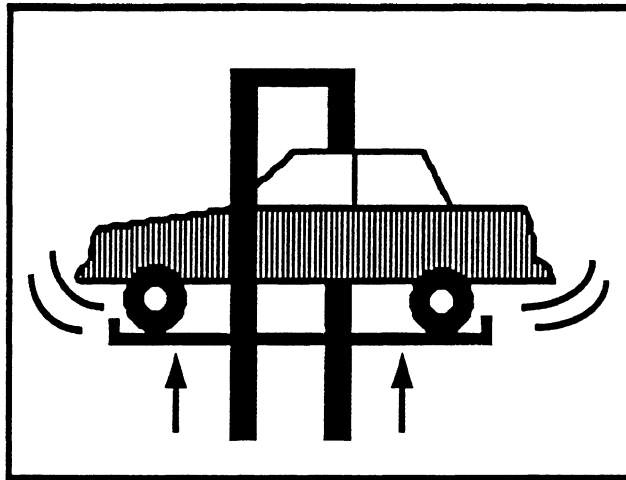


- Appendix C - Experiment 2 -

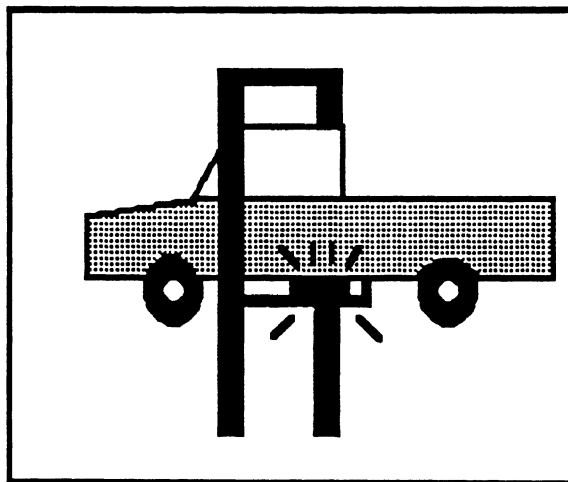
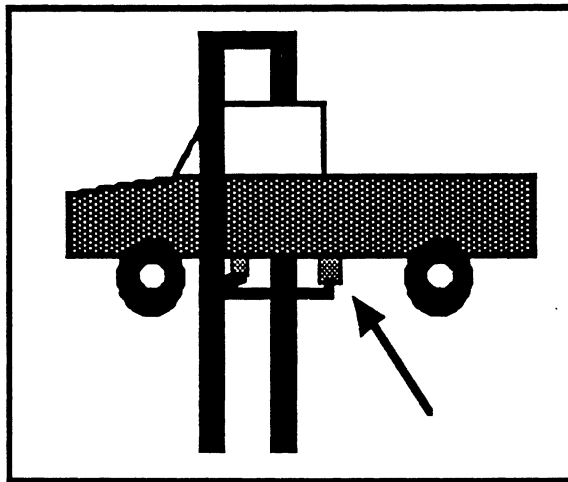
8. No one other than the trained operator should operate the hoist. Someone who is inexperienced might be hurt.



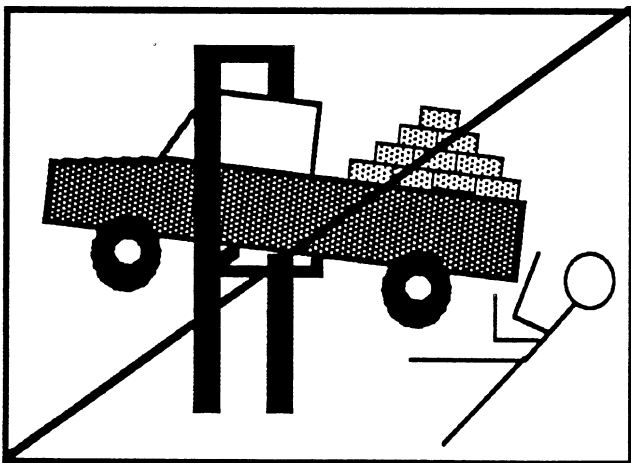
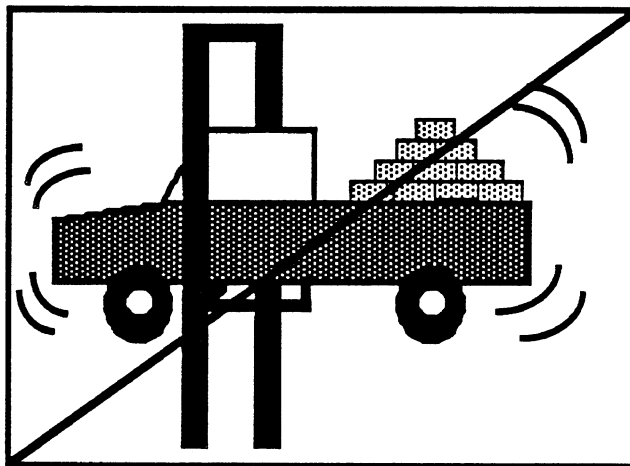
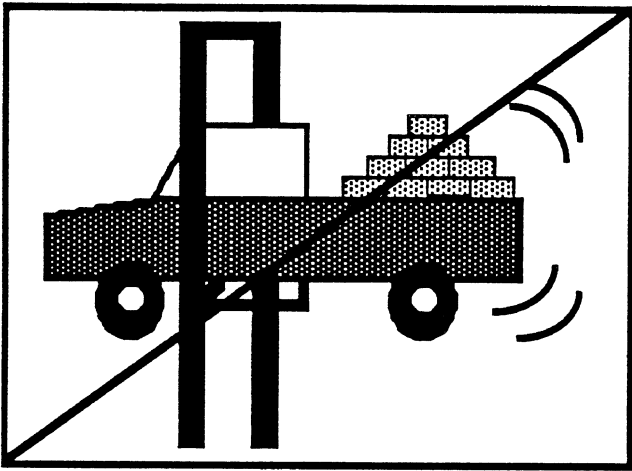
9. Use of auxiliary adapters may affect the capacity of the hoist, so that it will not be able to lift as much. If the vehicle with adapters attached exceeds the weight capacity of the hoist, the vehicle could fall.



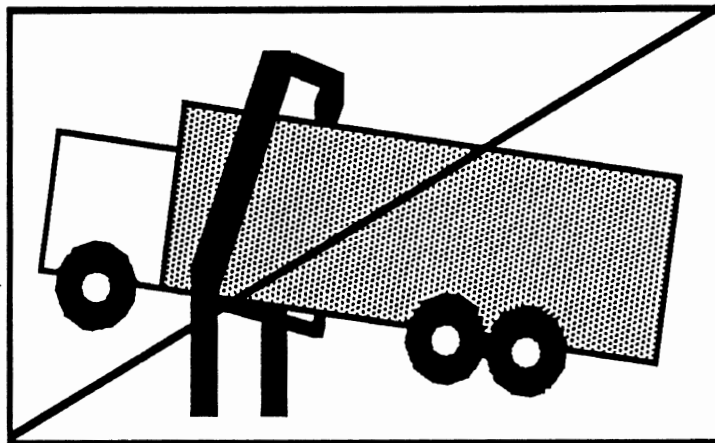
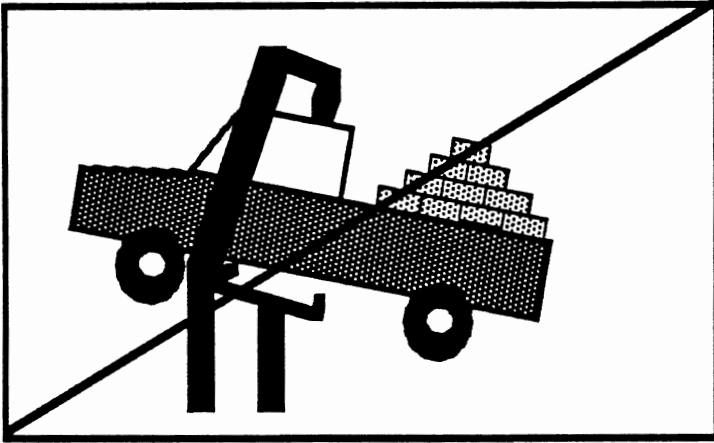
10. Some vehicles may require use of extenders for proper lifting. If extenders are not used the car would not be securely placed on the lift, and could fall off.



11. Do not exceed the weight capacity of the hoist. If the hoist is overloaded it could fail unexpectedly and injure someone. (See next page)



Number 11 continued

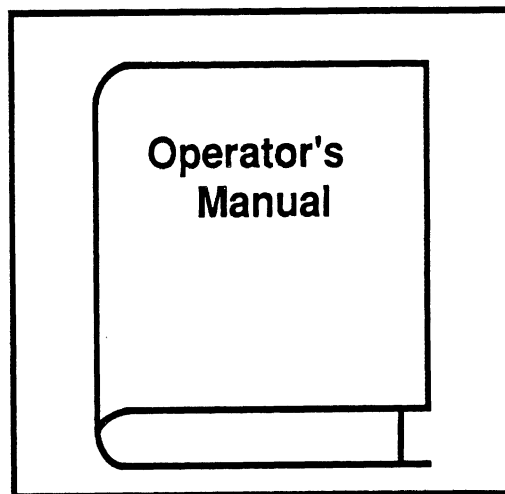
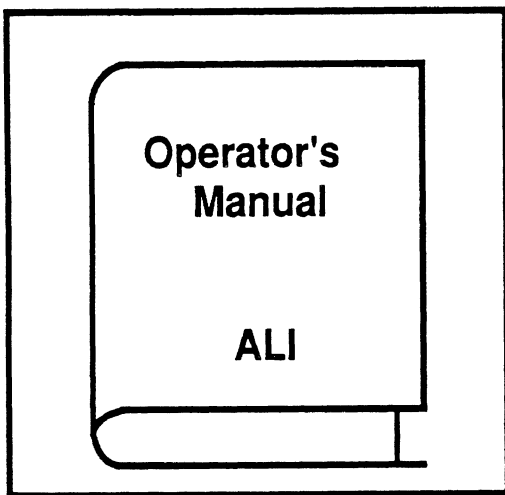
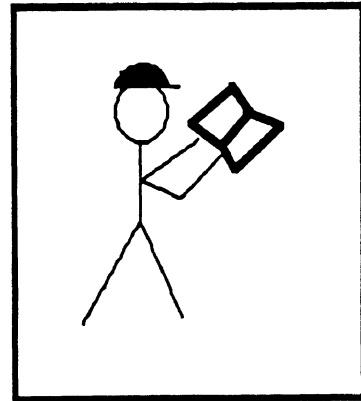
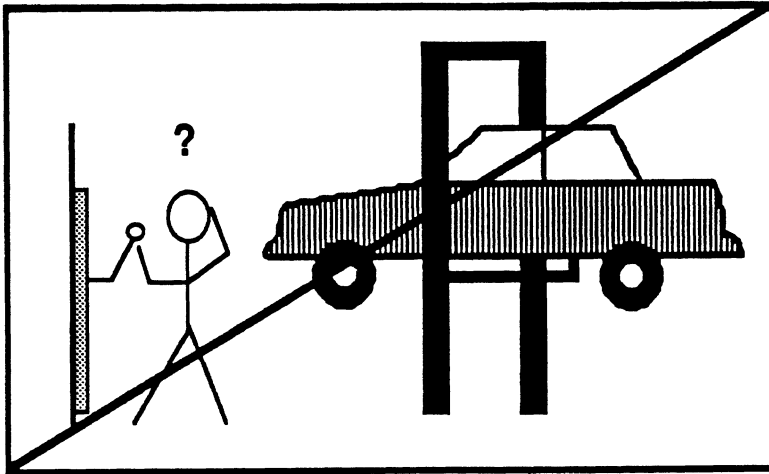


\*\*Please note in the space provided whether you prefer the large truck or the pickup with cargo for this warning.

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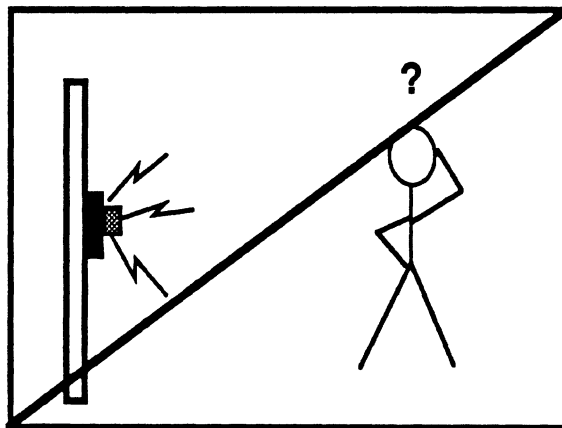
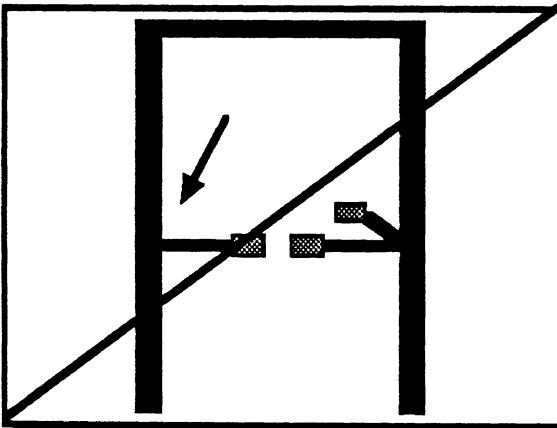
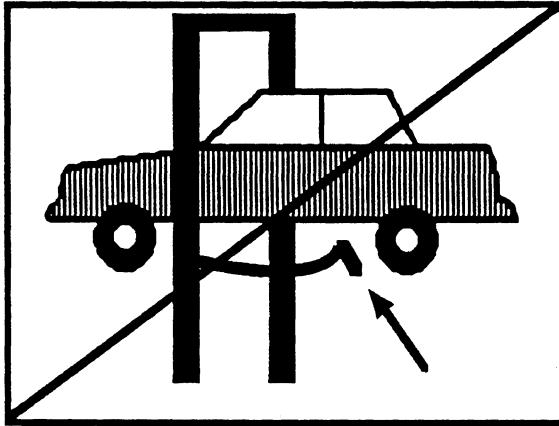
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12. Read the Automotive Lift Institute safety manual, the safety tips card, and all other lift-related printed material before operating the hoist.

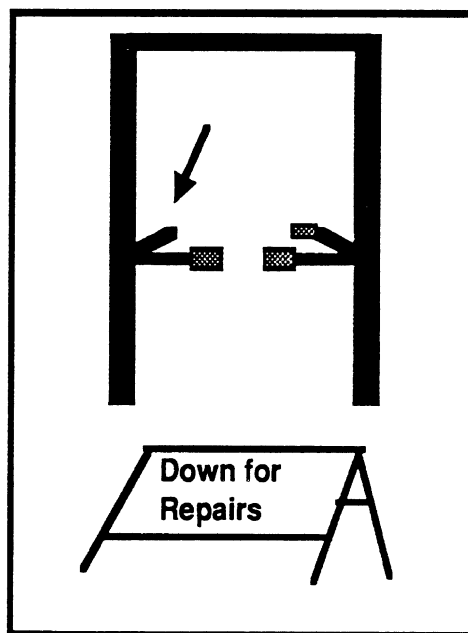
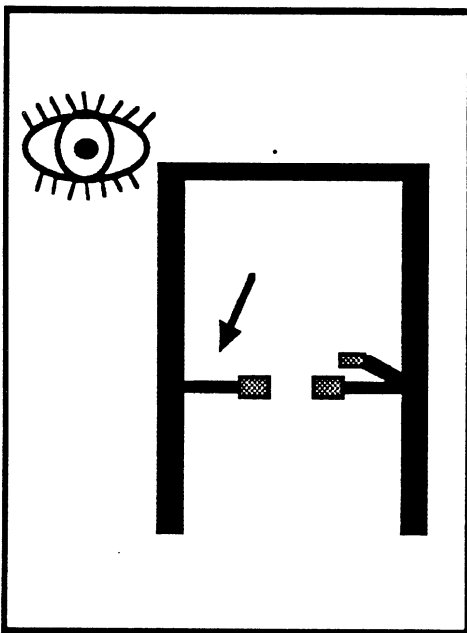
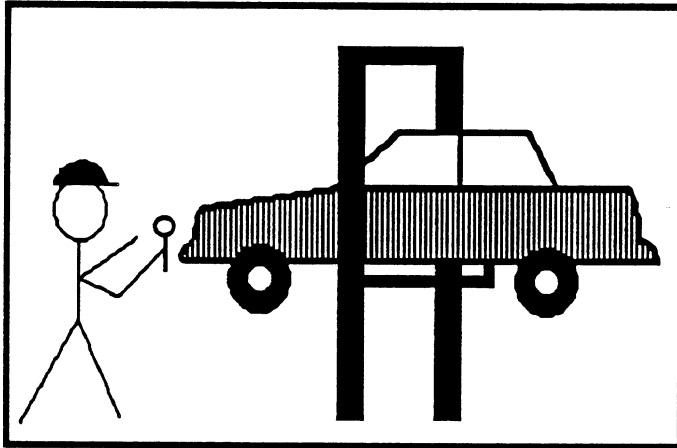




13. Do not operate the hoist if any part is not working properly.



14. Periodic inspection and maintenance of this hoist is required. If this is not followed the hoist could malfunction. Consult the owner's manual for proper maintenance procedures.



The last portion of this survey is very similar to the previous part. In this section, rank candidate text messages for the warning descriptions just as you ranked the pictures. Several candidate texts follow each warning description. Choose which text best fits the warning description given.

(1=best, 2=2nd best, 3=worst)

\*\*\*\*\*

**Warning #1:**

Use jack stands on vehicles from which components will be removed. Removing parts, especially large ones like engines and transmissions, changes the vehicle center of gravity which makes it easier for a vehicle to fall off a hoist and injure someone.

- \_\_\_\_\_ 1. Use jack stands when removing large components.
- \_\_\_\_\_ 2. Always use jack stands when removing heavy objects from vehicle.
- \_\_\_\_\_ 3. Always secure vehicle with proper jack stands when removing or installing large components.

**Warning #2:**

Always use proper vehicle spotting and manufacturer's recommended pickup points. If the proper places are not used, the vehicle will not be securely placed on the hoist and it could fall and cause serious injury. This is especially true for above ground hoists where it is tempting to place the vehicle too far forward so the doors will clear the posts.

- \_\_\_\_\_ 1. Lift vehicle using only designated pickup points.
- \_\_\_\_\_ 2. Raise vehicle at proper lift points.
- \_\_\_\_\_ 3. Check vehicle manufacturer lift points before using hoist.

**Warning #3:**

Do not stand under the hoist while it is raising or lowering the vehicle. If it falls, it could cause serious injury or death.

- \_\_\_\_\_ 1. Don't stand under hoist while raising or lowering.
- \_\_\_\_\_ 2. Stay clear of hoist when operating.
- \_\_\_\_\_ 3. Remain clear of hoist while raising or lowering vehicle.

**Warning #4:**

Do not excessively shake the vehicle while it is on the hoist. It might fall and injure someone.

- \_\_\_\_\_ 1. Keep vehicle stable when raised on hoist.
- \_\_\_\_\_ 2. Never rock vehicle while up on hoist.
- \_\_\_\_\_ 3. Do not shake vehicle in raised position.

**Warning #5:**

If the vehicle starts to fall, run away to avoid being struck by it.

- \_\_\_\_\_ 1. Run away if vehicle starts to fall.
- \_\_\_\_\_ 2. Leave area immediately should vehicle start to fall.
- \_\_\_\_\_ 3. Clear area if vehicle is in danger of falling.

**Warning #6:**

Keep feet from underneath the hoist while the hoist is being lowered so they will not be crushed.

- \_\_\_\_\_ 1. Stand clear of vehicle when it is being lowered.
- \_\_\_\_\_ 2. Keep feet clear of hoist while lowering.
- \_\_\_\_\_ 3. Keep feet from under hoist frame when lowering vehicle.

**Warning #7:**

Unauthorized people are not allowed in the hoist area. They could get hurt.

- \_\_\_\_\_ 1. Customers not allowed in service area.
- \_\_\_\_\_ 2. Authorized personnel only.
- \_\_\_\_\_ 3. Unauthorized persons please stay clear.

**Warning #8:**

No one other than the trained operator should operate the hoist. Someone who is inexperienced might get hurt.

- \_\_\_\_\_ 1. Trained personnel only.
- \_\_\_\_\_ 2. Experienced operators only.
- \_\_\_\_\_ 3. Hoist to be used by authorized personnel only.

**Warning #9:**

Use of auxiliary adapters may affect the capacity of the hoist, so that it will not be able to lift as much. If the vehicle with adapters attached exceeds the weight capacity of the hoist, the vehicle could fall.

- \_\_\_\_\_ 1. Check lift capacity when adapters are in use.
- \_\_\_\_\_ 2. Do not overload hoist auxiliary adapters.
- \_\_\_\_\_ 3. Auxiliary adapters may affect load capacity.

**Warning #10:**

Some vehicles may require use of extenders for proper lifting. If extenders are not used the car would not be securely placed on the lift, and could fall off.

- \_\_\_\_\_ 1. Use extenders when necessary to stabilize vehicle on hoist.
- \_\_\_\_\_ 2. Use extenders when required.
- \_\_\_\_\_ 3. Extenders must be used on vehicles requiring them to ensure safety.

**Warning #11:**

Do not exceed the weight capacity of the hoist. If the hoist is overloaded it could fail unexpectedly and injure someone.

- \_\_\_\_\_ 1. Check lift capacity before lifting.
- \_\_\_\_\_ 2. Do not exceed weight capacity.
- \_\_\_\_\_ 3. Do not overload hoist.

**Warning #12:**

Read the Automotive Lift Institute safety manual, the safety tips card, and all other lift-related printed material before operating the hoist.

- \_\_\_\_\_ 1. Know all proper lifting methods before using this equipment.
- \_\_\_\_\_ 2. Read safety manual before operating lift.
- \_\_\_\_\_ 3. Follow instructions in ALI safety manual when operating hoist.

**Warning #13:**

Do not operate the hoist if any part is not working properly.

- \_\_\_\_\_ 1. Do not operate a damaged hoist.
- \_\_\_\_\_ 2. Do not use faulty equipment.
- \_\_\_\_\_ 3. Hoist and components must be in proper working order before using.

**Warning #14:**

Periodic inspection and maintenance of this hoist is required. If this is not followed the hoist could malfunction. Consult the owner's manual for proper maintenance procedures.

- \_\_\_\_\_ 1. Periodic inspection is required.
- \_\_\_\_\_ 2. Service hoist regularly.
- \_\_\_\_\_ 3. Proper maintenance and inspection necessary for safe operation.

- Appendix C - Experiment 2 -

In this phase, develop warning messages using the words given below, in the order shown. Words in parentheses are optional. Circle the words selected. After choosing the words write the warning in the space provided. An example is shown below.

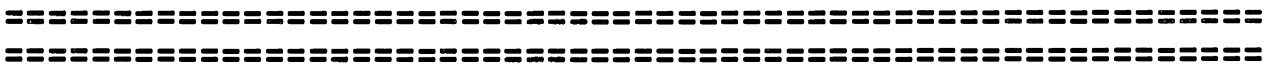
Smoking	causes	(lung)	cancer
	can lead to	(throat)	

<b>Smoking</b>	causes	lung	<b>cancer</b>
	<b>can lead to</b>	throat	

Smoking can lead to cancer.

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1. | (Always) | use | jack stands | when removing | large components |  
| | | safety stands | | heavy objects |  
--- | | from vehicle |

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2. | Don't | rock (ing) | vehicle | --- while on hoist |  
| Never | shake (ing) | car | |  
| Avoid (excessive) | | jolt (ing) | |  
| | | jounce (ing) | |

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- Appendix C - Experiment 2 -

3. | Keep | (feet) clear (of hoist) | while moving |  
| Stand | | | while lowering |

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4. | Experienced | operator(s) | only |  
| Trained | personnel | |

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5. | Use | extenders | if | required |  
| | extentions | when | necessary |  
| | adapters | | |

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6. | Read | safety | manual | before | use (ing) |  
| | operating | instructions | | hoist operation |

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## Response Data for Experiment 2--All 50 subjects (unedited)

Picture #1- Some vehicles require proper extenders for lifting

<u>Subject #</u>	<u>Response</u>
1	Do not lift in center of vehicle
2	About ground single post lift
3	Improper set up damage may occur
4	Watch for low hanging objects
5	Use contact points
6	Frame lift
7	Be sure the hoist arms contact the frame on trucks
8	Don't pick up cars with something on the hoist arms
9	Watch for proper location of hoist contacts
10	Do not lift in center of vehicle
11	Watch where you put hoist under car
12	No lift pads
13	Use proper blocks to give extra clearances, if needed to obtain proper contact
14	Check vehicle clearance
15	Be careful of vehicle under body when sing hoist
16	—
17	Use hoist adapter for certain vehicles
18	Make sure arms contact frame
19	Watch for lift arms hitting fuel tank
20	Do not lift off of lift rests
21	Use proper lift points
22	Center on frame no body panel
23	Watch for body damage
24	—
25	Not setting up right
26	Watch for underside obstructions
27	Not proper clearance
28	Watch low hanging parts on vehicle
29	—
30	Do not block under vehicle for lifting purposes
31	Hoist on body be careful of low things under truck
32	—
33	—
34	—
35	—
36	—
37	—
38	Hoist set too far to rear
39	Lift points
40	Improper lift of TAK hoist hitting bottom
41	Use proper lift points
42	Use correct pad locations
43	Do not leave objects on hoist arms
44	Set hoist clear of under body parts on vehicle
45	Truck not properly supported
46	Check pad clearance
47	Use of this style hoist could cause damage to underbody
48	—
49	Check under vehicle for low hanging parts
50	Make sure vehicle weight is centered before lifting

- Appendix C - Experiment 2 -

Picture #2- Use proper vehicle spotting and manufacturer's pickup points.

<u>Subject #</u>	<u>Response</u>
1	Looks more like directions to set a hoist and obviously not correct.
2	Above ground 4 point frame contact lift
3	Lift pads
4	Watch adjustment
5	Up and down position
6	—
7	Make sure all hoist arms are in place on hoist
8	Adjust hoist at these points
9	Make sure hoist arms are proper position when raising cars or trucks
10	Make sure pads are set in place before lifting
11	Arms go up- down
12	Pad not centered
13	Space lift points evenly
14	—
15	Always center vehicle and use proper lift points
16	—
17	Arrows show pad position
18	Watch for moving equipment
19	Inspect lift pads
20	—
21	—
22	Pad move by different controls
23	Lift points
24	—
25	Hoist not set right
26	Don't leave arms extended
27	Maintenance
28	—
29	Make sure pad are set properly
30	Adjust lifting arms to lift vehicle at proper lifting points
31	Lower hoist before using
32	—
33	—
34	—
35	Always use all lifting arms when using hoist
36	Hoist pads
37	—
38	Proper way to set hoist
39	Visual inspection
40	Don't know
41	Use proper lift points
42	—
43	Adjust hoist arms
44	Hoist arms swing in and out
45	Hoist with direction arms
46	Check hoist pads
47	Position hoist pads like this - ft pads 90 degrees, rear 45 degrees
48	—
49	Check hoist pads to be sure they are level
50	—

- Appendix C - Experiment 2 -

Picture #3 - Don't excessively shake vehicle

<u>Subject #</u>	<u>Response</u>
1	Watch for contact with top of vehicle
2	Do not lift if car is unsteady
3	Watch for shaking or vibration when lifting
4	No tall vehicles
5	Do not lift
6	No lift
7	Do not rock vehicle when on hoist
8	Make sure car doesn't teeter totter on hoist
9	Don't run car on hoist
10	—
11	Make sure car is on hoist level
12	Do not lift all the way up
13	Don't use a hoist when a vehicle shakes on it
14	Do not let vehicle bounce
15	Be sure vehicle is stable on hoist
16	Car in backwards
17	Do make car unstable when on hoist
18	Do not rock car
19	Excessive vibration when lifting
20	Center car on hoist
21	Do not allow vehicle to rock
22	Don't leave car running on hoist
23	Do not shake car
24	Do not shake vehicle
25	—
26	Watch overhead clearance
27	Do not shake
28	—
29	—
30	Do not lift vehicle if unstable on hoist/ relocate lifting arms
31	Watch car top
32	Center car
33	Do not raise vehicle too high
34	—
35	Make sure vehicle is stable on hoist
36	Do not raise if vehicle wiggles
37	Do not shake vehicle
38	Watch height of vehicle
39	Unsafe to hoist
40	Don't lift
41	Watch overhead clearance
42	Do not bounce vehicle
43	Do not rock vehicle
44	Do not hoist cars- damage may occur to top of car
45	Car unstable
46	Do not shake
47	Don't rock vehicle while on hoist
48	Warning- may cause damage to roof of vehicle if lifted too high
49	Warning- Do not run vehicle while in a raised position
50	Make sure vehicle is stable before lifting

- Appendix C - Experiment 2 -

Picture #4 - Use of auxiliary adapters may affect hoist capacity

<u>Subject #</u>	<u>Response</u>
1	Keep clear from this area of hoist
2	In-ground drive-on lift
3	Hoist arms lifting position
4	Beware of hoist legs
5	Arms swing in
6	Adjust arms in
7	—
8	Adjust hoist at these points
9	Be careful Hoist moves freely
10	—
11	Watch your step arms swing
12	Pad not out
13	Don't space arms too closely together
14	—
15	Center vehicle prior to driving onto hoist
16	—
17	Arrows show hoist pad movement
18	Swing arms inward to contact car frame
19	Excessive vibration when lifting
20	Make sure all arms are positioned
21	—
22	Four wax adjusted pads
23	—
24	Make sure hoist is secure
25	—
26	Don't use adapters
27	Do not adapters
28	—
29	—
30	Do not use hoist if lifting arms are badly worn
31	Drive on make sure load is centered
32	—
33	—
34	—
35	Make sure lift arms are locked before lifting a vehicle
36	—
37	—
38	Pads not fully under could slip out
39	Caution- Hazardous area- adapters in use
40	—
41	Use proper lift points
42	Beware of moving parts
43	Use adapters when necessary
44	—
45	Earthquake around hoist
46	Check all pads supporting vehicle
47	Hoist supported at these points
48	Hoist may sway
49	Be sure hoist is secure
50	—

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Picture #5 - Unauthorized people not allowed

<u>Subject #</u>	<u>Response</u>
1	Keep people away from hoisted vehicle
2	Hard hat required- Authorized personnel only
3	No customers allowed when vehicle is lifted
4	No people allowed in hoist area
5	Workers only
6	Technician only - No customers
7	Do not have other people around vehicle on a hoist
8	No customers under hoist
9	Wear hard hat when working in this area- No unauthorized personnel allowed
10	No customers allowed in hoist areas when in use
11	Keep people away from hoist with car on it
12	No customers in work area
13	Don't allow customers around hoists
14	Do not let customers under vehicle without hard hat
15	No customers under raised vehicles
16	Keep customers out of vehicle when on hoists
17	Do not allow pedestrians around hoist
18	Authorized personnel only
19	No unauthorized personnel near lift
20	Employees only in lift area
21	Do not allow unauthorized persons under vehicle on lift
22	Hard Hat No onlookers
23	Keep unauthorized people away
24	—
25	Shop people only
26	Keep out of mechanic stalls
27	Keep away
28	Pedestrians stay out
29	No customers in or under car while it's being worked on
30	Keep all personnel clear of hoist area
31	Stay away from under hoist
32	Do not go under lift
33	Wear hard hat in hoist area
34	Keep clear of hoist
35	No one but the operator should be near or under the hoist
36	—
37	Keep others clear while operating hoist
38	Keep customers out of work area
39	Caution - Hazardous area had hat required - no public allowed
40	Work area authorized people only
41	Mechanic only under car
42	No unauthorized people in area
43	Authorized personnel only
44	Keep unsupervised people away from hoist when in use
45	No relatives helping out on the job
46	Do not allow families near car while being worked on
47	Customers not allowed around vehicles while raised
48	No customers around hoist
49	Warning - No unauthorized persons in work area
50	Customers are not allowed in hoist areas

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Picture #6 - Don't stand under hoist while raising or lowering

<u>Subject #</u>	<u>Response</u>
1	Keep clear of vehicle when raising or lowering vehicle- Remain at controls
2	Electrically operated above ground hoist
3	Control panel operated
4	Stand clear
5	Use remote controls
6	—
7	Always use controls when lowering or raising car
8	The controls are wall mounted
9	What hoist moves up and down at any time
10	Stand clear when operating hoist
11	Stand clear car will go up or down
12	Hoist going up or down
13	Watch what vehicle is doing, when raising and lowering hoists
14	—
15	Be sure of how to control hoist prior to using
16	—
17	Operator moves hoist up and down from control on wall
18	Watch for raising and lowering of vehicles
19	—
20	—
21	Stand away from vehicle while raising or lowering
22	Hoist move in up and down mode
23	All the way up or down
24	—
25	Watch for falling
26	Use controls to raise and lower
27	Raise and lower
28	—
29	Remember up and down
30	Keep hoist controls far enough from hoist for safety purposes
31	Lower and raising hoist
32	—
33	—
34	Learn controls
35	—
36	Up and Down control is on wall
37	Keep clear while operating hoist
38	—
39	Caution - hoist area
40	Up and down controls
41	—
42	Stand clear of raising/lowering vehicle
43	Keep clear when raising and lowering
44	Hoist control
45	Knowing how to raise and lower hoist
46	Stand away while raising or lowering
47	Use control to lift of lower car
48	Stand clear of hoist when raising or lowering
49	Stay clear of hoist while raising and lowering
50	Do not stand under vehicles when lifting or lowering



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Picture #7 - Don't exceed weight capacity

<u>Subject #</u>	<u>Response</u>
1	Do not raise vehicle with load
2	Do not lift unstable heavy loads
3	Unsafe - Do not lift
4	Do not lift loaded vehicle
5	Don't overload one end
6	No lift of loaded vehicles
7	Do not put trucks with payloads on hoist
8	Don't raise trucks that are loaded
9	Center truck or Don't overload a hoist
10	Never lift uneven load
11	Watch that weight of vehicle is centered
12	No loads in rear while lifting
13	Overloaded or vehicles with mislocated weight transfer can cause shaking vehicle dangerous
14	Do not pick vehicle in this manner
15	Lift weighted vehicle evenly on hoist
16	Distribute wight evenly
17	Do not lift vehicle with overload in rear
18	Do not overload: distribute weight evenly
19	Overweight uneven load
20	Do not lift loaded trucks
21	Do not lift vehicle with uneven load
22	Don't lift with a load
23	Do not lift unbalanced load
24	Do not overload hoist
25	Too much weight
26	Don't overload
27	Unbalanced
28	Do not off balance vehicle
29	Don't lift with load unbalanced
30	Do not lift vehicle with balast
31	Uneven load use twin axle hoist
32	Balance weight
33	Do not raise a vehicle with a heavy load
34	Don't overload hoist
35	Do not attempt to lift a vehicle with an excessive load
36	Do not lift lopsided loads
37	Do not lift trucks when loaded
38	Vehicle not balanced properly
39	Don't lift unbalanced load
40	Don't overload
41	Do not lift loaded vehicles
42	Do not raise loaded vehicle
43	Do not overload hoist
44	Do not lift uneven or overloaded loads
45	Trucks rocking
46	Do not shake with tail heavy loads
47	Don't lift trucks that are loaded
48	No weight in truck beds when lifting
49	Do not raise uneven loads
50	Do not lift vehicles with uneven payloads

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Picture #8 - Don't operate if any part isn't working properly

<u>Subject #</u>	<u>Response</u>
1	Do not raise vehicle without all supports in place
2	Do not lift without all points in contact
3	Equipment damage - Do not lift
4	Watch for hanging pieces
5	Center vehicle
6	Position so all pads contact
7	Do not leave hoist arm away from vehicle when on hoist
8	Don't use the hoist if the arms are damaged
9	Make sure all hoist arms are in proper location before lifting
10	Don't lift if contacts are not in place
11	Watch for objects under car
12	—
13	Never use hoists with bent equipment
14	—
15	Do not use hoist if parts are missing or broken
16	—
17	Do not pick up car with hoist pad out of position
18	Do not obstruct lift operation
19	—
20	Position feet properly
21	—
22	Make sure hoist is centered
23	Do not use damaged equipment
24	—
25	Set up wrong
26	—
27	Damaged
28	Make sure all pads set good
29	Do not set pad except where you are supposed to
30	Do not use hoist if defective
31	Arm not contacting car set up uneven
32	—
33	Do not lift with broken hoist
34	—
35	—
36	Do not use if broken
37	Do not operate if hoist is damaged
38	Pad not set properly
39	Don't lift without proper pad location
40	Don't use damaged hoist
41	—
42	Do not leave parts hanging under vehicle
43	Inspect hoist before using
44	Do not lift cars with this hoist
45	Bent hoist support arm
46	Do not use with broken arms
47	Make sure all pads are making contact before lifting
48	Do not lift cars when lifting arm is not in contact with car
49	Do not raise vehicles until all pads are properly placed
50	Do not lift vehicles unless all contact points are firmly on vehicle

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Picture #9 - Trained operator only

<u>Subject #</u>	<u>Response</u>
1	Do not attempt to modify operation of hoist
2	Think before you operate
3	Watch before approaching
4	Think smart when using hoist
5	Use plenty of light
6	—
7	Use bright ideas when using hoist
8	Wearing a bump hat is a good idea
9	Wear hard hat and think - Understand hoist before operating
10	Know your hoist operation
11	—
12	To reset pad before lifting
13	I wonder why hoist was left up - find out and explain the danger
14	—
15	Use proper safety equipment when working under hoists
16	—
17	Be ingenious when using hoist
18	Be alert
19	—
20	Do not modify
21	—
22	Use in well lighted area
23	Think safety
24	Think before you operate a hoist
25	No foolishness
26	Where's the car
27	Person not sure of hoist
28	—
29	—
30	Do not alter hoist in any way
31	Better idea- Don't be too bright
32	—
33	Think before operating
34	—
35	Know how to use the hoist before attempting operation
36	—
37	—
38	Proper way to set hoist
39	Visual Inspection- Don't use if you don't know how
40	Use only if you know how
41	No bright ideas on changing hoist operation
42	—
43	Trained personnel only
44	Only trained personnel to operate hoist
45	Technician light-headed
46	Check hoist
47	Think before using hoist
48	Man with bright idea about hoist
49	Think before using this equipment
50	—

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Picture #10 - Run if vehicle starts to fall

<u>Subject #</u>	<u>Response</u>
1	If vehicle falls off hoist leave area
2	Run away from moving or falling car
3	Move away if danger is present
4	Do not stand around falling cars
5	Move away from direction of fall
6	Get out of the way of falling cars
7	If car is falling, head for the hills
8	If the vehicle falls run to the highside or away from low side
9	Watch for unstable cars, get out o the way if starts to fall
10	Move in opposite direction of falling car
11	If car starts to fall get out of the way
12	Car too far forward
13	Get out of the way if a vehicle gets out of control on a hoist
14	Look out
15	Stay clear of hoist if vehicle becomes unstable
16	Watch for falling cars
17	If the car is falling, get the h-- out of there
18	Stay away from uneven vehicles
19	Get out of area when car is falling
20	If car falls get out from under it
21	If vehicle tips while on hoist move in opposite direction
22	Keep clear if car falls
23	Run away opposite of falling car
24	If there are any signs of trouble, get out of the way
25	Do not leave hoist unattended
26	Get away from vehicle when in trouble
27	Car falls- Run opposite way
28	Run out center away from vehicle if falling
29	If car falls or is falling stand clear - you're not going to stop it
30	Clear the area if vehicle starts to fall
31	Move away from lowest part of falling car
32	Cars falling - Run
33	If car falls run in opposite direction
34	Get clear of falling vehicles
35	Keep clear of vehicle during lifting
36	If car starts to fall get away
37	Run away if vehicle falls
38	Not set properly stay out from under
39	If car starts to fall- get out of the way
40	If car falls don't try to save it! Save yourself
41	Move the opposite way that vehicle is falling
42	Move away from falling vehicle
43	Stand clear of falling vehicle
44	Keep clear from vehicle
45	Car improperly supported, technician running for life
46	Move away from falling car
47	Get away if vehicle starts to fall
48	If auto is to fall front first then exit rear of car
49	Stay away from falling cars on hoist
50	If vehicle should shift or fall from hoist - run in opposite direction

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Picture #11 - Periodic Maintenance required

<u>Subject #</u>	<u>Response</u>
1	Clearly mark broken hoist
2	Broken contact point
3	Pad missing
4	Broken lift
5	Hoist inoperable
6	Hoist down for repairs
7	Always notify others of equipment in repair
8	Don't use the hoist if titts broken, get it fixed
9	Don't use hoist- front left arm being repaired
10	Do not use - Hoist unsafe
11	Hoist inoperative
12	Pad missing
13	Discontinue using a damaged hoist until repaired
14	Broken
15	Don't use broken hoist
16	Keep hoist in top shape
17	Do not operate a broken hoist
18	Do not use
19	Lift inoperable: Broken pad
20	Do not use
21	Do not use hoist while under repair
22	Don't use
23	Broken hoist
24	This hoist should not be used
25	Do not use
26	Down for repairs
27	Do not use
28	Do not use broken hoist
29	Can not be used
30	Tag and lock out hoist for any repairs
31	Broken pad - Do not use
32	—
33	Notify someone if hoist is in need of repair
34	Tag hoist if it needs repairs
35	Check to make sure hoist is not out-of-service before operations
36	Hoist broken
37	Tag hoist that are unsafe
38	Pad missing - Don't use
39	Damaged equipment
40	Don't use
41	Do not use
42	Repair lift before operating
43	Do not use
44	Do not use hoist, down for repairs
45	Hoist broken
46	Do not use
47	Hoist broken Don't use
48	Hoist pad broken Do no use or operate
49	Make sure you use a sigh when hoist is broken
50	Do not use equipment that is broken or in need of repair

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Picture #12 - Read safety manual and instructions before operating

<u>Subject #</u>	<u>Response</u>
1	Use operator's manual, certified by ALI
2	Read all instructions before operating
3	Read of instructions before use
4	Read before use
5	Read operator's manual
6	Read of manual
7	Read Automotive Lift Institutes' Operator's manual before use
8	Use the operator's manual
9	Manual for safety and hoist operation
10	Location of operator's manual
11	Hoist manual
12	If you don't understand- read the manual
13	Read owner's manual
14	Read this
15	Read operator's manual prior to operating hoist
16	—
17	Read operator's manual before using
18	Read manual for proper operation
19	Lift instruction manual
20	Read operator's manual
21	Read and understand operator's manual before operation
22	Read if you have problems
23	Instruction book
24	Always refer to the operator's manual
25	All personnel must read
26	Refer to
27	See manual before using
28	Read instructions
29	If there's a problem with the hoist use manual
30	Read operator's manual before operating hoist
31	Something look at when something not working right
32	—
33	Refer to manual if in doubt
34	Read operator manuals
35	Operator's manual location
36	—
37	Read operator manual before using hoist
38	Read operator's manual
39	Locale of Operator's manual
40	Read operator's manual
41	Use operator's manual
42	Read manual before operating
43	Read manual
44	Use owner's manual to repair hoist
45	Proper manual for hoist
46	Check manual
47	Read operator manual
48	—
49	Read operator's manual for instruction of use
50	Do not operate until you have read manual and have been properly trained

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Picture #13 - Keep feet from under hoist while it's being lowered

<u>Subject #</u>	<u>Response</u>
1	Watch feet when lowering hoist
2	Keep clear of moving hoist
3	Do not lower with controls unattended
4	Stand clear when in operation
5	Know your position when lowering vehicle
6	Operate hoist from controls
7	Stay away from vehicle when it is lowered off hoist
8	Keep feet clear of the car while lowering
9	Watch hoist may be dangerous is not careful comes down at any time
10	Keep feet away from car when lowering
11	Watch your feet
12	Stay back when lowering
13	Don't get your foot trapped
14	Don't do this!
15	Keep feet clear of hoist when lowering hoisted vehicle
16	Watch feet
17	Don't let the car down on your foot
18	Keep feet away from lowering vehicles
19	Keep feet out from under car
20	Watch your feet
21	Keep away from vehicle's tires while lowering
22	Keep feet clear
23	Watch when lowering car
24	Car may roll on your foot
25	Watch out for pads
26	Foot hazard
27	Stay clear of car and hoist
28	Watch feet
29	Keep feet clear until car and hoist are all the way down
30	Keep clear of hoist area when letting vehicle down
31	Don't set on foot watch for rolling car
32	—
33	Keep clear when lowering
34	Keep feet clear when lowering hoist
35	Keep feet clear when lowering hoist
36	Watch your feet when lowering vehicles
37	Keep feet clear at pinch points
38	Watch feet when lowering vehicle
39	Stand clear when lowering
40	Keep clear at all times
41	Keep clear of hoist
42	Stand clear of lowering vehicle
43	Keep feet clear
44	Keep clear of vehicle when lowering
45	Foot caught under hoist
46	Do not roll car over foot
47	Injury may occur if you get too close to lowered vehicle
48	Stand clear of hoist when lowering
49	Keep feet clear of vehicle while lowering
50	Keep feet out from under vehicles that are being lowered

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Picture #14 -Don't exceed weight capacity

<u>Subject #</u>	<u>Response</u>
1	Do not lift loaded or unbalanced vehicle
2	Do not lift properly loaded vehicles
3	Unstable load - Do not lift
4	Do not lift loaded vehicle
5	Don't overload one end of vehicle
6	No lift loaded trucks
7	Do not put trucks with payload on hoist
8	Don't raise trucks while they are loaded
9	Don't overload a hoist
10	Do not lift uneven load
11	Check to see if car is set on hoist properly
12	No loads
13	Overloaded vehicle can cause dangerous rocking condition
14	Do not pick vehicle in this manner
15	Do not lift weighted vehicles unless correctly hoisted
16	Distribute weight evenly
17	Overloaded vehicles are unstable on a hoist
18	Do not overload: distribute weight evenly
19	Uneven and overweight load
20	Do not lift loaded tires
21	Do not lift or work on vehicle if unsteady on lift
22	Center pad on hoist for balance
23	Unbalanced load
24	Do not overload a hoist
25	Overload - not stable
26	Don't overload
27	Do not shake uneven load
28	Do not off-balance vehicle
29	Do not pick up unbalanced load
30	Do not lift vehicle with balast
31	Uneven load using wrong hoist
32	Do not shake car
33	Do not lift vehicles with heavy loads
34	Unbalanced loads may tip
35	Excessive weight may cause vehicle imbalance
36	—
37	Do not lift vehicle when loaded
38	Vehicle too heavy for hoist
39	Don't lift unbalanced load
40	Don't overload
41	Do not lift loaded vehicles
42	Do not lift loaded vehicles
43	Do not shake vehicles
44	Do not lift uneven loads or overweighted loads
45	Improper balanced truck
46	Do not shake
47	Overloaded vehicle may rock or fall
48	Do not use hoist with vehicle that is rear-end heavy
49	Do not run car while on hoist with a load on it
50	—



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Picture #15 - Don't shake vehicle

<u>Subject #</u>	<u>Response</u>
1	Do not attempt to steady falling vehicle
2	Do not try to hold falling vehicle
3	No standing - Danger
4	Do not lift unstable vehicle
5	Don't teter vehicle on hoist
6	Don't touch falling vehicle
7	Do not push car off hoist
8	Don't try to stop a car that's falling from falling
9	Make sure all arms and lifts are in proper places
10	Do not try stopping falling car - Injury may result
11	Too much weight on front
12	No rocking car while on hoist
13	Don't try to catch a vehicle rocking on hoist
14	Do not pick vehicle in this manner
15	Do not lift vehicles unless evenly and stably supported
16	Lower hoist evenly, front and rear
17	Do not push up on a car when on a hoist
18	Do not rock or unbalance vehicles
19	Do not attempt to hold car on lift when falling
20	Match the center of gravity
21	Do not rock vehicle while on hoist
22	Check to make sure car is balanced
23	Do not push on car
24	Do not try to hold a car - get out of the way
25	Car will drop
26	Don't raise one end and not the other or Don't push
27	Do not shake unbalanced
28	Vehicle must not be shaky
29	Do not stand near hoist or car when it's falling
30	Do not try to catch vehicle if falling
31	Uneven load can't hold car up too heavy in front should use stand
32	Do not try to stop falling car
33	Do not rock car when raised on hoist
34	—
35	Excessive movement of vehicle on hoist may cause the vehicle to tip
36	—
37	Do not shake vehicle while on the hoist
38	Vehicle not set properly
39	Proper pad location
40	Use proper setting points
41	Do not attempt to stop falling car
42	Do not bounce vehicle
43	Do not shake vehicle
44	Get clear of vehicle if it falls off hoist
45	Improper balanced car
46	Do not try to stop falling car
47	Don't push on rear of vehicle without safety brace
48	Do not come in contact with car that is falling
49	Danger- Vehicle may slide off hoist if its running while raised
50	—

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Picture #16 - Use of auxiliary adapters may affect hoist capacity

<u>Subject #</u>	<u>Response</u>
1	Do not lift vehicle by wheels
2	Above ground drive on hoist
3	—
4	Do not lift by tires
5	Center vehicle on pads
6	Runway lift
7	Be sure to apply brakes or chock wheel to avoid vehicle movements
8	Hoist will vibrate while going up
9	Make sure car is in center of hoist when operating
10	Do not lift by wheels on a contact hoist
11	Car could slide
12	—
13	Never place pads under tires to lift vehicle
14	—
15	Center vehicle on hoist
16	—
17	Hoist is moving up
18	Raise vehicle with ramps
19	Vibration problem
20	Lock arms when lifting on wheels
21	—
22	Hoist side move at the same time
23	Lift arms
24	—
25	Pick up wrong place
26	Caution- moving objects
27	Improper use
28	—
29	—
30	Lift vehicle under frame only
31	Always make sure cars are blocked good, in park, brake on
32	—
33	—
34	—
35	—
36	—
37	Center vehicle before raising hoist
38	Do not raise by tires
39	Proper pad location
40	—
41	—
42	—
43	Use adapters when necessary
44	Properly lift vehicle
45	Hoist going up
46	Check for proper lift
47	Car may roll while lifting
48	Vehicle moves when raising
49	—
50	—

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Picture #17 - Don't operate hoist if damaged

<u>Subject #</u>	<u>Response</u>
1	Do not lift vehicle without all 4 arms
2	Do not use with broken arm contact
3	Pad missing - Do not use
4	Use only properly, Do not use broken
5	Use all 4 pads
6	—
7	Make sure all hoist arms are in before driving vehicle on
8	Don't use the hoist if its missing parts
9	Hoist out of service, repair on left arm
10	Hoist unsafe for use
11	—
12	Hoist in repair
13	Don't use hoist with missing parts
14	—
15	Do not use hoist if damaged or parts are missing or broken
16	—
17	Do not operate with pad out of place
18	Don't use without all 4 arms in place
19	Lift inoperable, arm repair
20	Arm missing, do not use
21	Do not operate with three arms
22	Arm on hoist not working
23	Broken hoist
24	Do not use an unsafe hoist
25	Watch out for fall objects
26	Out of order
27	Broken hoist
28	Broken hoist - Do not use
29	Do not use, down for repairs, lift broken
30	Do not use hoist with broken parts
31	Missing arm
32	—
33	Do not use hoist if broken or parts missing
34	—
35	Do not lift vehicle unless all jacking points are being used
36	—
37	Do not use if hoist has missing parts
38	Pads improperly set
39	Don't use- damaged equipment
40	Don't use - needs repair
41	Do not use hoist
42	Do not use hoist with missing parts
43	Do not use if arm is missing
44	Do not use hoist - 1 leg missing
45	Missing part of equipment
46	Do not use with only 3 arms
47	Don't use hoist broken
48	Do not operate hoist with parts missing
49	Do not operate without the right amount of pads
50	Do not use broken hoist until properly repaired

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Picture #18 - Read lift-related printed material before using

<u>Subject #</u>	<u>Response</u>
1	Read owner's manual
2	Read instructions carefully
3	Read of manual before operating lift
4	Read operator manual first
5	Read manual
6	Read manual
7	Read instruction before operation
8	Read manual
9	Wear hard hat, and check safety regulation and proper operation of equipment
10	Read your owners manual before operating hoist
11	Read manual
12	—
13	Consult manual when in doubt
14	Read manual
15	Read the operators manual
16	—
17	Read operators manual
18	Read manual
19	Read manual before using lift
20	Read manual
21	Read operators manual
22	Read manual
23	Read operators manual
24	Always refer to manual
25	Read up on hoist
26	Read operators manual
27	See manual first
28	Read instructions
29	Know how to use hoist right, Read manual
30	Read vehicle manual for proper lifting points
31	Watch what you are doing
32	Read book
33	Read operating manual
34	Read instructions
35	Read operator's manual
36	Read
37	Read manual before using hoist
38	Read manual first
39	Read operator's manual
40	Read instructions
41	Use operator's manual
42	Read manual before using
43	Read manual
44	Read owners manual before operating
45	Read - you'll learn
46	Check manual
47	Read operator's manual first
48	Read instruction before operating
49	Read how to use equipment before use
50	—

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Picture #19 - Don't stand under hoist while it's going up or down

<u>Subject #</u>	<u>Response</u>
1	Do not stand under vehicle while raising or lowering
2	Do not stand under vehicle while lowering or raising vehicle
3	No standing - Danger
4	Stand clear when in operation
5	Know your position when raising or lowering vehicle
6	Don't stand under lift while in operation
7	Do not stand underneath vehicle while raising or lowering
8	Stay out from under the hoist while raising or lowering car
9	Don't stand under a hoist that is going up or down
10	Never stand under hoist when raising or lowering
11	—
12	Don't stand under when coming down or up
13	Never get under vehicle when it is being raised or lowered
14	Do not stand under vehicle and hoist
15	Do not stand under vehicle when raising and/or lowering hoist
16	—
17	Do not stand under vehicle when moving up or down
18	Do not stand under moving lift
19	No one under car when being lifted or lowering
20	Do not stand under a moving hoist
21	Do not stand under vehicle while raising or lowering
22	Don't stand under hoist
23	Do not stand under car unless fully raised
24	Do not stand under vehicle while going up or down
25	Do not stand under hoist
26	Don't lower if someone is under the hoist
27	Keep away when raising and lowering
28	—
29	Warning- Do not stand under lift when going up or down
30	Do not stand under vehicle when lifting or letting down
31	Hoist too high
32	Do not move lift while people are under lift
33	Do not stand under hoist when raising or lowering
34	Stay clear when raising or lowering
35	Do not stand under vehicle during hoist operation
36	Don't stand under vehicle when raising or lowering
37	Do not raise or lower vehicle if someone is under it
38	Do not get under moving hoist
39	Stand clear when lowering
40	Stand clear when raising and lowering
41	Do not stand under hoist when raising or lowering
42	Do not stand under vehicle when raising/lowering
43	Stand clear when lifting or lowering
44	Do not stand under unsecure vehicle on hoist
45	Don't stand under when going up or down
46	Do not stand under when in motion
47	Don't stand under car when raising or lowering
48	Do not stand under hoist when raising or lowering
49	Stay clear of vehicle while raising or lowering
50	Do not stand under hoist that is raising or lowering always set safetys

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Picture #20 - Don't shake vehicle

<u>Subject #</u>	<u>Response</u>
1	Do not raise vehicle if not secure on hoist
2	Do not use when car is unstable
3	Unstable load- Do not lift
4	Do not lift unstable vehicle
5	Make sure vehicle is stabilized
6	No lift
7	Always center vehicle properly on hoist to avoid movement
8	Don't let car teeter totter on hoist
9	Don't operate hoist with not all hoist arms in place
10	Never rock car while on hoist
11	Car could be shaky on hoist
12	Car not safe on rack
13	Stay away from unstable rocking vehicles on hoists
14	Do not let vehicle bounce
15	Lift vehicles only when stable and evenly supported
16	Do not leave hoist unattended
17	Do not make vehicle unstable when on hoist
18	Do not rock car
19	—
20	Do not lift misaligned car on hoist
21	Do not raise vehicle if not steady
22	Don't run car on hoist
23	Do not shake
24	Do not shake vehicle
25	Set up wrong - car will fall
26	Make vehicle secure
27	Do not shake
28	Make sure car is not shaky
29	—
30	Avoid excessive rocking or vehicle when on hoist
31	Make sure arms are in right place
32	Set lift properly
33	Do not rock car on hoist
34	Center vehicle on hoist
35	Do not shake vehicle while up on hoist
36	Do not lift when hoist wiggles
37	Do not operate hoist if vehicle shakes when lifting or lowering
38	Balance vehicle properly
39	Don't use hoists without supports
40	Incorrect hoist usage
41	Do not run vehicle on hoist
42	Do not bounce vehicle
43	Do not shake vehicle
44	Do not use hoist like this
45	Car improperly supported by lift
46	Do not shake while vehicle in air
47	Don't shake car while on hoist
48	Hoist unsafe
49	Don't run car while it's on the hoist
50	Do not work on a vehicle which is not stable on the hoist

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Picture #21 - Read instructions and safety material before using

<u>Subject #</u>	<u>Response</u>
1	Read operators manual
2	Read instructions
3	Read before operating lift
4	Read operators manual before use
5	Read manual
6	Operator's manual
7	Always read operator's manual before operating equipment
8	Use manual
9	Read operator's manual 1st before operating equipment
10	Operator's manual location
11	Read
12	—
13	Always use operator's manual when needed
14	Read book
15	Read your operator manual
16	—
17	Read operator's manual
18	Read operator's manual for proper operation
19	Read manual before operating lift
20	Read operator's manual
21	Read operator's manual
22	Read before using
23	Instruction book
24	If you have any questions refer to operator's manual
25	Read operators
26	(Refer to)
27	See manual first
28	Read instructions before using
29	Read this to know how to run your lift properly
30	Read operators manual for manufacturer's suggested lifting points
31	Instructions user's Bible- Hoist capacity, Hoist capability
32	Read
33	Read operator's manual
34	Refer to operators manual
35	Location of operator's manual
36	See operator's manual
37	Read operator's manual before using
38	Always consult operator's manual
39	Check operators manual for specific requirements
40	Use operator's manual for further information
41	Consult operator's manual
42	—
43	Read manual
44	Operator's manual
45	Read operator's manual before using equipment
46	Check manual
47	Read manual before using
48	—
49	Read operator's manual before use of equipment
50	—

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Picture #22 - Use jack stands when removing heavy parts

<u>Subject #</u>	<u>Response</u>
1	Support vehicle with jack stands if changing vehicle weight distribution while on hoist
2	Use support stands when removing engine
3	Support load when servicing
4	Always support car when working on
5	Use helper stands
6	Support car when transferring weight
7	Use additional support for vehicle when performing heavy component changes
8	Use safety stands when pulling motors or installing
9	Use safety stands for more support when changing an engine
10	Always use jack stands when pulling motors
11	Use jack stands when changing weight of car on hoist
12	Make sure jack stands are in right spots
13	Use proper support in proper locations when working on vehicles
14	Support vehicle in this manner
15	Perform engine removal/installation only when vehicle is properly supported
16	Jack stands are used
17	Place security stands in place when removing engine
18	Use stands when removing components
19	Support car when removing engine
20	Support car when removing engine
21	Use safety stands
22	Support car with safety stands
23	Support with stands when removing engine
24	Always use safety stands when vehicle is on the hoist
25	Wrong stands
26	Watch for obstructions
27	Use of supports when removing engines
28	Support ends of vehicle is necessary to off balance by removing heavy weight
29	Make sure car is supported right when removing large amounts of weight
30	Use safety stands for and aft when removing heavy components
31	Make sure car is stable - Watch open hood
32	Use jack stands
33	Use jack stands when working under car
34	Use jack stands
35	Always use support stands when removing heavy parts from vehicle on hoist
36	Use jack stands for support and look out for overhead obstacles
37	Use jack stands before removing large parts due to center of gravity change
38	Use safety stands
39	Use supports when hoisting
40	Correct usage of hoist
41	Use jack stands or high stands
42	Use extra support
43	Support vehicle properly
44	Use safety stands at both ends of vehicle when using this hoist
45	Support car with jack stands
46	Support vehicle ends when removing engine
47	Use high horses when removing an engine
48	Stand required under front and rear of car
49	Use jack stands for stabilizing car
50	Properly support vehicles when removing heavy engine components



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Picture #23 - Run away if vehicle starts to fall

<u>Subject #</u>	<u>Response</u>
1	Get away from vehicle if slips
2	Run away when car is falling
3	Danger - Move away
4	Stand clear of falling cars
5	Move away from direction a vehicle is falling
6	Get away from falling car
7	If car begins to fall stay away
8	If the hoist drops - run to the high side or away from the low side
9	If car is falling or unstable get out of the way
10	Move in opposite direction of falling cars
11	If car slides - move out
12	Car not set right
13	Get away from hoist of a vehicle is being lost
14	Run
15	If vehicle becomes unstable stay clear of hoist
16	Watch for falling cars
17	If car is falling get the h--- out of the way
18	Do not near unstable vehicles
19	Leave lift area when car may fall
20	If car falls get out of the way
21	Move in opposite direction if vehicle slides
22	Stay clear if moving
23	Run opposite of falling car
24	If car shifts or sways, get out of the way
25	Car falling
26	Set hoist before raising
27	Car falls - run opposite way
28	Get away if vehicle is falling or tipping
29	Stand clear of falling car, get help
30	Stay clear of hoist area if vehicle starts to fall
31	Stay away from unstable car, make sure arms are in right spot
32	Run
33	Run opposite way car is falling
34	Get clear if vehicle falls
35	Stay clear of hoist while lifting vehicle
36	If car starts to fall get away from it
37	If vehicle falls run away from hoist
38	Get out from under vehicle if hoist slips
39	If car starts falling - get out quick
40	Danger - Hoist set incorrectly car falling
41	Do not try to stop falling car, get out of the way
42	Emergency escape route
43	Stand clear when car is falling .
44	Stand in safe area when hoisting vehicle
45	Car falling off hoist "run"
46	Car starting to fall - Move away
47	If car falls move away quickly
48	Hoist unsafe to work under
49	Stay away from improperly positioned cars on hoist
50	If vehicle shifts of falls run in opposite direction

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Picture #24 - Don't stand under the hoist while raising or lowering

<u>Subject #</u>	<u>Response</u>
1	Do not work under vehicle while raising or lowering
2	Do not lay under car when working on hoist
3	Danger - Move away when lowering lift
4	Stand clear from moving vehicle
5	Use safety locks and stands
6	Caution - vehicle can drop
7	Do not be under car when it's falling
8	Don't get under car while lowering hoist
9	Don't work on your back - If hoist goes all the way up use it when it is all the way up
10	Never lay under car when running while car is raised
11	Don't sit under car
12	Car coming down
13	Never lay down when a vehicle is coming down, under it - it could kill you
14	Don't sit under vehicle and hoist
15	Do not do sit down operation under hoisted vehicle
16	Don't lay under cars
17	Don't lay under car when car is coming down
18	Do not stay under lowering vehicles: use safety locks
19	Do not work under car when lowering
20	Do not stay under car while hoist is moving
21	Do not stand under vehicle while lowering
22	Stay clear if moving
23	Do not lay under partially raised car
24	—
25	Do not sit under hoist
26	Don't lay under vehicle
27	Do not stand under hoist when not locked
28	Make sure area is clear before moving up or down
29	Don't lay under car, lift all the way up and stand to do work
30	Never let vehicle down, if area is not clear of personnel
31	Never get under car being lowered
32	Stop lift
33	Do not lay down under car
34	Stay clear when raising vehicle
35	Do not work under vehicle while it is up on the hoist
36	—
37	Do not lower vehicle while under car
38	Stay out from under moving hoist
39	Don't stand or be under hoist when lowering
40	No sitting under car locks on hoist not set car falling
41	Do not lay under hoist
42	Do not stand under vehicle when lowering
43	Stand clear when lowering car
44	Stand clear when lowering vehicle
45	No laying under hoist - hoist coming down, hit technician
46	Do not work under car when coming down
47	Don't stand under vehicle while lowering hoist
48	Do not stand under hoist when it is being lowered
49	Stay away while car is coming down
50	—

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Picture #25 - Use of auxiliary adapters might affect hoist capacity

<u>Subject #</u>	<u>Response</u>
1	Do not raise unstable vehicle
2	Above ground drive on lift
3	Raise with weight positioned evenly
4	Set brake so car can not move or lift
5	Block wheels
6	Runway lift
7	Apply parking brake or chock wheels before raising car
8	Hoist may vibrate while going up
9	Use full length hoist if car is running
10	Make sure car is secure on hoist when raising
11	—
12	Car going up
13	Don't raise vehicle when it shakes on hoist
14	Vehicle bouncing
15	Center vehicle on hoist
16	—
17	Vehicle is going up
18	Raise vehicle with ramps
19	Lift by wheels
20	Car will jounce while hoist is going up
21	—
22	Pad move at same time
23	Do not shake car
24	Make sure car is secure on hoist
25	Beware when going up
26	Lift here
27	Do not shake
28	Make sure car does not roll
29	—
30	Use extenders where required
31	Make sure car is blocked good or in park with brake on
32	—
33	No rocking or rolling of vehicle
34	—
35	Support stand locations
36	—
37	Center vehicle on hoist before lifting
38	Secure vehicle before raising
39	Hoist vehicle with wheels blocked
40	—
41	Start car then raise
42	Do not move vehicle while on lift
43	Use adapters when necessary
44	Put vehicle in park when hoisting
45	Car not in park and rolling back and forth on hoist
46	Check centering of car before raising fully
47	Vehicle will roll if not secured
48	—
49	Use the proper hoist while testing running condition
50	—

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Picture #26 - Don't exceed weight capacity

<u>Subject #</u>	<u>Response</u>
1	Do not attempt to secure unbalanced vehicles
2	Run away when car falling
3	No standing - Unstable load
4	Stay away from unstable loads
5	Don't overload one end of vehicle
6	Don't lift loaded vehicles
7	Do not put trucks with heavy loads on hoist
8	Don't raise trucks while loaded
9	Don't overload hoist and stay out of the way if it starts to fall
10	Never lift uneven load injury may result
11	Don't try to hold car up - Move out
12	Car falling to the rear
13	Never get under vehicle with mislocated load
14	Check load on vehicle
15	Do not go under unevenly supported vehicles
16	Watch for rear heavy loads
17	Don't try to support an unbalanced vehicle
18	Do not overload: distribute weight evenly
19	Do not try to support truck when overloaded
20	Do not lift loaded trucks
21	Do not raise vehicle with uneven load
22	Don't overload car when lifting
23	Unbalanced load
24	Do not stand underneath unstable vehicle
25	Do not overload hoist with people under
26	Don't use if not balanced
27	Improperly used
28	Do not off balance vehicle
29	—
30	Remove balast before lifting vehicle - do not overload hoist
31	You can't stop or hold back unstable load
32	—
33	No heavy loads on hoist
34	Unbalanced load may tip
35	Excessive loads may cause vehicle imbalance during lifting
36	Do not raise with lopsided load
37	Do not lift over ballasted vehicles
38	Vehicle not balanced properly
39	Don't hoist vehicle with unbalanced load - it could fall
40	Don't lift from improper lift point or uneven weight distribution
41	Do not lift uneven or loaded vehicles
42	Make sure vehicle is equally balanced
43	Do not lift loaded trucks
44	Do not lift overloaded or unevenly loaded vehicles
45	Truck improperly supported, technician trying to hold truck up
46	Do not raise vehicle when poorly loaded e.g. tail heavy
47	Balance weight before lifting or don't lift vehicle that is end heavy
48	Rear of vehicle too heavy for hoist
49	Make sure vehicle has an even load before raising up
50	—

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Picture #27 - Keep feet from underneath hoist

<u>Subject #</u>	<u>Response</u>
1	Keep feet from under hoist
2	Keep away from hoist when car is coming down
3	Danger - Do not stand near hoist when lowering
4	Stand clear of moving lift
5	Know your position when lowering vehicle
6	Watch your feet
7	Do not stand next to vehicle when lowering
8	Keep feet clear of hoist arms
9	Watch for hoist coming down, stay out of the way
10	Stand clear when lowering hoist
11	Keep feet clear
12	Keep feet clear of hoist
13	Don't get your foot caught under hoist
14	Keep clear of hoist when lowering vehicle
15	Keep feet clear of hoist at all times
16	Warning: floor runners, watch feet
17	Watch feet position when letting hoist down
18	Keep feet away from lowering arms
19	Keep feet out from under hoist
20	Watch your feet
21	Keep feet away when lowering or raising hoist
22	Keep feet away
23	Watch when lowering hoist, danger to feet
24	Watch out when lowering hoist
25	Hoist drop on feet
26	Danger foot hazard
27	Keep feet away when lowering
28	Watch feet
29	Watch your feet hoist comes to floor
30	Stand clear of hoist area when letting vehicle down
31	Watch feet while lowering hoist
32	Watch your feet
33	Stand clear of hoist when lowering
34	Keep feet clear of hoist
35	Keep feet clear when lowering vehicle
36	Keep feet clear
37	Keep clear of pinch points
38	Keep feet clear from under hoist
39	Stand clear when lowering
40	Keep clear - all hands, feet and other body parts
41	Keep hands and feet clear of hoist
42	Do not stand under moving hoist
43	Keep feet clear
44	Keep feet clear of hoist when lowering
45	Technician let hoist down on foot "no brains"
46	Watch your feet when lowering
47	Keep feet away while lowering vehicle
48	Keep body clear of hoist when lowering
49	Keep feet clear of car and hoist while lowering
50	Keep feet from under vehicle when being lowered

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Picture #28 - Always use proper vehicle pickup points

<u>Subject #</u>	<u>Response</u>
1	Do not secure, hoist off center
2	Frame contact lift
3	Support load evenly
4	Check your pads
5	Use correct contact points
6	Frame lift
7	Make sure hoist contacts frame before lifting vehicle
8	—
9	Make sure hoist arms are in proper places
10	Make sure contacts are in place
11	—
12	Make sure pad set right
13	Center vehicle on hoist properly
14	Lifting point
15	Center vehicle on hoist
16	Car in air
17	Be sure of pad position when operating
18	Be sure arms contact frame
19	—
20	Center of gravity
21	—
22	Lift on frame
23	Shows support arm lift on frame
24	Vehicle frame lift points
25	Set up wrong
26	Set hoist properly
27	Use of extension pads
28	Set pads properly
29	—
30	Check center of gravity of vehicle before lifting
31	Rear arms
32	Setting hoist properly
33	Use proper lifting location
34	—
35	—
36	Check pickup points
37	Center lift arms
38	—
39	Proper placement of lift pads
40	Improper use
41	Use proper lift points
42	Make sure pads are set correctly
43	Lifting points
44	—
45	No jack stands for safety, but show me a shop that uses them
46	Check frame contacts
47	Position post here for proper lifting
48	—
49	Position hoist pads in proper place
50	—

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Picture #29 - Use jack stands

<u>Subject #</u>	<u>Response</u>
1	Do not use jack stands to secure hoist
2	Use support stands when necessary
3	Support load
4	Support your work
5	Use safety stands
6	Support vehicle
7	Use stands to support vehicle
8	Use safety stands
9	Use jack stands
10	Always use jack stands when working under raised hoist
11	Use jack stands
12	Make sure jack stands are set right
13	Use extra adequate support when needed- properly loaded
14	Support vehicle
15	Use safety stands
16	No floor jack's
17	Place security stands in place
18	Use stands in pairs
19	Do not leave stands under car unattended or when lowering
20	Jack stands on inside of hoist
21	Do not use ladders under hoist
22	Safety stand needed
23	Use jack stands to support vehicle
24	Always use safety stands when vehicle is on hoist
25	No jack stands
26	Don't leave obstruction under vehicle
27	Use of supports of stands
28	Do not leave things under car when on hoist
29	Jack stands in use
30	Use approved safety stands before doing any maintenance on vehicle
31	Watch stands could tip car if lowered
32	Use jack stands
33	Jack stands required
34	Use safety stands
35	Use support stands while hoist is raised
36	Use jack stands
37	Keep jack stands clear when lowering
38	—
39	Supports necessary when working on hoisted vehicle
40	Use jack stands for proper use
41	Use high stands
42	Use extra support
43	Support vehicle properly
44	Properly support vehicle
45	Supports too low, not touching vehicle
46	Use two support stands
47	Position high horses evenly under vehicle
48	Use safety stands
49	Use safety stands while car is up
50	Properly support vehicle when working on large components

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Picture #30 - Use proper vehicle pickup points

<u>Subject #</u>	<u>Response</u>
1	Means nothing to me
2	Tire contact point lift
3	Center hoist on suspensions
4	Check wheel base
5	Block wheels
6	Rotate
7	—
8	Rock the vehicle
9	Dual axle hoists
10	Center front and rear wheels when driving on hoist
11	—
12	—
13	Rotation of tires
14	Where to spot wheels of vehicle
15	Lift front and rear of hoist evenly
16	Car in forward
17	Raise vehicle by axles
18	Center wheels
19	Axle lift only
20	—
21	Do not roll vehicle
22	Four wax adjust mount
23	Lift points on axle
24	Vehicle axle lift points
25	—
26	Set hoist at these points
27	Use of front and rear axles
28	Set pads here
29	Hoist picks car up by axle
30	Move vehicle fore and aft to line up on hoist
31	Axle contact
32	Wheel base
33	—
34	—
35	—
36	—
37	Lift points of vehicle
38	—
39	Lift from front and rear axles
40	Rotate front to rear or pad lift points
41	Use proper lift points
42	—
43	Lifting points
44	—
45	Four wheel drive
46	Lift points
47	—
48	—
49	Make sure wheel base of vehicle is enough for this hoist
50	—



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Picture #31 - Use extenders when needed

<u>Subject #</u>	<u>Response</u>
1	Use fold up stands to keep vehicle level
2	Use height adapters when required
3	Support load evenly
4	Pick up your load evenly
5	Use correct contact points
6	Frame lift
7	Use blocks on vehicles with high frames
8	Use upper step on hoist arms
9	When raising trucks use extension arms
10	Make sure contacts are in correct position
11	—
12	Pad lift are in
13	Proper centering of truck on hoist
14	Where to lift vehicle
15	Center vehicle on hoist
16	Secure rear post
17	Be sure of pad position
18	Use adapters for trucks and vans
19	Needs extensions
20	Center of gravity
21	Use hoist with pads in up position
22	Pads on frame
23	Lift points on frame
24	How to lift up a truck
25	Set up wrong place
26	Center vehicle on lift
27	Use of adapters
28	—
29	Warning - picked up by frame
30	—
31	Stands up in rear
32	—
33	Use proper extensions on hoist
34	Use hoist pad at right location
35	Lift vehicle only on proper lifting points
36	Check pickup points
37	Center vehicle and arms before lifting
38	—
39	Proper placement of lift pads
40	Proper pad placement
41	Use hoist extensions
42	Do not use extra lift blocks
43	Use proper pads for vehicle
44	Use proper supports when hoisting trucks
45	Possible truck supported with proper adapters
46	Use spacer blocks to keep vehicle level
47	Use truck adapters when lifting trucks
48	Inspect hoist mounts to vehicle
49	Use pad extensions on trucks
50	Do not use wood blocks to lift a vehicle

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Picture #32 - Read instructions and safety manual before operating

<u>Subject #</u>	<u>Response</u>
1	Do not operate without instructions
2	Do not operate without knowing
3	Do not operate unless qualified
4	If you don't know - Don't do
5	Read operator's manual
6	Don't operate till you read manual
7	Don't operate hoist unless you know how to
8	Don't use hoist unless you know what you are doing
9	Know what you are doing before operating a hoist
10	Know how to operate your hoist
11	Be sure you know how to operate hoist
12	Don't forget which way - up or down
13	Don't raise vehicle without watching what you are doing
14	Do not stand in front of vehicle while lifting
15	Do not use hoist unless you have adequate experience
16	—
17	Do not operate hoist when in doubt
18	Do not operate without proper knowledge
19	Don't lift when uncertain
20	Know how to operate
21	Do not use hoist if not trained
22	Don't stand under car
23	Think before lifting car, watch when lifting
24	Do not operate hoist if you have an questions
25	Do not operate if not know
26	Know how to use before operating
27	Do not use if not experienced
28	Unexperienced people do not use
29	Don't forget direction - right up, left down
30	Never operate hoist unless properly trained
31	Not sure didn't release safety
32	Do not use lift unless you know what you are doing
33	Know how to operate hoist before using
34	Read instructions
35	Read instruction manual before using hoist
36	—
37	Do not operate if you don't know how
38	—
39	Don't use if you don't know how
40	Don't use until qualified
41	Do not operate unless you know how
42	Do not use hoist without knowledge
43	Read instructions first
44	Do not operate hoist without proper knowledge
45	Technician unfamiliar with equipment
46	Do not use if you don't know what you are doing
47	Untrained persons shouldn't use hoist equipment
48	Do not operate hoist without reading instructions
49	Don't operate hoist without knowledge of the equipment
50	Do not operate the equipment unless you have been properly trained

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Picture #33 - Don't exceed weight capacity

<u>Subject #</u>	<u>Response</u>
1	Overloaded vehicle may cause damage to hoist
2	Do not use damaged rack
3	Danger - Unstable load - damage may occur
4	Do not pick up loaded vehicles
5	Don't overload one end of vehicle
6	Don't raise loaded vehicles
7	Trucks with loads can exceed load limit of hoist
8	Don't lift trucks while loaded
9	Don't overload a hoist
10	Do not overload hoist capacity
11	Do not overload hoist
12	Hoist bent from load
13	Never raise overloaded truck/vehicle on hoist
14	Not to lift vehicle when loaded
15	Support hoist load evenly
16	Watch weight in rear of vehicle
17	Do not raise vehicle when excess load is in the back
18	Do not overload
19	Overweighted or unbalanced
20	Do not lift loaded trucks
21	Do not lift loaded vehicles
22	Center car
23	Do not use with uneven load
24	Do not lift vehicles with heavy loads
25	Overloaded
26	Don't overload
27	Overloaded
28	Don't lift trucks with weight in back which will off balance vehicle
29	Don't lift with load unbalanced
30	Do not overload hoist beyond normal lifting capacity
31	Overloaded uneven load using wrong hoist unload before using hoist
32	Heavy weight on rear
33	Do not lift vehicle with ballast
34	Over weighted loads may tip
35	Excessive loads may cause vehicle imbalance during lifting
36	Do not pick up unbalanced vehicle
37	Do not overload hoist damaging hoist
38	Too heavy for hoist
39	Unbalanced load could cause hoist to fail
40	Don't overload
41	Do not lift loaded or uneven vehicles
42	Do not lift vehicle with extra load
43	Do not lift loaded vehicle
44	Do not hoist loaded trucks
45	Dummy forgot to unload truck and technician is crazy for putting it on hoist - broken hoist
46	Poor loads can break hoist
47	Overloading of hoist could cause hoist to fall
48	May damage hoist if overloaded
49	Warning - Unsafe load will result in hoist failure or breakage of equipment
50	Exceeding hoist capacity could cause damage to equipment and personal injury

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Picture #34 - Only trained operator should use

<u>Subject #</u>	<u>Response</u>
1	Do not set hoist pads without proper knowledge
2	Do not use without knowing
3	Do not walk near when unattended
4	If you don't know don't do
5	Read operator's manual
6	Read manual
7	Do not operate hoist if uncertain about proper procedure
8	Don't use hoist unless you know what your doing
9	Don't use hoist until you check to see what the problem is and if it is fixed
10	Know what to look for when problems arise
11	If you don't understand find out
12	Front pads not out
13	Don't leave hoist raised and/or with pads inward
14	Do not leave hoist
15	Do not leave hoist in raised position unless it is supporting a vehicle
16	—
17	Do not operate pad position is unknown
18	Do not operate without proper knowledge
19	Hoist inoperable
20	Do not leave hoist in up position
21	Do not use hoist if not properly trained
22	Check manual
23	Do not lift empty hoist
24	—
25	—
26	Don't operate without vehicle
27	Inoperable
28	Do not leave pads in air may walk into
29	Don't forget how to set car on hoist
30	Do not use hoist unless properly trained
31	Hoist up - pull arms straight
32	Do not use
33	Do not leave hoist raised with no vehicle
34	Do not use hoist without instructions
35	Know where lift points are for each vehicle
36	Do not leave lift up when not in use
37	Do not use if you don't know how
38	Read manual before using
39	Don't use if you don't know how
40	Don't use until instructed upon operation of hoist
41	Do not operate unless you know how
42	—
43	Read instructions before operating
44	Do not operate hoist without proper knowledge of operation
45	Unfamiliar with hoist
46	Do not use if you don't know what you are doing
47	Don't use hoist unless familiar with equipment
48	—
49	Don't leave hoist in a raised position without a vehicle on it
50	—

- Appendix C - Experiment 2 -

Picture #35 - Unauthorized people not allowed

<u>Subject #</u>	<u>Response</u>
1	Do not allow bystanders near hoist
2	Authorized personnel only
3	No customers when in use
4	Stay clear of work area
5	Workers only
6	No customers under lift
7	Do not play around a car when on hoist
8	No customers under hoist
9	Don't let customers or others stand or come near hoist
10	No customers allowed in hoist area
11	Keep people away
12	No customers around car when up in air
13	Don't allow customers under hoists
14	Do not let customers under vehicle
15	No customers under raised vehicles
16	No unauthorized people around hoist
17	Do not operate with pedestrians around
18	Authorized personnel only
19	No unauthorized personnel near lift
20	Employ only by lift
21	Do not allow unauthorized people under vehicle while on hoist
22	No children in shop
23	Do not have people around hoist
24	Do not let customers or kids near car while on hoist
25	No other operator hoist
26	No playing under hoist
27	Keep people not authorized away
28	OSHA regulations no uninsured people in hoist area
29	Warning - no customers under car while in air
30	Keep all personnel clear of hoist area
31	Don't dance under hoist - no eye glasses, stay clear car on hoist
32	—
33	Authorized personnel only in hoist area
34	Stay clear of vehicle being raised
35	Avoid standing under vehicle while it is in the air
36	Do not have meeting under raised vehicles
37	Keep others clear while using hoist
38	Keep customers outside work area
39	Unsafe for public to be around (hazardous area)
40	Hazardous area - Don't enter
41	No customers friends... under hoist
42	Do not let other people around raised car (unauthorized persons)
43	No unsupervised persons
44	Do not have unsupervised people under hoisted vehicle
45	Keep customers away from area their very accidental people with big lawyers if they get hurt
46	Keep non-working people away when in use
47	Don't allow customers to go under vehicle
48	No customers under hoist
49	Warning - Keep customers and unauthorized persons away while in a raised position
50	Customers are not allowed in the work area

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Picture #36 - Don't operate if hoist isn't working properly

<u>Subject #</u>	<u>Response</u>
1	Watch for faulty controls
2	Do not use without knowing
3	Danger - Do not touch
4	Watch out for warning signs
5	Read operator's manual
6	Electrical hazard
7	—
8	Know what to do if alarm goes off
9	Watch for electricity - Be careful check with operator's manual
10	Know your emergency switch
11	—
12	Remember safety switch
13	Don't use hoists when you hear warning bell- See what's wrong
14	Warning horn
15	—
16	—
17	Be aware of warning systems
18	Caution: voltage
19	Electrical hazard warning
20	Do not leave controls while in operation
21	Do not service electrical unless authorized
22	Sometimes not work right
23	—
24	—
25	—
26	Watch for warning signs
27	Not sure - Don't use
28	—
29	Warning - may cause shock
30	Do not use defective hoist
31	Don't push buttons you don't know
32	—
33	—
34	—
35	—
36	—
37	Do not use if hoist has electrical problems
38	—
39	Don't use if you don't know how, or damaged
40	Read instructions before using
41	Caution: high voltage
42	—
43	—
44	—
45	This picture get help, turn off power, but not everyone thinks that way
46	—
47	Caution - Electrical box - High voltage!
48	—
49	Did you forget to shut off power to hoist before leaving
50	—

- Appendix C - Experiment 2 -

Picture #37 - Periodic inspection required

<u>Subject #</u>	<u>Response</u>
1	Look out for possible damage before using hoist
2	Look out for broken pieces
3	Check equipment before operation
4	Check your hoist before using
5	Use safety glasses
6	Look
7	Inspect hoist arms occasionally for wear
8	Check hoist for damage before using
9	Left front hoist arm missing - Don't use
10	Visual inspection
11	Keep your eyes open
12	I see no arm on rack
13	Don't use incomplete, or malfunctioning hoists
14	Inspect hoist
15	Do not use hoist if damaged or missing parts
16	—
17	Watch for pad out of position
18	Inspect before use
19	Inspect lift for problems and maintenance
20	—
21	—
22	Keep eyes on pads when lifting
23	Watch arms for eye damage
24	Check hoist for any visible damage
25	Watch what you are doing
26	Look before you lift
27	Broken
28	Watch for hoist pads in air
29	—
30	Give visual inspection of hoist before using
31	Arm missing - be alert
32	Watch your head
33	Look before entering hoist area
34	—
35	Make sure all lifting arms are being used on the vehicle
36	Look for hoist pads that are up without vehicles
37	Inspect hoist for damaged or missing parts
38	Watch each time operating hoist
39	Visual inspection required
40	Visual inspection required
41	Inspect hoist carefully
42	Inspect hoist before operating
43	Inspect before using
44	Watch for proper position of hoist arms
45	Look to make sure all equipment is intact before using
46	Check your lift arms
47	Look for any equipment problem before using
48	Inspect hoist before using
49	Check all working parts of hoist before use
50	Visually inspect your equipment before each use

- Appendix C - Experiment 2 -

Picture #38 - Use proper vehicle pickup points

<u>Subject #</u>	<u>Response</u>
1	Raise vehicle between front and rear wheels on body
2	Tire contact hoist
3	Pad position proper lift
4	Lift here
5	Use correct contact points
6	Position arms
7	Contact frame at these points on vehicle when lifting
8	Pick up car from points between front and rear wheels
9	Proper lift points for hoist and or car
10	Contact points
11	—
12	Set pad here
13	Locate hoist contact points properly
14	Lifting points on vehicle
15	Know your lift points on the vehicle you are lifting
16	Frame points for raising vehicle
17	X's show jack position
18	Contact arms under vehicle as shown by x's
19	Lift at these points
20	lift contact points
21	Use proper lift points on vehicle
22	Lift points
23	Lift points
24	Vehicle lift points
25	Place pads here
26	Lift at these points
27	Frame hoist
28	Set pads here
29	Pick car up at these points only
30	Lift vehicle at approved lifting points only
31	Put on frame only
32	Lift points
33	Know proper jack locations
34	—
35	Recommended lifting locations
36	—
37	Use approved lift points on vehicle
38	Correct method to use hoist
39	Safe lift points
40	Pad lift points
41	Proper lifting points (use them)
42	Make sure to use correct pad positions
43	Lifting points
44	Lift vehicle at areas marked with X
45	Proper places for hoist support arms
46	Use correct lift points
47	Lift vehicle after positioning pads at these spots
48	Lifting positions
49	Make sure hoist pads are positioned in proper place
50	Use proper lift points on every vehicle - refer to manual for lift points



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Picture #39 - Keep feet clear of hoist while lowering

<u>Subject #</u>	<u>Response</u>
1	Keep feet from under hoist
2	Keep feet away
3	Danger - Injury may result
4	Stand clear of moving lift
5	Know your position when lowering vehicle
6	Watch feet
7	Always wear steel toed boots when operating hoist
8	Keep feet clear of hoist arms
9	Don't stand under hoist or have feet under hoist
10	Keep feet clear of hoist contacts when lowering
11	Watch your feet
12	Rack coming down on foot
13	Don't get foot caught under lowering hoist arms
14	Keep feet clear
15	Keep feet clear of hoist at all times
16	Keep feet from under hoist
17	Be aware of foot position to avoid injury
18	Keep feet from under lift arms
19	Keep feet from under lift
20	Watch your feet
21	Keep feet away when lowering vehicle
22	Keep feet away from pads
23	Watch for foot when lowering
24	Watch your feet when hoist is lowered
25	Watch for pads
26	Foot hazard
27	Keep feet away
28	Watch feet
29	Watch your feet when hoist comes to floor
30	Stand clear of hoist area while letting vehicle down
31	Watch feet while lowering hoist
32	Watch your feet
33	Do not stand under hoist when lowering - Keep feet clear
34	Keep feet away from hoist
35	Keep feet clear when lowering vehicle
36	Beware of where your feet are
37	Keep feet clear of pinch points
38	Keep feet clear
39	Stand clear
40	Keep clear
41	Keep feet clear
42	Keep feet clear of hoist
43	Keep feet clear
44	Wear safety shoes
45	Hoist coming down - stay clear, keep feet away if you are normal
46	Watch your feet around hoist arms
47	Don't put your feet under hoist pads
48	Stand clear of hoist when lowering
49	Warning - Keep feet clear of hoist while its coming down
50	Keep feet out from under hoist

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Picture #40 - Periodic inspection required

<u>Subject #</u>	<u>Response</u>
1	—
2	Hard hat required working on hoist
3	Wear safety equipment when working on lift
4	Wear hard hat when working under car
5	Wear hard hat
6	Technician only
7	Always wear protective helmet when repairing car on hoist
8	Wear a bump hat while working with hoist
9	Wear hard hat when working in this area
10	—
11	—
12	—
13	Approach vehicle straight on
14	Wear hard hat
15	Use proper safety equipment working on hoisted vehicles
16	—
17	Wear a hard hat when operating
18	Wear hard hat
19	—
20	—
21	—
22	Hard hat needed
23	—
24	—
25	—
26	Wear hard hat
27	Partial lift for easy access
28	—
29	—
30	Wear hard hat when performing any repairs under vehicle
31	Wear hat
32	—
33	—
34	Wear a hard hat
35	Use proper safety equipment when working around hoist
36	—
37	—
38	—
39	Hard hat area or hoist maintenance required
40	Hard hat area
41	Wear hard hat when working on vehicle
42	Wear proper safety equipment
43	Use proper safety equipment
44	Use proper safety equipment
45	Wear hard hat when working on junk unless you are past that stage of life
46	—
47	Wear a hard hat while working under vehicle
48	Use bump hat when working under vehicle
49	Wear a hard hat when working under a vehicle
50	Hard hat use required

*- Appendix C - Experiment 2 -*

**Picture #41 - Use jack stands when removing heavy objects**

<u>Subject #</u>	<u>Response</u>
1	Do not lift unbalanced vehicles
2	Must be stable when working
3	Unsafe - do not lift
4	Do not work unsupported
5	Use safety stands
6	Lift properly positioned
7	Do not remove heavy components from vehicle without supporting it
8	Don't lower car while there is something under it
9	Use support jacks when changing an engine
10	Always use jack stands when working under car
11	Do not use for engine removal
12	Do not leave objects under cars when lowering
13	Don't leave objects under vehicle on hoist
14	Watch for weight change on vehicle
15	Don't have vehicle raised on hoist for engine removal
16	—
17	Do not tip car over with object under car
18	Keep weight distributed evenly
19	Do not lower car with obstacles underneath
20	Do not remove engines without proper support
21	Do not tilt vehicle
22	Balance car on hoist
23	Load off center
24	Do not place any objects under vehicle while on hoist
25	Remove garbage
26	Look before lowering
27	—
28	Do not pull heavy weight from vehicle when unbalanced
29	—
30	Do not remove heavy components unless safety stands are used fore and aft
31	Car on hoist wrong, large load take out of front made car unstable
32	Proper lift points
33	Make sure vehicle is positioned on hoist before lifting
34	Unbalanced loads may tip
35	Removing heavy parts from vehicle on hoist may cause tipping
36	Do not leave things under vehicle
37	Watch for center of gravity changes when removing large parts
38	Watch objects placed under hoist
39	Keep under hoist clear
40	Don't use unless you are using proper supports
41	Do not have car lifted when pulling motor
42	Be sure vehicle is balanced when removing weight
43	Properly support vehicle
44	Do not use without proper safety stands
45	Tech installed motor, motor fell out, then car fell off hoist, normal condition
46	Do not remove engines
47	Don't remove engine without supporting rear of vehicle
48	Read of vehicle may be too heavy
49	Warning - Do not raise vehicle unless it's level
50	Do not remove major components without supporting vehicle properly

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Picture #42 - Don't exceed weight capacity of hoist

<u>Subject #</u>	<u>Response</u>
1	Do not lift heavy truck
2	Do not overload hoist
3	Unstable load - Overweight - Danger
4	Do not overload
5	Don't overload hoist
6	Don't lift unless properly positioned
7	Do not lift trucks on this hoist
8	No dual axle trucks on hoist
9	Center vehicle on hoist - Don't overload
10	Never overload hoist capacity
11	Not a truck hoist
12	No heavy trucks
13	Use the correct hoist for the size of vehicle
14	Vehicle not for this hoist
15	Do not lift heavy truck on this hoist
16	Load must be evenly distributed
17	Do not overload hoist
18	Distribute weight evenly: Do not overload
19	Do not lift oversized or overweight vehicles
20	Do not lift off center of gravity
21	Do not tilt vehicle
22	Don't overload hoist
23	Load off center
24	Do not overload hoist
25	Too large vehicle
26	Don't overload
27	Uneven load
28	Do not lift big trucks on small hoist
29	No oversized trucks on this hoist
30	Do not lift trucks on this hoist
31	Need axle hoist uneven load
32	Proper lift points
33	Do not lift truck on car hoist
34	Too heavy for hoist
35	Make sure hoist is capable of lifting the vehicle
36	Do not raise vehicles not intended for hoist to lift
37	Don't lift vehicles that are overweight for the hoist
38	Too heavy for hoist
39	Don't overload hoist
40	Don't overload
41	Do not lift objects too heavy for hoist
42	Do not overload hoist
43	Do not lift trucks
44	Do not hoist trucks on this hoist
45	Truck not on hoist properly
46	Do not lift heavy trucks
47	Don't over-weight hoist with large trucks
48	Vehicle too large for hoist
49	Warning - Do not overload hoist
50	Do not lift vehicles not suited for hoist

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## **APPENDIX D INJURY STATISTICS**

This appendix contains statistics related to occupational injury and illness. Since specific data related to garage lift injuries is not available, the overall industry data is used to get a general sense of where and how automobile related injuries occur.

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## INJURY STATISTICS

Specific data on injuries due to garage lifts is not available as previously mentioned in the Introduction. However, general industry level data does appear in Accident Facts (National Safety Council, 1988), and the Bureau of Labor Statistics Supplementary Data System did give some related general statistics. Table 1 shows occupational injury and illness incidence data by industry with summary statistics given for the Standard Industrial Classification (SIC) codes of interest here, 55, Automobile Dealers and Service Stations, and 75, Auto Repair, Services, and Garages. In most cases the numbers reported for these categories are below the national average, though the differences are usually not large.

Table 1, BLS Estimates of Occupational Injury and Illness Incidence Rates, 1986

<b>Industry</b>	<b>SIC Code</b>	<b>Total Cases</b>	<b>Lost Workday Cases</b>	<b>Nonfatal Cases W/o Lost Workdays</b>	<b>Lost Workdays</b>
Agriculture, Forestry & Fishing	01-09	11.2	5.6	5.6	93.6
Mining	10-14	7.4	4.1	3.2	125.9
Construction	15-17	15.2	6.9	8.3	134.5
Manufacturing	20-399	10.6	4.7	5.9	85.2
Transportation & Public Utilities	40-492	8.2	4.8	3.4	102.1
Wholesale & Retail Trade	50-59	7.7	3.3	4.3	54.0
<b>Automotive Dealers &amp; Service Stations</b>	<b>55</b>	<b>7.1</b>	<b>2.7</b>	<b>4.4</b>	<b>48.1</b>
Finance, Insurance & Real Estate	60-65	2.0	0.9	1.1	17.1
Services	70-89	5.3	2.5	2.7	43.0
<b>Auto Repair &amp; Garages</b>	<b>75</b>	<b>6.8</b>	<b>3.2</b>	<b>3.6</b>	<b>54.7</b>
Average		7.9	3.6	4.3	65.8

Source: National Safety Council, 1988. p 41-43

Tables 2 and 3 show the subcodes that make up SIC codes 55 and 75. Within code 55 there are two subcodes for which automotive lift use is common -- 551, New and Used Motor Vehicle Dealers, and 554, Service Stations. Within code 75 the subcode of interest is 753, Automotive Repair Shops, and all subcodes below it (7531, 7534, 7535, 7538, and 7539).

Table 2, Subcodes of SIC 55, Auto Dealers and Service Stations

<b>SIC Code</b>	<b>Industry</b>
551	Motor Vehicle Dealer, New and Used
552	Motor Vehicle Dealer, Used Only
553	Auto and Home Supply Stores
554	Service Stations
555	Boat Dealers
556	Recreational Vehicle Dealers
557	Motorcycle Dealers
559	Auto Dealers Not Elsewhere Classified

Table 3, Subcodes of SIC 75, Auto Repair and Garages

<b>SIC Code</b>	<b>Industry</b>
751	Automotive Rental & Leasing Without Drivers
752	Automotive Parking
753	Automotive Repair Shops
7531	Top & Body Repair Shops
7534	Tire Retreading and Repair Shops
7535	Paint Shops
7538	General Auto Repair Shops
7539	Gen. Auto Repair, Not Classified
754	Auto Services Except Repair

While the intent of this project was not to develop such detailed statistics, some effort was made to retrieve that information from the U.S. Department of Labor (Bureau of Labor Statistics). Phone conversations with them (Biddle, 1989; Johnson, 1989) revealed that some relevant statistics were available from the Supplementary Data System. That program aggregates state workmen's compensation data for 23 states. The data are somewhat flawed as each state uses slightly different criteria to decide when a claim should be filed (anywhere from 1-8 days of disability) and further, the reporting schemes vary from state to state. However, the claims are in a database and can be retrieved.

Shown in Tables 4-7 are data on the causes of injuries, the nature of the injury, the body part injured, and the type of injury. These data are for 1986, the most recent year available. Readers should bear in mind that these data reflect injuries associated with all sources, not just lifts. It is possible that more specific information could be obtained by purchasing the Supplementary Data System tapes from NTIS and writing a program to search the raw data. However, such was beyond the scope of this project.



- Appendix D - Injury Statistics -

Table 4, Causes of Injuries

Cause	--- Number of Injuries for Each SIC ---						
	551	554	7531	7534	7535	7538	7539
boxes	524	579	42	6	3	65	68
chemicals	289	111	34	1	3	34	19
hand tools	741	336	112	24	3	157	131
machines	115	112	27	9	1	54	44
metal items	2026	534	274	46	17	574	443
vehicles	2193	709	158	22	15	326	195
wood items	34	25	9	2	2	16	12
working surfaces	1227	885	120	21	13	189	120
Misc. classified	3104	1870	273	120	21	553	384
non-classified	291	167	56	9	2	85	64
<b>Total</b>	<b>10544</b>	<b>5328</b>	<b>1105</b>	<b>260</b>	<b>80</b>	<b>2053</b>	<b>1480</b>

Table 5, Nature of Injury

Nature of Injury	--- Number of Injuries for Each SIC ---						
	551	554	7531	7534	7535	7538	7539
amputations	23	25	4	-	1	20	10
heat burns	281	318	31	1	-	88	56
chem burns	130	85	10	-	2	17	7
bruises	787	502	50	20	5	178	124
cuts	1641	643	191	25	10	286	273
fractures	872	597	90	38	12	246	122
abrasions	664	167	106	7	10	133	139
sprains/strains	4059	1749	369	116	28	683	489
illnesses	442	187	75	7	3	65	50
other	923	553	104	31	5	225	123
non-classified	722	502	75	15	4	112	87
<b>Total</b>	<b>10544</b>	<b>5328</b>	<b>1105</b>	<b>260</b>	<b>80</b>	<b>2053</b>	<b>1480</b>

Table 6, Body Parts Injured

Body Parts Injured	---Number of Injuries for each SIC---						
	551	554	7531	7534	7535	7538	7539
eyes	923	254	153	8	13	188	179
head/neck	592	423	40	11	4	87	64
fingers	1147	451	132	21	9	234	215
upper extremities	1404	725	148	31	17	307	238
Back	2453	1069	250	76	14	464	313
Trunk	1039	542	111	47	5	197	141
lower extremities	1820	1077	161	44	13	359	195
mult. body parts	878	628	74	18	3	174	104
body systems	199	108	30	3	1	28	14
non-classifiable	89	51	6	1	1	15	17
<b>Total</b>	<b>10544</b>	<b>5328</b>	<b>1105</b>	<b>260</b>	<b>80</b>	<b>2053</b>	<b>1480</b>

- Appendix D - Injury Statistics -

Table 7, Type of Accident

Type of Accident	---Number of Injuries for each SIC---						
	551	554	7531	7534	7535	7538	7539
struck by/against	2742	1518	293	69	20	614	450
fall	1354	973	136	24	15	227	147
caught in/under	490	255	38	16	4	111	84
rubbed or abraded	609	146	107	6	9	122	131
bodily reaction	1029	393	75	13	5	134	70
overexertion	2099	1159	280	111	1	556	393
contact w/temp extremes	266	307	31	1	-	81	55
contact w/ radiations	353	148	60	1	4	45	35
highway motor accidents	603	137	30	4	-	66	45
other classifiable	165	165	11	4	-	33	16
non-classifiable	234	127	44	11	2	64	54
<b>Total</b>	<b>10544</b>	<b>5328</b>	<b>1105</b>	<b>260</b>	<b>80</b>	<b>2053</b>	<b>1480</b>

Tables 8 and 9 show the source of illness or injury for both the public and private sector. Notice in particular the categories of retail trade and services, as these would include car dealerships and service stations. These two categories are not the largest sectors but they do represent a sizable percentage. However, it is not clear if automotive lift injuries are all classified within the 2600 codes or not.

Table 8, Source of Injury Codes

Injury code	Source of Injury of illness
2600	Hoisting apparatus unspecified
2625	Hoists (air, chain, electric)
2650	Jacks (mechanical,hydraulic, air, etc.)
2699	Hoisting apparatus not elsewhere classified

Table 9, Source of Injury by Industry

Private and Public Industry Div	---Number of Injuries for Each SIC---			
	2600	2625	2650	2699
Agriculture,forestry, & fishing	4	11	39	25
Mining	14	23	109	366
Construction	49	111	243	233
Manufacturing	130	384	544	343
Transportation & public utilities	12	49	245	76
Wholesale trade	16	48	342	58
Retail trade	23	150	728	94
Finance, real estate, insurance	-	5	9	10
Services	26	85	258	225
Not available	3	2	16	4
Public sector	18	50	122	74
<b>Total Private Sector</b>	<b>277</b>	<b>868</b>	<b>2533</b>	<b>1434</b>
<b>Total Private and Public</b>	<b>295</b>	<b>918</b>	<b>2655</b>	<b>1508</b>

- *Appendix D - Injury Statistics* -

From these numbers, it is still rather ambiguous how these relate to automotive lifts specifically. Despite the lack of lift data, these statistics give a general idea for where the automobile industry injuries occur and why. With further analysis, perhaps specific lift-related injury data can be extracted. However, this is beyond the scope of this project and would only be pursued if further funding was available.

