

CONCERNS ABOUT THEATRICAL RIGGING

From a Risk Management Point of View:

IDENTIFICATION OF HAZARDS AND PRODUCTS

1. **Because the rigging on any stage is in actuality an operating machine, all facets and components of that machine shall be closely and meticulously scrutinized at all times for problems, defects, and malfunctions.**
2. **It is imperative that you have knowledge of all the working parts of the stage machinery and can identify those components.**
3. **This identification is the basic approach to any task that has to be performed on the stage or in any rigging situation.**
4. **Each component is an intimate part of the total machine and must function with efficiency and accuracy.**
5. **Individuals who work with stage machinery shall constantly be in the process of identification of components to determine their safe operation.**
6. **They shall know what they are as a product.**
7. **They shall be able to identify the exact product.**
8. **They shall know the exact use they are being put to.**
9. **They shall know the hazards that accompany them.**
10. **They shall know the strengths and weaknesses of these products.**
11. **What are the warning signs that indicate to you that a product is not working satisfactorily or has not been correctly specified for the task?**
12. **They shall have a comprehension of when these components are being applied correctly, and when they are eroding, and when they should be replaced.**
13. **You must be able to identify certain products and find the traceability codes on them?**

Identification of the parts of the rigging machine is the first element in a risk management approach to rigging on the stage or in any venue.

- **Who are the manufacturers of the products that you use on the stage/**
- **Which manufacturers produce the best products?**
- **What are, if there are, differences in the products that should make you wary of selecting certain products?**
- **Do you regularly check the catalogs and study the specifications?**
- **How are the products brought into the system?**
- **Is the purchasing arm of the theater knowledgeable about the products you use?**
- **Are you familiar with the Standards that apply to products you use in rigging?**

- **Are there particular Standards that you have intimate knowledge of and apply to your rigging work?**
- **Do you have a working knowledge of the rigging Standards that are being developed by professional groups and associations and how that process works?**

ANALYSIS AND EVALUATIONS OF HAZARDS AND PRODUCTS

Analysis is the second level in any risk management program in rigging. You must be able to examine carefully the products you are working with on a daily basis, and make a judgment as to the reality of those products in relationship to your particular rigging machinery.

Safety is a word that has many parameters and many connotations. We must constantly think of products and operations as “free of hazards” because it is very difficult to wrap your arms around the word safety or safe. This is the movement in the industrial community and it is worth thinking about.

- 1. Always ask questions and do not be put off by a barrage of information. You have a need to know and it should be satisfied. There is always someone who knows what you need to know.**
- 2. Develop a procedure that you follow religiously in examining any product or component in the system. We have developed a format that is very useful in this pursuit, as we do many product analyses.**
- 3. You must keep in mind that each of these products are part of the rigging machine, and the failure of one can too easily spell a domino effect that can be catastrophic.**
- 4. Search out information from reliable sources. There is an enormous amount of material on rigging and many companies will share this with you. Develop your own library of rigging equipment materials and books.**
- 5. Compare products that will exactly fulfill the tasks you have designated for a particular use. Unfortunately there are many products in the marketplace, from many countries, and they are not always of quality.**
- 6. Counterfeit products in our industry are rampant, and you must be constantly looking for these. Vendor evaluations are vital in this area, as many of them try to stay in business in this economic climate, substitute and change and mull over.**
- 7. Shopping for products at Home Depot or other ordinary hardware stores is not wise. You must be the judge and peruse carefully all products. This identification is paramount in your work.**
- 8. Apply the OSHA Standards as designated by signage: Risk, Danger, Caution, and Warning. These are carefully spelled out for you in the DOL and OSHA documents.**

9. There are many government sources for rigging information, some where you would not suspect: Dept. of Commerce, Dept. of the Interior, Coast Guard, Army, Navy, Air Force, and others. It does take a bit of digging but they are useful and spell out the many Regulations that govern rigging.
10. There are also many companies and associations, in this country and overseas, that deal in rigging equipment and standards.
11. Risk assessments or inspections of your machinery are of prime importance. Never take anything for granted or assume that the system is in top-notch shape unless it has been thoroughly checked.
12. Accurately record the results of your risk assessments with written reports and photographs. This is one area that must be emphasized. In case of any incident these records are valuable. They certainly tell of your diligence in providing risk and hazard free rigging and operations.
13. Notification of the proper authorities, e.g., supervisors and administrators, is part of the Due Diligence that is required by law.
14. The Department of Labor, Occupational Safety and Health Administration (OSHA) provides the legal language and the enforcement arm to mandate compliance with those Regulations that directly relate to rigging. CFR 1910>OSHA, CFR 1926 the Construction Code of the Federal Codes are strict in their mandates for compliance.
15. "The employer shall furnish a place of employment this is free of recognized hazards." That states it succinctly. If this is not accomplished then the employee may speak to OSHA and relate their problem.
16. Follow OSHA, ANSI 830.9 or manufacturers guidelines. Use by untrained persons is hazardous. Also OSHA 1926.251
17. The individual who works with rigging should pursue all of the codes that are applicable to the particular rigging that he or she does.
18. The Right to Know laws also provides protection and a means to have the safe working environment and equipment, e.g. rigging equipment. Even those these are particularly keyed to chemicals they have a carry over to work environments.
19. It is the law that instructors in educational facilities have the obligation for hazard free and acceptable risk environments. Instructors are liable and that is why there is a need for training in this particular area, e.g. rigging.
20. You have the Duty to Warn, by all the laws that relate to liability. If you should observe or know of equipment, material, machinery, products that are defective or capable at this time of failure, you must notify the authorities that govern your work environment and we recommend that you do it in writing and with photography.
21. The Standard of Care shall always apply in every single situation.

22. Every lawsuit deals with the Standard of Care plus the Standard of Operations as well as the Laws and Regulations. Indeed, if there were no regulations, there is a Standard of Care that should be applied for the personal protection of the persons involved.
23. This Standard of Care can apply to any operation or function on the entire theater complex.
24. It also applies to care for the parts of the structure and the building itself.
25. It does apply to the administration and its Due Diligence in making sure the rigging system and all that is related to its structural and equipment well-being as well as to those that operate the systems.

THE PROCESS OF RISK MANAGEMENT IN RIGGING

Working on stage is dangerous. Operating stage machinery is dangerous. Not having the proper professional training and working with defective equipment improperly installed is very dangerous.

There are inherent hazards. There is a large quantity of material over your head, and most of it moves and thus the need for procedures and protocols that deal with overhead rigging equipment. We developed an overhead safety program in the 80's and early 90's for the Disney Corporation and to my knowledge it still is in place and working.

The risk management process is developed and implemented to identify and evaluate hazards, risks and dangers. It is the only program that absolutely will cover all of the bases that must be identified and explored.

On Going Programs

Once the evaluations have taken place and the identification have been collated, there is a very detailed and specific body of knowledge that you have to make decisions about and from that point of view, eliminate the hazards, reduce the hazards, and finally arrive at an acceptable risk. The acceptable risk is what you must have to work in this industry. No other is reasonable or acceptable.

All Actions Must Be Acceptable

Every action that is taken in rigging is to operate the stage machinery in a manner that is free of hazards and as risk acceptable as possible. This means that equipment and materials that are identified, specified and selected and eventually purchased and installed, must be those that are free of hazards, follow a quality control program, and present the personnel and the venue with a risk that is acceptable.

This is not a one shot operation. It must be done constantly and accurate records must be maintained with dates, signatures, findings, and corrections. Log shall be developed and computer programs for backup.

Professional Training

Professional training is also a key to this acceptable risk operation of rigging. An incredible number of individuals from many areas of rigging work in the industry, and have little knowledge and competency, few skill sets and very little knowledge of acceptable risk operations. This is a sad state of affairs.

The four to five thousand individuals who have freely elected to participate in my Risk Management Rigging Workshops over the last twenty-six years, can give credence to this situation. This fact gives legs to the reasons for professional Certification of many types of rigging.

APPROACH TO RIGGING PRODUCTS: TERMINOLOGY

- 1. Know the exact names of the products one must use or purchase.**
- 2. Know what the products are specified for.**
- 3. Know its working load limit (WLL): the total or maximum mass or load or force that the product is authorized to support in a particular service or situation or condition.**
- 4. Stress: force or forces applied (pounds per square inch) [psi] is the result of an applied load.**
- 5. Applied load: external forces that may be applied in different ways.**
- 6. Impact loads or shock loads: Sudden forces that increase the load factors to any product. Sudden force that is equal to at least two times the static value. Velocity and load enter into this as components.**
- 7. Tension: the forces that pull products apart**
- 8. Compression: the forces that push products together**
- 9. Strain: changes in dimensions due to stress and deformation**
- 10. Proof load: the average load to which a product may be subjected before visual deformation occurs**
- 11. Proof test: a test applied to see if a product has been manufactured according to specifications and standards and might be defective; a tensile test**
- 12. Repeat loading: repeated forces and loads on a product.**
- 13. Vibration and movement forces**
- 14. Shear: forces moving to tear products apart**
- 15. Ultimate Strength: the average load or force at which a product fails or can no longer function and support the load. Usually certified by manufacturer as in wire rope.**
- 16. Strength reduction factors: Those factors that reduce the strength of any product, reduce the static load breaking strength in the termination of wire rope clips.**

17. **Design factor:** a term used in the industrial world: reserve capability of a product. Can be determined by: dividing the catalog ultimate load by the working load limit. Often expressed as ratio. The weight the particular product is to lift, such as in wire rope.
18. **Load increase factors:** variables that may increase the load limit above the design level or limit, e.g. curtains gaining weight from moisture, from sprinklers for fire curtains, point loads on battens, and torque loads with motors from starting inertia or pulley friction.
19. All overhead hardware shall be rated and it shall be carefully examined to determine that each item is in excellent condition and that it is truly forged and rated. Once again, be wary of very good counterfeit products, and have a system in place and trained personnel to identify products.
20. The reasoning behind using and specifying Crosby all of the time is that they produce excellent forged and rated hardware that can be traced and identified. This is something that you need to do in your daily work and always in case of some incident.
21. Always concern yourself with overloading problems that may go undetected if not carefully evaluated and observed.
22. Corrosion problems also impact the hazard level of any product.

Engineering and Mathematical Formulae

There are formulas for determining the strengths of products, and it is wise to look at the research and testing data. Engineering manuals are available and some of them are quite easy to understand.

There are not a lot of formulas we need in the rigging industry, but the few that we do need it is wise to know and be able to work with. Do not burden yourselves with many formulas, only those that can aptly apply to your specific need. Engineering formulas can be applied and it is always wise to have them checked and double checked for their applications.

Of Prime Concern: Competency of every person who works on and operates stage-rigging equipment.

These are some terms used in the rigging industry and these apply to your work. There are many more terms and definitions and pieces of knowledge that are required to be a competent rigger, e.g. one who has a body of pertinent knowledge and can apply it, has experience in the field and at different rigging tasks, and has the skill sets to apply what they know in actual situations requiring that expertise.

- Bearings are impacted by the ordinary use and the extraordinary impact of problems mentioned above. When applying any inspection techniques it is wise to do so in an atmosphere and environment where it is as quiet as you can get it. No air-conditioning and fans, scenery making, etc. You need quiet

to hear bearings when running the system. I often use a stethoscope to check for bearing wear and noise.

- If lines are running hard, or make noise there could possibly be some problem with bearings or with freezing blocks. Check carefully and do not delay this inspection.
- Loads affect all blocks used in the theater. Examination of blocks usually will tell you what is occurring with any particular block. Alignment, wire rope abrading, cutting into the side plates or spacers, catching on something, bent or bird caged, and any number of other conditions.
- Overloading of systems, in our experience, is very common. Balanced systems are the norm and should always be that way. Unfortunately there are creative technicians and demanding directors and creative designers and sometimes the system is not designed or manufactured or installed for this burst of creative energy.
- We have seen I beans deflect as much as nine inches. We have seen support steel torque. It does occur and is something to be aware of.
- Impact upon beams and other structural support mechanisms. Once one item is out of kilter, it translates like a domino down the system into many areas you cannot see, such as the building structure and its envelope. Be wary and cautious and know your system very well.

Considerations for Manila and Synthetic Ropes

1. Constant inspection is the rule that must apply at all times. There are no exceptions.
2. Whether it is multi line or manila or some other new synthetic, it is a product and it will be subject to wear upon constant use.
3. The only preventive maintenance factor for rope is to use it properly, check it frequently, do not overload it, and replace it when it is worn sufficiently to be a hazard.
4. Rigging technicians must know about rope and be able to determine if there are hazards that visually can be detected.
5. Ropes that are questionable in any way must be tagged and not used.
6. Obtain several books on ropes and peruse them carefully from time to time.
7. Rope locks are rope locks not brakes.
8. Rope locks shall receive frequent risk assessments.
9. All knots shall be according to the book and standard rigging practices. There are to be no magic knots.
10. We have a book in development dealing with ropes in this industry, co-authored with Randy Longerich, well known in the cordage industry throughout the world.

Ladders and Lifts

Many types of ladders and lifts are used on the stage by technicians.

Despite the Federal and State Regulations, along with manufacturers guidelines for their products, technicians continue to use ladders and lifts in their own personal manner. We observe on our risk assessments and hear of misuse of ladders and lifts everyday. It is the third highest item that comes into our data base of incidents and deaths.

The Regulations guiding the use of ladders and lifts is very direct. Misuse of these ladders and lifts lead to injury, maiming and death.

- **Ladders require proper use.**
- **They require preventive maintenance.**
- **There shall be no piece of equipment, ladder or lift, that should be allowed to be used unless it meets all of the maintenance and operational standards.**
- **The rules for using ladders and lifts are very specific. There are very specific Regulations for the manufacture of ladders and their use.**
- **All technicians shall be trained to competently use ladders and lifts. In many of our risk assessments we conduct part of the class showing technicians how to use ladders and lifts.**
- **No technician shall be allowed to use a ladder or lift that a professionally competent person on the staff has not trained.**
- **These rules and Regulations shall be strictly enforced.**

Fall Protection

Fall Protection for technicians who work overhead has been around for many decades. The increase in number of incidents and deaths has ratcheted up the enforcement of fall protection.

It is literally impossible to calculate the number of lift incidents, as most of them are not reported. The deaths however seem to be fairly well reported. The death last week at the Meadowlands in New Jersey hit the media. The Texas Tech lift incident and death certainly was noted.

The specific Fall Protection Law was enhanced in 1998 by the Department of Labor and is enforced by OSHA.

There have been a number of articles written in this area for the laws application to the entertainment industry, and there is a need for everyone who does rigging to be kept up to speed on this requirement.

Ergonomics

Although Federal authorities have downplayed this specific area it still remains a major area of concern for anyone working in the rigging industry. There is lifting, pushing, turning, reaching, and pulling for all riggers. Sweden and Finland have gone to total motorization of rigging so that there will not be lifting of stageweights.

We have always recommended that there be at least fifteen minutes of warm up before any technicians begins work on stage and especially with the rigging. The exercises should be more than just stretching.

Physical fitness is crucial for a rigger. They may mistakenly believe that fast food, smoking, long hours, and lack of organized exercise does not take its toll, but they are dead wrong. Rigging is a difficult task, if done correctly.

TASKS AND INFORMATION

All tasks that the rigger does must have a job analysis to determine the very best way to protect the rigger and his health.

- What are his or her specific duties?
- Is there any special set of skill sets that is needed to fulfill those duties?
- Is there any special physical ability or stamina required to fulfill those duties?
- What is his or her eyesight?
- Do they wear contacts or glasses?
- Color blindness?
- Any eye disease?
- Knowledge of their craft?
- Length of experience in a particular position?
- Physical fitness program or exercise?
- Bad backs?
- Other physical problems that might deter them from doing this work?
- Former incidents or accidents (privacy section) that might defer them from doing this work?
- Worker Compensation from a rigging incident or injury?
- Any physical limitations in doing rigging prescribed by a physician or therapy group?
- Have they work experience and references?
- In this particular job position?
- Privacy issue (drug or alcohol).
- Ability to work with other riggers.
- Attitudes at work with others?
- Awareness of Regulations?
- Cognizance of dangers in working with rigging equipment?
- Training background? Workshops, seminars, courses? How many? From whom? How long? Subjects covered? Certificates? OSHA or other groups.
- Involvement with rigging companies or manufacturers of rigging?
- Tour rigging? What groups?
- Involvement with safety committees that deal with rigging and all its aspects?

- **Special areas of expertise and competency in rigging? Ballroom, Concert, Arena, Theater, Cruise Ship, strictly educational and what level, theme park, outdoor rigging, casinos, tour rigging, magic shows, circus rigging, community theatre and little theater, flying people, etc.**
- **Individuals they have worked with in the Industry who have a reputation in rigging?**
- **Specific jobs and projects where they have been involved in rigging or rigging installations?**
- **Countries you have rigged in?**
- **Training in scaffolding and lifts and forklifts?**
- **Written any articles or materials on rigging? What area?**
- **Construction work? How long?**
- **Training in fall protection? From whom?**
- **Mountain climbing and rappelling experience?**
- **Rigging fire curtains? With whom?**
- **Experience in only manual rigging?**
- **Motorized rigging?**
- **Computerized rigging?**
- **Hydraulic rigging?**
- **Rigging in movie industry?**
- **In television industry?**
- **In the church groups?**
- **Decorative rigging in convention centers and civic centers?**
- **Bungee jumping?**
- **Licenses from other countries, e.g. Germany, England, Canada, Australia?**

These are only a few of the questions that should be inquired about and answered in dealing with rigging personnel. Some of the areas are in the privacy domain and therefore should be approached with the legalities in mind.

The vital concern is that riggers who are hired and work at rigging should be competent in those particular skills that are absolutely necessary for safe rigging.

What we have been able to determine in our own personal rigging career since 1943, that there are many individuals who belong to groups, associations, and union, who present or send out individuals who are supposedly skilled and competent and have experience, but they are not.

There are many in the entertainment industry that profess to be professional riggers but range from those who have no rigging experience to those who have very little skill in rigging. Not surprisingly, many of these are sent out and hired at major venues and their incidents that occur, deaths and injuries also.

In this country and around the world there are many methods of rigging and there are thousands of incidents, recorded, known, and not recorded. Human error, equipment failure, lack of preventive maintenance, a horrendous lack of training and competency, poorly designed equipment, poor to horrendous installations, and rigging companies that have people that truly seem to not provide quality control in their rigging.

Standards for Rigging: in development since 1975

1975 saw the first move to develop standards for rigging, in this country. Germany has had the equipment DIN Standards for a long time, and the training of stage technicians in yearlong courses. In the early nineties I was privileged to take my Risk management rigging workshops to Europe and the Far East and work with riggers from thirty countries. We trained many people in the United Kingdom and Europe and China and India. Some of these individuals have begun to develop their own standards.

USITT and then ESTA have taken up the task of rigging standards and now are working on Certification of Riggers. Our own work in this area goes back to the beginning of 1975, and in certification in 1991. We established, two years ago, a professional rigging association, ProRig, with headquarters in Florida, but it will soon move to New Hampshire. We have developed a set of skills and competency levels for different types of rigging. This curriculum (body of knowledge and experience and courses) ranges from basic to motorized, computerized, and hydraulic and is spelled out for all types of rigging designations, as listed above.

It is our thinking, along with others in the industry, that there is a need for Certification of Riggers, and this means extensive training. We believe that we have developed that curriculum and have been seeking certification credentialing in this important area, both in this country and in Canada, for a few years.

Risk Management Workshops in Professional Rigging

We are fully cognizant of the rigging industry needs and the specific areas they address, due to our major involvement for so many years (1943-2001).

We have individuals from the list above who teach with us and for us, e.g., 69 professionals in all. They are presidents of rigging companies, leaders in their fields, heavily involved in all areas of the rigging industry and all its components.

They are members of USITT, ESTA, IAAM, UL, and belong to many professional engineering companies worldwide. We have been most fortunate to receive assistance from these individuals and companies for the last twenty-six years, and look forward to there continue work with us in the Entertainment

Industry. The individuals and companies read like a who's who of the rigging industry.

Most of our Risk Management Rigging Classes are five days in length, with some of them in Europe and the Far East, eight and nine days, as requested.

Professional Involvement

It has been our good luck to be involved with worldwide wire rope companies, major hardware companies, worldwide rigging equipment and manufacturing companies, some of the worlds largest construction and petroleum industry corporations who do a lot of rigging, entertainment rigging and equipment companies in major countries, many thousands of riggers across thirty countries, rope companies, government agencies in a number of countries, engineering companies, and professional consultants who are some of the leading designers and consultants in the world.

We have been working for a dozen years with individuals and companies from Canada, the U.K, Germany, Australia, and Japan in developing rigging standards and training programs. It is our hope that some of this involvement may be of assistance to you. We are always willing to share this information and contacts around the world with those interested in enhancing the acceptable risk status of rigging in entertainment.

Scope and Purpose

It is the intention of our professional work to train individuals in skill sets in the rigging industry, in all areas of rigging, and in all types of rigging, and to establish professional certification standards of competency for entertainment riggers.

It is with this background that we bring you the information in rigging, limited to this one day.

Dr. Randall W. A. Davidson, Educational Performing Arts, and Entertainment Consultant and Expert

