17 ROPES, CHAINS, AND SLINGS

ANSWERS—QUIZ 1

1. a
2. a
3. b
4. a
5. b
6. a
7. d
8. c
9. d
10. b
11. a
12. Dragging a fiber rope wears away its outer fibers. While it is being dragged, it can pick up dirt and sand, which can cause abrasion within its strands and shorten its life.
13. The *intended use* of a wire rope determines the size, number, and arrangement of wires, the number of strands, the lay, and the type of core used.
14. Improved plow steel is the minimum strength recommended for hoisting rope.
15. At a minimum, OSHA requires that wire rope or cable be inspected after installation and then checked yearly, with documentation when used as a lifting device.
16. Riggers need to know the load and be able to judge distances; they must properly select tackle and lifting gear and know how to direct the operation.
17. The safety of a chain sling depends on the kind of material used, the strength of the material for the load, the method of fastening the chain to its fittings, and proper inspection and maintenance.
18. The following information must be shown: the name or identification number of the manufacturer, the sling's code number, the rated load capacities for useable types of hitches, and the type of material used to make the sling.
19. Multiple layering causes the rope to wear, thus shortening its life-especially at the point where the rope rises to the next layer. Where practical, it is best to use drums with enough diameter and length that they can take all the rope in a single layer. Using spirally grooved drums that can accommodate one layer of rope also minimizes crushing and excessive wear. In all cases, the number of layers should be limited to three. It is recommended to use rope lifters at the flanges when two or more layers of rope are wound on drums. To distribute wear evenly at crossover points, one-and-a-quarter wraps should be cut off every six months or three or four times during the life of the rope. OSHA states that, in no case, should there be fewer than two full wraps on a drum; three is preferred. It is also important to avoid reverse bending.
20. There are two tips for increasing the life of wire rope slings. First, use pads or saddles to protect the rope if loads have sharp edges or sharp corners. Second, splice thimbles in the ends of slings to reduce wear. It is also important to remember that slings can be used at various angles and rope stress increases rapidly with the angle of lift. Fortunately, there are tables that provide lift ratings for the most-used and most-critical angles of lift. One of the problems with load tables, however, is that they are based on newly manufactured slings. As a sling is used, abrasion, nicking, distortion, corrosion, and bending around small radii affect the load rating so that it may be different from what is suggested on a table.

ANSWERS—QUIZ 2

1. a
2. b
3. a
4. b
5. a
6. c
7. b
8. b
9. d
10. a
11. b
12. A "finger test" is used to estimate the strength of fibers. Scratch the rope with a fingernail and weak fibers will easily tear apart. It is a quick test for chemical damage.
13. Wire rope has greater strength and durability under severe working conditions. Its physical characteristics do not vary depending on the environment and it has controlled and predictable stretch characteristics.
14. Preformed wire rope does not unravel, so it is good

for slings to hoist heavy equipment. It is less likely to set or kink; therefore, broken wires are less likely to be a hazard to workers.

15. These changes are caused by the general deterioration of the structure of the interior rope. This can be related to corrosion of wires that cannot be inspected or the deterioration of the core.
16. Fatigue of wire rope resulting from bending stresses depends on the *diameter* of drums and sheaves: the *larger the diameter*, the more favorable a rope's service life will be.
17. They are ideal for loads that need their surfaces protected because they are soft and supple.
18. These factors are (1) use of the right sling for the right load and (2) the construction of the sling.
19. Whenever a load is picked up, stopped, moved, or swung, there is increased force. The more rapidly or suddenly such actions occur, the greater this increase will be. In extreme cases, the force put on the rope may be two, three, or even more times greater than the normal load. Dynamic effects are greater on fiber ropes with little stretch, such as Manila, than on ropes with higher stretch, such as nylon. They are also greater on a shorter rope than on a longer one. Working load figures are calculated for very modest dynamic loads and therefore do not apply in when rope is regularly used for dynamic loading.
20. Chain slings require initial inspection, frequent inspection, and periodic inspection. During an initial inspection, both new and repaired slings need to be examined to determine whether they meet the requirements of the purchase order, whether they are the correct type and have the proper rated capacity, and whether they have been damaged in shipment, unpacking, or storage. Frequent inspections should be conducted by the person handling the sling each time it is used. Periodic inspections should be conducted every six months or more often by an experience employee. The timing of periodic inspections should be based on frequency of use, severity of service conditions, and knowledge about the service life of slings used in present or similar conditions.

ANSWERS—CASE STUDY

1. In order to provide general guidelines for choosing rope, working loads are calculated for rope in good condition, with appropriate splices in noncritical applications, under normal service conditions, and under very modest dynamic loads. Higher working loads should only be approved based on expert knowledge of conditions and a professional estimate of the risks involved. Several factors should be considered: whether the rope has been subject to dynamic loading or other excessive use, whether it has been inspected and found to be in good condition, whether it is to be used in a recommended manner, and whether the application involves high temperatures, extended periods under load, or obvious dynamic loading. For all such applications and for applications involving more severe conditions of exposure, or for recommendations for special applications, the manufacturer should be consulted.
2. There are many reasons why wire ropes deteriorate. In some cases, the interior wires of a rope can corrode, a process that is highly dangerous and difficult to detect. Wear also causes deterioration, which workers can often spot on the crown or outside wires, and results from contact with sheaves and drums. Kinks, which result from improper installation or from hoisting with slack in the rope, cannot be removed without creating a weak place along the rope. Fatigue, caused by bending, whipping, vibrating, pounding, or torsion, is another factor in deterioration. Heat and operating pressure can cause a wire rope to dry out. Overloading can damage wire rope if acceleration and deceleration are important factors; however, this type of damage may not be known until some time after the overload. When the length of a rope is greater then a drum can handle in a single layer overwinding can occur, causing heavy abrasion and excessive wear at crossover points. Mechanical abuses also factor into wire rope deterioration. They include running over the rope with equipment and not removing obstructions from the rope's path of travel.