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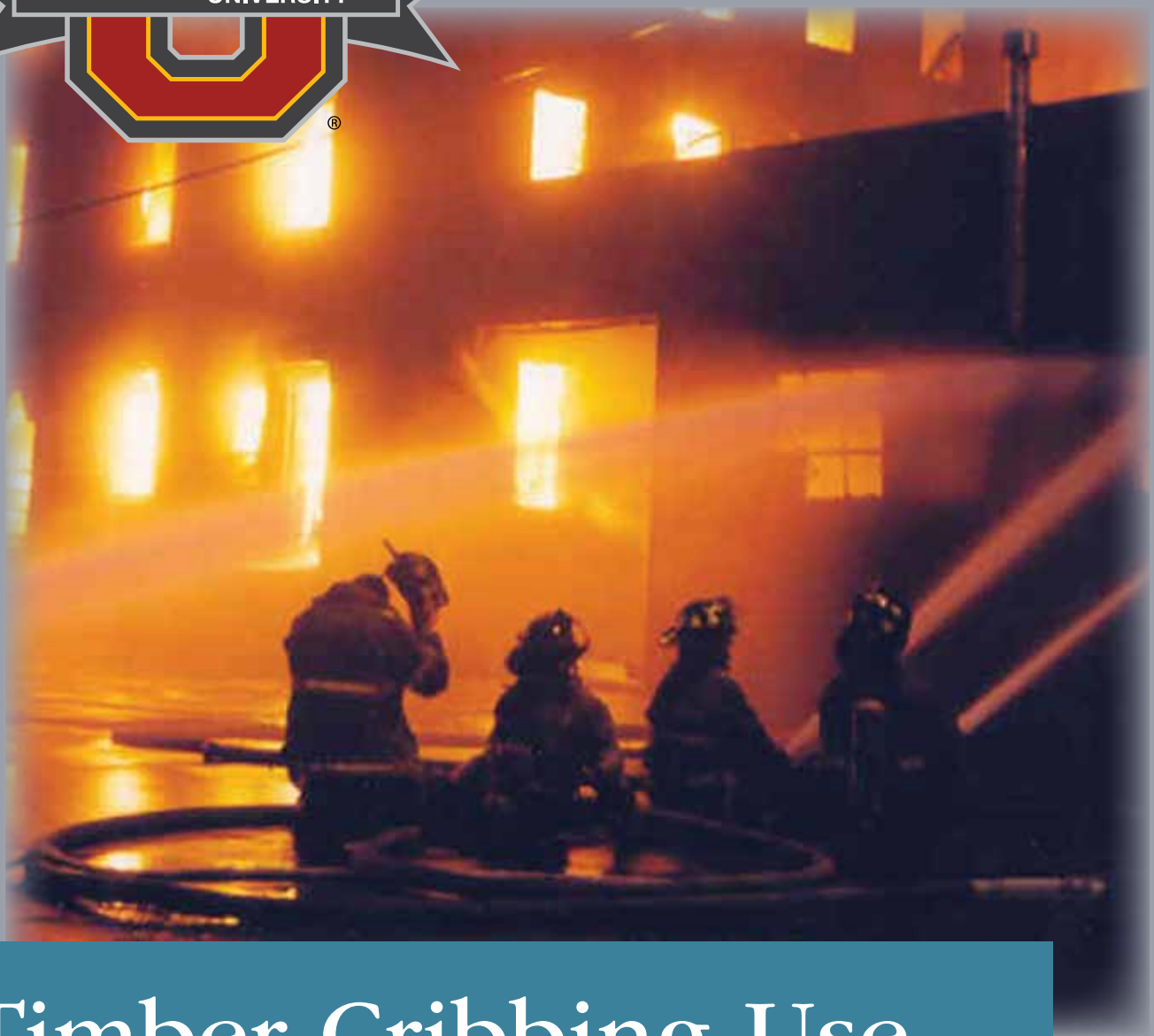

Timber Cribbing Use

BY BILLY LEACH JR.

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Timber Cribbing Use

Educational Objectives

On completion of this course, students will

1. Determine why cribbing is one of the most frequently used and essential tools on the fire ground.
2. Understand how cribbing is used to manage the natural force of gravity.
3. Discover why stabilization is a dynamic process.
4. Learn three smart cribbing considerations.

BY BILLY LEACH JR.

CRIBBING IS ONE OF THE MOST frequently used and essential tools during rescue operations and is considered to be among the strongest means of support. Gravity is inescapable; thus, cribbing is used to transfer the weight of a load into a "footprint" and provide a simple *temporary* support during rescue operations.

To correctly and effectively transfer weight from top to bottom, full and direct contact must be made with both the load and lower surface. Rescuers should begin with a solid base of support, especially in soft surfaces such as mud, sand, snow, and so on. This substantial base of support will assist in effective weight transfer and should be level or nearly so, if possible. Attempt to keep all cribbing plumb and level to provide greater stability. Remember, stabilization is a dynamic process that frequently needs inspection to ascertain its effectiveness.

Three smart cribbing considerations follow:

1. Avoid the area of danger—i.e., remain clear of the load's footprint.
2. Mitigate the hazard if possible—i.e., upright a heavy vehicle off a smaller vehicle.
3. Crib or shore from a safe area into an unsafe area. Always place cribbing/shoring in a manner that provides both responder and patient egress.

Prior to cribbing/shoring, rescuers should ask themselves the following three questions:

1. Are the needed materials readily available?
2. Are the needed tools readily available?
3. Are the rescuers trained, and do they possess the expertise to perform the needed operations?

Hardwood and softwood seem to be the most commonly used materials for cribbing. Hardwood and softwood generally refer to the type of tree producing the wood and not the strength of the wood itself. Hardwood trees shed their leaves in the fall, while softwood trees retain their leaves/needles consistently. The softwoods most frequently used are Southern Yellow Pine and Douglas Fir, although other species are also used. Always attempt to obtain and use #1 Grade timber for cribbing/shoring.

Softwood is the preferred piece for cribbing for FEMA engineers; simply, hardwood doesn't offer advantages provided by softwood. Advantages of softwood cribbing pieces include being lighter in weight compared to hardwood and, most importantly, it provides warnings of failure. These warnings include visible cracking or splitting of the wood and the sounds produced by such cracking. Generally, the signs of failure begin near the ends of the timber piece as "checks" and "splits." Checks are separations in wood transecting the annular growth rings; splits occur when wood cells tear apart parallel to the grain of the wood.

(1) Stack crib height shouldn't exceed three times its 'footprint' if all contact points are covered. (Photos by author.)

The properties of wood that allow the noticeable signs of failure result from the two primary growing seasons—spring and summer. Spring growth produces softer fibers; summer growth produces harder fibers. Spring's softer fibers produce the noise of cracking and the evident physical cracks during cross-grain loading. When building stack cribbing, the load is perpendicular to the wood grain, producing slow, noisy, and visible warnings of failure. This compression stress actually crushes a timber piece. Timber pieces with greater strength values in perpendicular compression [stated in pounds per square inch (psi)] are better suited for wedges and bearing timbers (cribbing). Axial loading such as in shoring operations relies on buckling failure. Greater strength in compression

parallel to the grain is better suited for columns such as those used in shoring.

In some instances, 50 or more pieces may be needed to stabilize an upright school bus. If your primary response vehicle doesn't carry this amount, is it easily obtainable? Preplanning for the need of cribbing is fundamental for heavy rescue. How can your agency obtain the timber needed 24/7/365? If it is not readily available, establish a quantity to be stored at your agency. Pack this cribbing according to dimension or primary purpose into easily handled open mesh crates. Consider storing a hand truck with the cribbing to transport a large quantity quickly using minimal personnel.

Wooden cribbing should be left *unfinished* and *unpainted*. Cribbing pieces rely on gravity and friction between bearing points for stability. Painted surfaces become slippery when wet and may hide damage or defects on the pieces. Cribbing pieces may be "toe-nailed" together to maintain integrity. Use a cordless or pneumatic nailer to drive 16d framing nails into place. Optimally, drive nails so that two-thirds of their length extends into the second piece of wood. Attach colored handles of rope or webbing near the ends of cribbing to separate the types and sizes. Paint or label the ends of cribbing to identify various types and sizes.

(2) 2 × 2 construction method of building a stack crib uses two pieces of cribbing per layer, each layer at right angles.

(3) 3 × 3 construction method uses three pieces per layer, each layer at right angles.

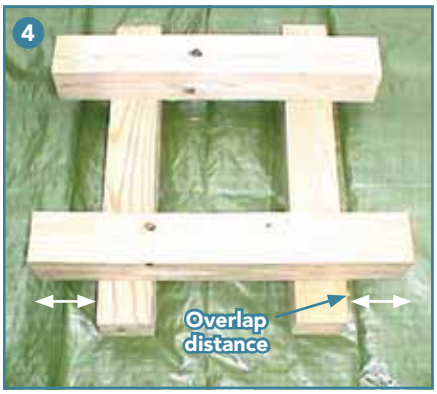
Inspect cribbing frequently for physical and chemical damage or other deterioration such as cracks and moisture (a bitter enemy of cribbing). Store it in a clean, dry, and ventilated area with room for air movement among the pieces, if possible. If cribbing is found to be damaged, remove it from service and do not use it for training.

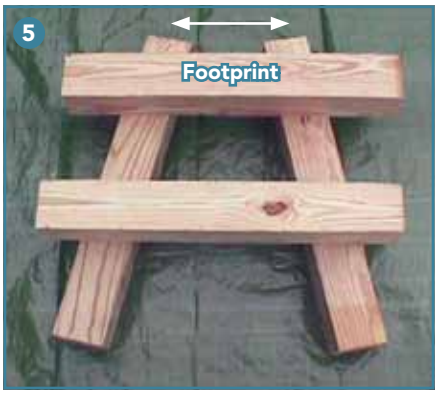
You can use varied lengths of cribbing. However, an accepted value is that the height of a stack crib shouldn't exceed 3× its width (footprint), provided all contact points are covered (photo 1). For example, if the footprint of a stack crib is 18 inches (calculated using 26-inch timber pieces and allowing eight inches of overlap measurement), the height shouldn't exceed 54 inches (3:1 ratio). Therefore, rescuers may gain insight into cribbing length based on this value, especially if considerable height is anticipated. Although shorter lengths are more commonly used, longer cribbing pieces such as four, six, and eight feet should be in a timber cribbing inventory.

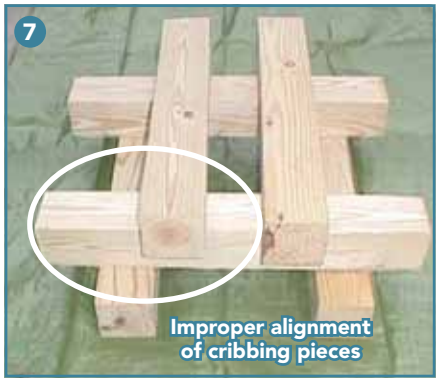
The 3 × 3 construction method (photo 3) uses three pieces per layer, each layer at right angles. Using the 2 × 2 construction method (photo 2) with four- × four-inch timbers, the weight bearing capacity of the stack crib is 24,000 pounds, or 6,000 pounds per column (12 tons total) *if all four contact points are covered*. The weight-bearing capacity would increase to 55,000 pounds, or 6,111.1 pounds per column (27½ tons total), if the 3 × 3 construction method was used and *all nine contact points were covered*. The 3 × 3 construction method increases the weight-bearing capacity. However, it uses only 50-percent more cribbing pieces. The weight-bearing capacity of a stack crib is calculated by the maximum perpendicular load to the grain (stated in psi) as accepted by structural engineers on the sum of all bearing points. Stack cribbing must be centered under the load if possible, maintaining the majority of the load in the center third of the stack crib.

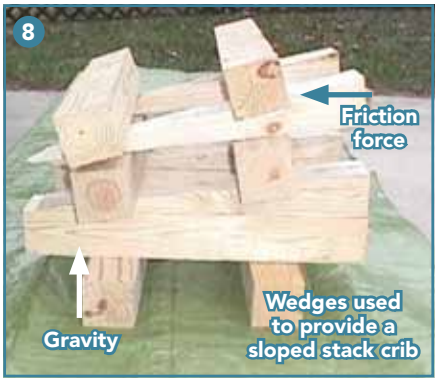
Do not use the 2 × 2 construction method when using stack cribbing as a platform for air bag lifting systems *unless* the top tier of cribbing is completely solid and capable of supporting the force imposed by the air bag as it lifts the load. Ideally, connect the solid top tier of cribbing pieces by some means to prevent unwanted movement—i.e., "scabs." High-pressure air bag lifting systems tend to inflate from the center outward and may dislodge a stack crib, resulting in catastrophic failure during a lifting operation.

Using six- × six-inch timbers and the 2 × 2 construction method, the weight-bearing capacity is 60,000 pounds, or 15,000 pounds per column (30 tons total). The weight-bearing capacity would increase to 136,000 pounds, 15,111 pounds









per column (68 tons total) if the 3 × 3 construction method were used. These capacities are valid if the load covers *all contact points*.

The formula to calculate weight-sustaining capacity *per column* is total surface (in square inches) of cribbing piece × the compression strength perpendicular to the grain (stated as psi). The weight-bearing capacity values expressed here are based on the use of undamaged #1 Grade Southern Yellow Pine or Douglas Fir and are accepted by the Federal Emergency Management Agency for urban search and rescue response. It is vitally important for responders to determine specifically the strengths of their respective cribbing pieces using accepted engineering values. There is no strength loss for treated vs. untreated wood, provided the moisture content is less than 19 percent.

Cribbing pieces should be of #1 Grade, which provides greater strength and better cosmetic appearance. Manufacturers are now producing varied cribbing pieces using plastic. These pieces are formed into such tools as stepchocks, wedges, buttresses, "lock blocks," and others. The surfaces of plastic cribbing are resistant to soiling and staining. The durability of these pieces is reported to be longer than wood, and the weight-bearing capacity is also greater.

The ends of cribbing pieces should overlap the preceding layer by the width of that particular piece (photo 4) for two primary reasons: (1) Should the cribbing pieces slip minimally, some degree of integrity will be maintained; and (2) failure will begin at the ends of the cribbing pieces, showing warning signs of deteriorating integrity. For example, when using four-inch timber, the ends of each layer should overlap a minimum of four inches.

Rescue situations may dictate that the cribbing pieces be placed in shapes other than a square (photos 5, 6). When a shape other than a square is used, the footprint will vary. Thus, the safe column height will vary. If the square shape of a cribbing stack is modified, the safe height of the stack is limited to 1× the footprint (1:1 ratio). For example, if the footprint of modified stack cribbing is 12 inches, the safe height of the column is limited to 12 inches. Stack cribbing should form columns that support the load. The pieces should be aligned vertically to form such a column and provide the required strength.

If all contact points of a stack crib aren't covered, the safe and stable height of the stack will be affected (photo 7). If three of the contact points are covered when using 2 × 2 construction, the safe and stable height for the stack crib is 2× the footprint (2:1 ratio). If two of the contact points are covered, the safe and stable height of the stack crib is 1.5× the footprint (1.5:1 ratio). If only one contact point is covered, the safe and stable height for the stack crib is 1× the footprint (1:1 ratio). The weight-bearing capacity of the stack crib will vary also if all contact points aren't covered.

Use wedges to fill voids between the load and cribbing pieces; they should be the same width and preferably the same length as the cribbing pieces (photo 8). If four-inch timber cribbing pieces are used, the wedge should be four inches in width. The length of a wedge shouldn't exceed 6× its width—

Table 1. Weight-Bearing Capacity/Stack Cribbing Height

(All contact points covered)

Timber Size	Construction Method	Weight-Bearing Capacity	Stack Cribbing Height
4″ × 4″	2 × 2	24,000#	3× footprint
4″ × 4″	3 × 3	55,000#	3× footprint
6″ × 6″	2 × 2	60,000#	3× footprint
6″ × 6″	3 × 3	136,000#	3× footprint

Configurations other than square stack crib are 1× footprint.
Cribbing of sloped surfaces are 1.5× footprint.

Table 2. Weight-Bearing Capacity/Stack Cribbing Height

(Less than 4 contact points)

Timber Size	Contact points	Weight-Bearing Capacity	Stack Cribbing Height
4″ × 4″	3	18,000#	2× footprint
4″ × 4″	2	12,000#	1.5× footprint
4″ × 4″	1	6,000#	1× footprint
6″ × 6″	3	45,000#	2× footprint
6″ × 6″	2	30,000#	1.5× footprint
6″ × 6″	1	15,000#	1× footprint

Configurations other than square stack crib are 1× footprint.
Cribbing of sloped surfaces are 1.5 × footprint.

Table 3. Types and Strength of Wood Pieces

Tree species	Compression perpendicular to grain, maximum fiber stress at proportional limit
U.S. HARDWOODS	
Red Maple	1,000 psi
White Oak	1,070 psi
Pin Oak	1,020 psi
Southern Red Oak	870 psi
Yellow Poplar	500 psi
U.S. SOFTWOODS	
Douglas Fir, Southern	740 psi
Douglas Fir, Northern	770 psi
Pine, Eastern White	440 psi
Pine, Loblolly	790 psi
Pine, Longleaf	960 psi
Pine, Slash	1,020 psi
Pine, Virginia	910 psi

i.e., if four-inch timber cribbing pieces are used, a 24-inch wedge is the maximum size that should be used (6 × 4 = 24).

Proper placement of wedges serves to transmit the load into a column, with no more than two wedges stacked on one another. Stacking more than two wedges will likely produce instability by dislodging the middle wedge. Wedges can also be used to change the vertical direction of the stack crib, allowing rescuers to support a sloped load, which has two primary forces acting on it—gravity and friction. Gravity produces a vertical load force; friction produces a load that acts as a downslope. Friction is the resistance encountered when two solid surfaces slide or tend to slip. The degree of surface roughness has an influence on the coefficient (measurement) of friction. When a surface is soft and coarse, greater frictional resistance is produced. The coefficient of friction is expressed as an angle or its decimal equivalent—i.e., 15° = .27. Stack cribbing generally may be used to a height of less than three feet against a sloped surface with an angle less than 15°, or 30 percent.

Small protractors are useful in determining angles. When building a stack crib into a sloping surface, the height of the cribbing shouldn't exceed 1.5× the footprint, or instability may result. Optimally, the stack crib should be constructed plumb and level with wedges used on the top tier or underneath the bottom tier to produce stability. Sloped surfaces may alter the direction of downward force on the stack crib, necessitating frequent monitoring of stability.

When placing cribbing pieces, NEVER put a part of your body between the load and the cribbing. Use a tool or another piece of cribbing to maneuver it into place. During cribbing operations, the use of personal protective equipment is necessary to ensure safety.

Cribbing is an essential rescue tool, often supporting tremendous weight while rescuers operate underneath. It is necessary that all rescuers understand the safe and proper use of this vital tool.

Table 3 lists representative wood species and their strengths in compression perpendicular to the grain. By no means are these the only wood species used for cribbing pieces. Investigate the wood used by your agency and determine its strength characteristics. ●

● **BILLY LEACH JR.** is a captain for the North Carolina Emergency Management USAR Task Force 7 and Ash-Rand Rescue & EMS, Inc. and has been actively involved in the emergency services since 1976, combining career and volunteer experience. He is the developer and senior presenter for Big Rig Rescue™. He trains in vehicle rescue and has presented at the International Vehicle Extrication Learning Symposium, Search and Rescue Disaster Response Conference, FDIC, American Towman Exposition, NC Extrication College, Fire Department of New York's Technical Rescue School, and many regional fire/rescue training seminars. He is a coauthor of *Big Rig Rescue*.

Notes

Timber Cribbing Use

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COURSE EXAMINATION

1) What is one of the most frequently used and essential tools during rescue operations?
   a. Shoring
   b. Halligan
   c. Hoselines
   d. Cribbing

2) What natural force is inescapable and must be managed during rescue operations?
   a. Gravity
   b. Hydraulics
   c. Thermodynamics
   d. Chemical reactions

3) How is cribbing used to manage the effects of gravity during rescue operations?
   a. Shift the weight to higher ground
   b. Shift the weight to lower ground
   c. Transfer the load to a "footprint" for temporary support
   d. Distribute the load in as small a surface area as possible

4) To correctly and effectively transfer weight from top to bottom, full and direct contact must made with:
   a. Both the load and lower surface
   b. The ground
   c. The object's load-bearing surfaces
   d. The base of the load only

5) Rescuers should always begin with a solid base of support.
   a. True
   b. False

6) Stabilization is dynamic process that frequently needs what to ascertain its effectiveness?
   a. Attention
   b. Inspection
   c. Changing
   d. Additions

7) Which of the following is one the three smart cribbing considerations?
   a. Stand near the load to inspect when needed
   b. Stand close to the area of danger to prevent others from entering
   c. Avoid the area of danger
   d. Enlarge the load's footprint as needed

8) Which of the following is one of the three smart cribbing considerations?
   a. Leave a vehicle alone if it is on top of another vehicle
   b. Stand as close to the load's footprint as possible
   c. Tie off load to a moveable object
   d. Mitigate the hazard if possible

9) Which of the following is one of the three smart cribbing considerations?
   a. Crib or shore from as far away as possible
   b. Crib or shore from a safe area into an unsafe area
   c. Do not upright a vehicle if it is on top of another vehicle
   d. Tie off a load to a far away object

10) Always place cribbing/shoring in a manner that provides both responder and patient egress.
   a. True
   b. False

11) Which is one of three questions rescuers should ask themselves?
   a. Can we make-due with materials on-hand?
   b. Should we send for help later due to needed manpower during the first few minutes of rescue operations?
   c. Are the needed materials readily available?
   d. Are the needed materials cost-effective?

12) A question a rescuer should always ask is whether the needed tools are readily available?
   a. True
   b. False

13) A question a rescuer should never ask is whether the rescuers are trained and possess the expertise to perform the needed operations.
   a. True
   b. False

14) Which materials are most commonly used for cribbing?
   a. Hardwood and softwood
   b. Plastic and Hardwood
   c. Thermoplastics and Hardwood
   d. Softwood and Carbon-Fiber

Timber Cribbing Use

15) Hardwood and softwood generally refer to the strength of the wood.

a. True
b. False

16) What type of wood is the preferred piece for cribbing for FEMA engineers?

a. Hardwood
b. Softwood
c. Mahogany
d. Oak

17) When building stack cribbing, the load is _____ to the grain?

a. Perpendicular
b. Horizontal
c. Vertical
d. Parallel

18) The accepted value of cribbing is that the height of a stack crib should not exceed what?

a. 5 times its length
b. 4 times its height
c. 3 times its width
d. 2 times its area

19) Do not use 2 x 2 construction methods when using stack cribbing as a platform for airbag lifting systems.

a. True
b. False

20) What is a rule when placing cribbing pieces?

a. Never use wet gloves
b. Remove electrical hazards
c. Only place a part of your body under a load if supported with hydraulic rams
d. Never put a part of your body between the load and the cribbing

Notes

Timber Cribbing Use

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Please check the correct box for each question below.

1.	❑ A	❑ B	❑ C	❑ D	11.	❑ A	❑ B	❑ C	❑ D
2.	❑ A	❑ B	❑ C	❑ D	12.	❑ A	❑ B	❑ C	❑ D
3.	❑ A	❑ B	❑ C	❑ D	13.	❑ A	❑ B	❑ C	❑ D
4.	❑ A	❑ B	❑ C	❑ D	14.	❑ A	❑ B	❑ C	❑ D
5.	❑ A	❑ B	❑ C	❑ D	15.	❑ A	❑ B	❑ C	❑ D
6.	❑ A	❑ B	❑ C	❑ D	16.	❑ A	❑ B	❑ C	❑ D
7.	❑ A	❑ B	❑ C	❑ D	17.	❑ A	❑ B	❑ C	❑ D
8.	❑ A	❑ B	❑ C	❑ D	18.	❑ A	❑ B	❑ C	❑ D
9.	❑ A	❑ B	❑ C	❑ D	19.	❑ A	❑ B	❑ C	❑ D
10.	❑ A	❑ B	❑ C	❑ D	20.	❑ A	❑ B	❑ C	❑ D

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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 1.

1. To what extent were the course objectives accomplished overall?	5	4	3	2	1
2. Please rate your personal mastery of the course objectives.	5	4	3	2	1
3. How would you rate the objectives and educational methods?	5	4	3	2	1
4. How do you rate the author's grasp of the topic?	5	4	3	2	1
5. Please rate the instructor's effectiveness.	5	4	3	2	1
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8. Would you participate in a similar program on a different topic?		Yes		No	

9. If any of the continuing education questions were unclear or ambiguous, please list them.

10. Was there any subject matter you found confusing? Please describe.

11. What additional continuing education topics would you like to see?

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