

Miller Safety Consulting, Inc.

Safety, Loss Control, and Risk Management Services

5750 Pecos Suite #6
Denver, CO 80221
Phone (303) 477-1044
Fax (303) 477-1078

* Certificate of Test *

We observed and coordinated the test of the Carnie Cap on March 16 and 17, 1998 as described following. We are a qualified third party testing/consulting entity with separate interests from, and independent of, the manufacturer as described and required in CAL OSHA Construction Safety Orders, Section 1712 and explained in (John Howard Memo) CAL OSHA Interpretation Letter Dated February 25, 1994 and amended 3/15/94. We are Qualified Persons in this subject matter as defined by OSHA 29 CFR 1926.32(m).

Test Rationale: The test was coordinated:

1. To follow the intent of the protocol set up in CAL OSHA Construction Safety Orders, Section 1712 and explained in (John Howard Memo) CAL OSHA Interpretation Letter Dated February 25, 1994 and amended 3/15/94, and;
2. To replicate actual and anticipated conditions which may be presumed based on usual and customary, and legal practices (according to OSHA law) in the construction industry as determined by a qualified person (as defined by OSHA), and;
3. To provide proof of testing for the claims of the manufacturer of the Carnie Cap within the limits of these claims.

Limitations:

1. The test does not, nor does it attempt to, quantify the potential for other types of injuries (other than rebar impalement injuries) which may result from falls onto wooden rebar guards held by Carnie Caps (plastic system components), nor where the falling person may strike similar objects such as (but not limited to) other plastic rebar caps, other wooden rebar guards, wood handrails, form work, wooden benches to tool rests, saw horses or other similar hazards.
2. The possibility of impalement, as well as other types of injury from striking wooden or plastic rebar guards or covers, must be evaluated by competent persons employed by each employer and the workers, prior to choosing Carnie Caps and lumber as the system of choice. This agency makes no guarantees other than for the validity and accuracy of this test report. This testing agency takes no responsibility for the decisions of the users, for the product tested, or for the warranty or guarantees offered or implied by the manufacturer, whether for merchantability, fitness for a particular purpose, or based on any theory of liability.

Testing Conditions and Equipment: The test rig included the following:

- ▶ The test bed, which was approximately 4' wide x 12' long with 1' depth concrete with number 5 rebar embedded upright at approximately 24" centers, and;
- ▶ A second test bed prepared exactly as the first except that #4 rebar was embedded in the concrete at 24" centers. The #4 rebar were wired by the rodman with common rebar tie wire to two #10 bar horizontally placed on either side in an X fashion approximately 10 " from the bottom at the highest point. The #4 bar extended up approximately 18".
- ▶ Randomly selected copies of the subject Carnie Cap, selected from the supply available on the job and at the offices of the contractor, which had been purchased by this contractor from the manufacturer. The Carnie Cap is a commercially available fall protection device designed to hold lumber (in this case 2" by 4" nominal) atop exposed vertically protruding rebar, so as to prevent impalement hazards to workers who may inadvertently fall into the area that has the upturned rebar and/or upon the exposed rebar and;
- ▶ a test weight that is sized and fabricated to roughly simulate a falling human body, to wit: a 27" nylon "canvas" bag system with 250 lbs. of sand. The sand had been weighed in the inner sack on a certified and calibrated electronic shipping scale. The inner sack was placed inside two outer nylon canvas bags. The outer bag had 2 nylon webbing lifting straps sewn centrally around the bag and up the other side with each end extending approximately 6 " above the upper edge of the bag and sewn back onto itself into an eye - forming four lifting eyes. The total weight including the additional outer bags was approximately 255 lbs, and;
- ▶ Several used pieces of lumber (nominal dressed 2" x 4") that were chosen at random from a jobsite actively engaged in forming and pouring concrete. The lumber had been used on the job, presumably for handrails, braces, forms and other typical uses on this job, and were visually inspected to confirm that, despite use, they had no gross deformities, splits or checks, and;
- ▶ Standard 16D duplex forming nails, standard 8D nails, 16 ga. tie wire, and;
- ▶ Number 4 rebar dowels, and;
- ▶ A standard quick release test hook with remote release rope used in fall protection equipment testing
- ▶ A on-the-job carpenter and a rodman, and the on-the-job crane operator (Grove hydraulic crane) assisted the test team.

Procedure Test #1:

The first test was conducted with three Carnie Caps atop three adjacent #5 rebars spaced approximately 24" on center. The carpenter placed one 2" x 4" into the top of the Carnie Caps and nailed on two sides of each Carnie Cap with 16D nails approximately 1" deep. The nails were bent over on the outside of the Carnie Caps. The test weight was raised to a height of over 10 feet above the top of the lumber (approximately 11.75 feet above test deck grade). The test weight was positioned exactly over the center of the top of the board, and centered on the top of the center Carnie Cap. The load was release by remote pull rope when the load was stationary, and allowed to free fall unobstructed. The weight struck the top of the wood virtually centered on the Carnie Cap. The three Carnie Caps and the lumber were removed from the test equipment pool to prevent reuse.

Procedure Test #2:

The second test was conducted with three Carnie caps atop three adjacent #4 rebars spaced approximately 24" on center. The #4 rebars were wired by the rodman with common rebar tie wire to the stub ends of sawed off #5 bar (embedded), and extended up approximately 18". The carpenter placed one 2" x 4" into the top of the Carnie Caps and nailed with 16D nails on two sides of each Carnie Cap with nails approximately 1" deep. The nails were bent over on the outside of the Carnie Caps. The test weight was raised to a height of over 10 feet above the top of the lumber (approximately 11.75 feet above test deck grade). The test weight was positioned exactly over the center of the top of the board, and centered on the top of the center Carnie Cap. The load was release by remote pull rope when the load was stationary, and allowed to free fall unobstructed. The weight struck the top of the wood virtually centered on the Carnie Cap. The three Carnie Caps and the lumber were removed from the test equipment pool to prevent reuse.

Procedure Test #3:

The third test was conducted with three Carnie caps atop three adjacent #4 rebars embedded in the second test bed spaced approximately 24" on center. The #4 rebars were wired to a 10 bar horizontally placed on either side in an X fashion approximately 10 " from the bottom at the highest point, to minimize wobbling of the bar by the rodman with common rebar tie wire. The #4 bar extended up approximately 18". The carpenter placed one 2" x 4" into the top of the Carnie Caps and nailed with 8D nails on two sides of each Carnie Cap with nails approximately 1" deep. The nails were bent over on the outside of the Carnie Caps. The test weight was raised to a height of over 10 feet above the top of the lumber (approximately 11.75 feet above test deck grade). The test weight was positioned exactly over the center of the top of the board, and centered on the top of the center Carnie Cap. The load was release by remote pull rope when the load was stationary, and allowed to free fall unobstructed. The weight struck the top of the wood virtually centered on the Carnie Cap. The three Carnie Caps and the lumber were removed from the test equipment pool to prevent reuse.

Procedure Test #4, #5, and #6:

The fourth test was conducted with two Carnie caps atop the outer most #4 rebars embedded in the second test bed, approximately 8 feet apart. Three additional rebars which were "bare" (had no Carnie Caps) and were between the two outer rebars. Each was spaced approximately 24" on center. The carpenter placed one 2" x 4" into the top of the Carnie Caps and nailed with 8D nails on two sides of each of the two Carnie Caps with 8D nails approximately 1" deep. The nails were bent over on the outside of the Carnie Caps. The test weight was raised to a height of over 10 feet above the top of the lumber (approximately 11.75 feet above test deck grade). The test weight was positioned exactly over the center of the top of the board, and centered on the top of the center Carnie Cap. The load was release by remote pull rope when the load was stationary, and allowed to free fall unobstructed. The weight struck the top of the wood virtually centered on the first "bare" rebar, 24" inboard and adjacent to the end rebar with the Carnie Cap. The weight was raised again to the same distance and released as before and allowed to strike centrally in between two "bare" rebar on the other end of the lumber, with the impact point being between two bars approximately 36" from the end bar with the Carnie Cap. The weight was raised again to the same distance and released as before and allowed to strike near the first impact point and in

between the first impact point over the rebar and the next adjacent "bare" rebar.

Pass/Fail Criteria: Any penetration of the rebar through the top of the wood and/or impalement of (any penetration into) into the bag (weight) is failure.

Results:

Test #1. Passed. The #5 rebar did not penetrate the top of the lumber nor impale the bag. A significant margin of safety remained in that 75% of the full depth and resistance of the wood remained as a buffer between the falling object and the potential impalement.

In test number one impalement of the weight was resisted by the combination of the Carnie Cap and the lumber which was held by the Carnie Cap. The Carnie Cap, expected to be sacrificial, was broken by penetration and cracking of the top and body. The lumber, expected to be damaged, was penetrated less than 3/8" by the rebar. The adjacent caps and the rest of the lumber were stressed, but held the lumber in place, with minor deflection to one side. Minor cracking occurred adjacent to the impression made in the underside of the wood.

Test #2. Passed. The #4 rebar did not penetrate the top of the lumber nor impale the bag. A significant margin of safety remained in that 75% of the full depth and resistance of the wood remained as a buffer between the falling object and the potential impalement.

In test number two impalement of the weight was resisted/deflected by the combination of the Carnie Cap and the lumber which was held by Carnie Cap. The center Carnie Cap, expected to be sacrificial, was broken by penetration of the top and cracking of the body. The lumber, expected to be damaged, was penetrated less than 3/8" vertically by the rebar. The center bar flexed and displaced in one direction and the wood split on the side opposite the direction of the deflecting force. The adjacent Carnie Caps and the rest of the lumber were stressed but held the lumber in place, with minor deflection to the same side.

Test #3. Passed. The #4 rebar did not penetrate the top of the lumber nor impale the bag. A significant margin of safety remained in that 75% of the full depth and resistance of the wood remained as a buffer between the falling object and the potential impalement.

In test number three impalement of the weight was resisted/deflected by the combination of the Carnie Cap and the lumber which was held by Carnie Cap. The Carnie Cap directly under the impact point, expected to be sacrificial, was broken by penetration of the top and cracking of the body. The lumber, expected to be damaged, was penetrated less than 1/2" vertically by the rebar. The adjacent Carnie Caps and the rest of the lumber were stressed but held the lumber in place, with minor deflection to one side.

Test #4, 5, 6. Passed on all three successive drops on the same Carnie Cap and lumber assembly. The #4 rebar did not penetrate the top of the lumber nor impale the bag in any of the three successive tests. A significant margin of safety remained in that 65- 75% of the full depth and resistance of the wood remained as a buffer between the falling object and the potential impalement in the worst case.

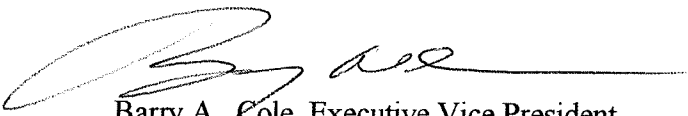
In test number 4., 5, and 6 impalement of the weight was resisted/deflected by the combination of the Carnie Cap and the lumber which was held by the Carnie Caps. The Carnie Caps, expected to be sacrificial, were stressed on the sides and internally by the impact forces on adjacent areas of the lumber after the first drop. The lumber, expected to be damaged, was penetrated by the respective rebar less than 3/8" vertically on the rebar adjacent to test #5 and less than 1/2" on the rebar adjacent to test #4 and #6. Whenever a rebar penetrates the wood, when a drop is overtop of the rebar, characteristically the adjacent rebars also begin a minor impression/penetration into the underside of the lumber. The penetration of the lumber by the adjacent rebars is minimal and not measured.

Conclusions:

1. The Carnie Cap fall/impalement protection system passes the intent of the referenced CAL OSHA Construction Safety Orders, Section 1712 and explained in (John Howard Memo) CAL OSHA Interpretation Letter Dated February 25, 1994 (amended 3/15/94), and should be approved by CAL OSHA for use on grade and above grade in falls up to and including the Cal OSHA limit of 7.5 feet.
2. The Carnie Cap when used in conjunction with common building grade 2 x 4 lumber, in accordance with the manufacturers instructions, will meet the Federal OSHA Standards (for Construction), including 29CFR 1926.701(b), requiring protection of rebar, for rebar equal to or larger than #4 bar, to prevent impalement hazards to workers who may fall while working over rebar, for falls up to ten feet above the top of the upturned rebar.
3. Workers working higher than 10 feet above the top of upturned rebar covered with Carnie Caps and lumber, should use alternative fall protection equipment until further tests are conducted on their location.
4. In our opinion the test results would be the same or better on larger rebar or more closely spaced rebar, based on physics principals of greater surface area of the larger bar and greater resistive force of larger corresponding surface area of lumber.
5. The Carnie Cap fall/impalement protection system provides a significant factor of safety even after being struck in a test situation on the same system three times, twice in nearly the same place. This is an extreme test that would be considered abuse of the product and the manufacturer's warnings if done on a actual jobsite. Neither the Carnie Caps nor any lumber that is actually subjected to a falling weight or that is damaged should be reused.
6. Lumber that is significantly weakened from extensive use, stress, cracks, checks, rot, or splits should not be used as part of the Carnie Cap system for impalement protection.

Signed:

Miller Safety Consulting, Inc.



Barry A. Cole, Executive Vice President
Design, Testing and Engineering Manager

Last Transaction

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