



the standard in safety

Underwriters  
Laboratories

July 22, 2009

Reference: File No. MH46945, Project 09CA06218

Subject: Test Results On Industrial Head Protection

Dear Mr. Wong:

Any information and documentation involving UL Mark services are provided on behalf of Underwriters Laboratories Inc. (UL) or any authorized licensee of UL.

Project 09CA06218 was established to evaluate your NTC hard hat per ANSI Z89.1-2009 American National Standard for Industrial Head Protection. Testing has been completed, and the test data is attached.

The following tests were conducted per ANSI Z89.1-2009: Flammability, Force Transmission, Apex Penetration, Electrical Insulation.

Thank you for this opportunity to provide your company with these services. Please do not hesitate to contact us if you should have questions or comments.

Should you have any questions or comments pertaining to the above, please contact the undersigned at our Research Triangle Park Office.

Sincerely,

Reviewed By:

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#### GENERAL

Results relate only to the items tested unless otherwise specified.

Tests were conducted per  
ANSI Z89.1, 2003 Edition

#### SAMPLES:

Industrial Hard Hats Model NTC

The following tests were conducted:

Flammability  
Force Transmission  
Apex Penetration  
Electrical Insulation

FLAMMABILITY TEST - HELMETS

ANSI Z89.1-2003, Section 9.1

1.0 APPLICATION

1.1 This test shall apply to complete helmets.

2.0 SPECIMENS

2.1 Specimens shall be one helmets of each different style or model.

3.0 SAMPLE PREPARATION

3.1 Samples for conditioning shall be complete helmets.

3.1 Specimens shall be conditioned for room temperature conditions per 03-LO-W0072 (PPE Work Instruction for Helmets, Helmet Trim, and Eye Protection Preconditioning).

4.0 PROCEDURE

4.1 Test in accordance with ANSI Z89.1-2003, Sec. 9.1. See 03-LO-W0070 (PPE Work Instruction for Flame Resistance Test - Helmets and Eye Protection).

4.2 Testing shall be performed at room temperature  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ), and a relative humidity of  $50 \pm 5\%$ .

5.0 REPORT

5.1 Any afterflame time shall be recorded and reported.

FLAMMABILITY TEST - HELMETS (CONT'D):

ANSI Z89.1-2003, Section 9.1

6.0 RESULTS

Helmet Model: NTC

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Flame Temperature (°C)	848.0
After Flame Time (sec)	0.00

7.0 REQUIREMENT

7.1 No flame shall be visible 5 seconds after removal of the test flame.

8.0 OBSERVATION

8.1 Flame was not visible 5 seconds after removal of the test flame.

Test Conditions: 23 deg. C and 63% Humidity

Helmet tested immediately after removal from Room Conditioning of 23 deg. C and 48% Humidity.

FORCE TRANSMISSION - HELMETS

ANSI Z89.1-2003, Section 9.2

1.0 APPLICATION

1.1 This test shall apply to complete protective helmets.

2.0 SPECIMENS

2.1 Specimens shall be twelve helmets of each different style or model.

3.0 SAMPLE PREPARATION

3.1 Samples for conditioning shall be complete helmets.

3.2 Samples shall be preconditioned for each of the following conditions per 03-LO-W0072 (PPE Work Instruction for Helmets, Helmet Trim, and Eye Protection Preconditioning) before each impact:

3.2.1 Cold Temperature Conditioning

3.2.2 Hot Conditioning

4.0 PROCEDURE

4.1 Test in accordance with ANSI Z89.1-2003, Sec. 9.2. See 03-LO-W0048 (PPE Work Instruction for Helmet Force/Acceleration Impact/Penetration Tests).

4.2 Testing shall be performed at room temperature  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ), and a relative humidity of  $50 \pm 5\%$ .

5.0 REPORT

5.1 The individual maximum force readings for all test samples shall be recorded along with the impact velocities.

5.2 The values for hot conditioned test samples shall be averaged and this result recorded. Likewise, the values for cold conditioned test samples shall be averaged and recorded.

5.3 The results of each system verification shall be recorded and reported and shall be made part of the test results for the specimens being tested.

6.0 INTERPRETATION

6.1 One or more helmet specimens failing the individual helmet requirement constitute failing performance.

6.2 The averages for both conditions failing the average helmet requirement shall also constitute failing performance.

FORCE TRANSMISSION - HELMETS (CONT'D):

ANSI Z89.1-2003, Section 9.2

7.0 RESULTS

Helmet Model: NTC

SAMPLE NUMBER	CONDITION	PEAK FORCE (lbf)	PEAK FORCE (N)	VELOCITY (in/sec)	VELOCITY (m/sec)
1	Hot	564.80	2512	218.3	5.54
2	Hot	647.57	2880	218.3	5.54
3	Hot	499.97	2224	216.9	5.51
4	Hot	563.83	2508	218.3	5.54
5	Hot	594.74	2645	217.4	5.52
6	Hot	549.44	2444	218.3	5.54
7	Hot	605.21	2692	217.9	5.53
8	Hot	523.85	2330	217.9	5.53
9	Hot	555.99	2473	216.9	5.51
10	Hot	592.41	2635	217.9	5.53
11	Hot	631.53	2809	216.9	5.51
12	Hot	588.37	2617	217.9	5.53
Average		576.48	2564	217.7	5.53

Hot Conditioning Started: 2009-07-07 at 8:35 AM

Test Started: 2009-07-07 at 2:45 PM

Room Temp 21 deg. C and 57% Humidity

FORCE TRANSMISSION - HELMETS (CONT'D):

ANSI Z89.1-2003, Section 9.2

SAMPLE NUMBER	CONDITION	PEAK FORCE (lbf)	PEAK FORCE (N)	VELOCITY (in/sec)	VELOCITY (m/sec)
1	Cold	566.03	2518	217.9	5.53
2	Cold	561.81	2499	216.9	5.51
3	Cold	582.07	2589	217.9	5.53
4	Cold	752.50	3347	217.4	5.52
5	Cold	648.43	2884	217.4	5.52
6	Cold	725.57	3227	217.4	5.52
7	Cold	556.23	2474	217.9	5.53
8	Cold	572.82	2548	216.9	5.51
9	Cold	559.17	2487	216.9	5.51
10	Cold	700.89	3118	216.9	5.51
11	Cold	582.37	2590	217.9	5.53
12	Cold	578.76	2574	217.4	5.52
Average		615.55	2738	217.4	5.52

$$N = \text{lbf} \times 4.448$$

$$\text{m/s} = \text{in/sec} \times 0.0254$$

Cold Conditioning Started: 2009-07-07 at 8:00 AM

Test Started: 2009-07-07 at 2:45 PM

Room Temp 21 deg. C and 57% Humidity

FORCE TRANSMISSION - HELMETS (CONT'D):

ANSI Z89.1-2003, Section 9.2

#### 8.0 SYSTEM REPEATABILITY RESULTS

Drop	Velocity (m/sec)		Peak Force (N)	
Pre-Test				
1.	157.7 in/sec	4.01 m/sec	2018.75 lbf	8979 N
2.	157.7 in/sec	4.01 m/sec	2019.42 lbf	8982 N
3.	158.2 in/sec	4.02 m/sec	2016.18 lbf	8968 N
Average	157.9 in/sec	4.01 m/sec	2018.12 lbf	8977 N
Post-Test				
1.	157.7 in/sec	4.01 m/sec	2014.41 lbf	8960 N
2.	158.0 in/sec	4.01 m/sec	2010.61 lbf	8943 N
3.	157.7 in/sec	4.01 m/sec	2010.12 lbf	8941 N
Average	157.8 in/sec	4.01 m/sec	2011.71 lbf	8948 N

Velocity of impact shall be maintained at 4.0 m/sec  $\pm 0.03$  m/sec.

The total range for the three values shall not exceed  $\pm 5\%$  of the average values.

#### 9.0 REQUIREMENT

9.1 An individual specimen shall not transmit a force to the test headform that exceeds 4450 N (1000 lbf).

9.2 The averaged values (of the maximum transmitted force of individual test samples for each condition) shall not exceed 3780 N (850 lbf).

#### 10.0 OBSERVATION

10.1 An individual specimen did not transmit a force to the test headform that exceeded 4450 N (1000 lbf).

10.2 The averaged values (of the maximum transmitted force of individual test samples for each condition) did not exceed 3780 N (850 lbf).



APEX PENETRATION - HELMETS

ANSI Z89.1-2003, Section 9.3

1.0 APPLICATION

1.1 This test shall apply to complete protective helmets.

2.0 SPECIMENS

2.1 Specimens shall be three helmets of each different style or model.

3.0 SAMPLE PREPARATION

3.1 Samples for conditioning shall be complete helmets.

3.2 Samples shall be preconditioned for each of the following conditions per 03-LO-W0072 (PPE Work Instruction for Helmets, Helmet Trim, and Eye Protection Preconditioning) before each impact:

3.2.1 Cold Temperature Conditioning

3.2.2 Hot Conditioning

4.0 PROCEDURE

4.1 Test in accordance with ANSI Z89.1-2003, Sec. 9.3. See 03-LO-W0048 (PPE Work Instruction for Helmet Force/Acceleration Impact/Penetration Tests).

4.2 Testing shall be performed at room temperature  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ), and a relative humidity of  $50 \pm 5\%$ .

5.0 REPORT

5.1 The impact velocity associated with each drop shall be recorded.

5.2 The pass or fail result for each helmet shall be recorded and reported based on any indicated electrical contact.

6.0 INTERPRETATION

6.1 One or more helmet specimens failing this test shall constitute failing performance.

APEX PENETRATION - HELMETS (CONT'D):

ANSI Z89.1-2003, Section 9.3

## 7.0 RESULTS

Helmet Model: NTC

HELMET NUMBER	CONDITION	PASS / FAIL	IMPACT VELOCITY (in/sec)	IMPACT VELOCITY (m/sec)
1	Hot	Pass	276.2	7.0
2	Hot	Pass	276.2	7.0
3	Hot	Pass	275.5	7.0
1	Cold	Pass	274.7	7.0
2	Cold	Pass	275.5	7.0
3	Cold	Pass	274.7	7.0

## 8.0 REQUIREMENT

8.1 The penetrator shall not make contact with the top of the test headform.

## 9.0 OBSERVATION

9.1 The penetrator did not make contact with the test headform.

Cold and Hot Conditioning Started: 2009-07-07 at 11:45 AM

Room Temp 21 deg. C and 57% Humidity

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ELECTRICAL INSULATION TEST - HELMETS, CLASS G      ANSI Z89.1-2003, Section 9.7

1.0    APPLICATION

1.1    This test shall apply to complete protective helmets.

2.0    SPECIMENS

2.1    Specimens shall be two helmets of each different style or model.

3.0    SAMPLE PREPARATION

3.1    Samples for conditioning shall be complete helmets.

3.1    Specimens shall be conditioned for room temperature conditions per 03-LO-W0072 (PPE Work Instruction for Helmets, Helmet Trim, and Eye Protection Preconditioning).

4.0    PROCEDURE

4.1    Test in accordance with ANSI Z89.1-2003, Sec. 9.7, Class G.  
See 03-LO-W0073 (PPE Work Instruction for Electrical Insulation Test - Helmets).

4.2    Testing shall be performed at room temperature  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ ), and a relative humidity of  $50 \pm 5\%$ .

5.0    REPORT

5.1    For each test sample the leakage current shall be recorded.

6.0    INTERPRETATION

6.1    One or more helmet specimens failing this test shall constitute failing performance.

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ELECTRICAL INSULATION TEST - HELMETS, CLASS G      ANSI Z89.1-2003, Section 9.7  
(CONT'D):

#### 7.0 RESULTS

Helmet Model: NTC

Helmet Number	Current leakage (mA)
1	0.7
2	0.7
3	0.7

#### 8.0 REQUIREMENT

8.1 For Class G, leakage shall not exceed 3 milliamperes at 2200 volts.  
For Class G, the force transmission test shall not be conducted first.

#### 9.0 OBSERVATION

9.1 For Class G, leakage did not exceed 3 milliamperes at 2200 volts.  
For Class G, the force transmission test was conducted first.

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ELECTRICAL INSULATION TEST - HELMETS, CLASS E      ANSI Z89.1-2003, Section 9.7  
(CONT'D):

7.0      RESULTS

Helmet Model:    NTC

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Helmet Number	Current leakage (mA)	Burn Through At 30,000 V
1	4.5	No
2	4.1	No
3	4.5	No

Note: To prevent flash over the water level was lowered 40 mm below the static test line on both the inside and outside parts of the helmet.

8.0      REQUIREMENT

8.1      For Class E, leakage shall not exceed 9 milliamperes at 20,000 volts.  
For Class E the force transmission test shall be conducted first.  
For Class E the test sample shall not burn through at 30,000 volts.

9.0      OBSERVATION

9.1      For Class E, leakage did not exceed 9 milliamperes at 20,000 volts.  
For Class E the force transmission test was conducted first.  
For Class E the test sample did not burn through at 30,000 volts.