

December 9, 2003

Refer to: HSA-10/CC75B

Owen S. Denman, P.E.  
President  
Barrier Systems, Incorporated  
180 River Road  
Rio Vista, California 94571-1208

Dear Mr. Denman:

In your November 3 letter, you requested formal Federal Highway Administration acceptance of a “family” of crash cushion designs called the Universal TAU-II Crash Cushion System. The primary difference from the original parallel-sided TAU-II designs was the introduction of variable-width diaphragms that result in a 5-degree outward flare of the attenuator side panels to allow direct shielding of hazards up to 2.6 m (8.5 feet) in width. Included with your letter were copies of Safe Technologies, Incorporated, October 2003 report, “NCHRP Report 350 Crash Test Report – Barrier Systems, Incorporated. Wide TAU-II Crash Cushion System” and CD-ROMs and VHS tapes of the certification tests that were run. In preliminary discussions with members of my staff, it was mutually agreed that selected tests on both the narrowest and widest versions of the wide TAU-II would be sufficient to accept less critical configurations of these two designs as also meeting NCHRP Report 350 evaluation criteria. The two configurations tested and the summary test results are shown in Enclosures 1 through 7.

Based on these test results, I agree that the TAU-II configurations shown in Enclosure 8 may be considered acceptable for use on the National Highway System with the following *caveats*:

- The four designs tested to Report 350 (including earlier TL-2 and TL-3 tests of the parallel-sided designs), and all those in between, may be considered to meet all pertinent evaluation criteria for the speeds listed. This includes the systems in Enclosure 8 for impact speeds of 70, 80, 90 and 100 km/h that have 3, 4, 5, 6, 7 or 8 bays, respectively.
- The tested 10-bay parallel-sided configuration met Report 350 evaluation criteria for the head-on impact with the 2000P truck at a nominal speed of 110 km/h (70 mph). The remaining designs shown under the 110 km/h heading may also be assumed to have adequate capacity to stop the pickup truck impacting head-on at 110 km/h within the occupant risk limits recommended in NCHRP Report 350 and to satisfy **all** test requirements at the standard TL-3 impact speed of 100 km/h.

- Based on favorable comparisons of predicted OIV's and ridedown accelerations with actual values from your previous 70-km/h test of the parallel-sided TL-2 design, I will also accept the 50 km/h and 60 km/h system designs shown in Enclosure 8 based upon predicted OIV and G values being lower than Report 350 preferred values.

Sincerely yours,

*/Original signed by/*

John R. Baxter, P.E.  
Director, Office of Safety Design  
Office of Safety

8 Enclosures

cc: HSA-10 (Reader, HSA-1; Chron File, HSA-10;  
R. Powers, HSA-10)

**Appendix D (cont.)**

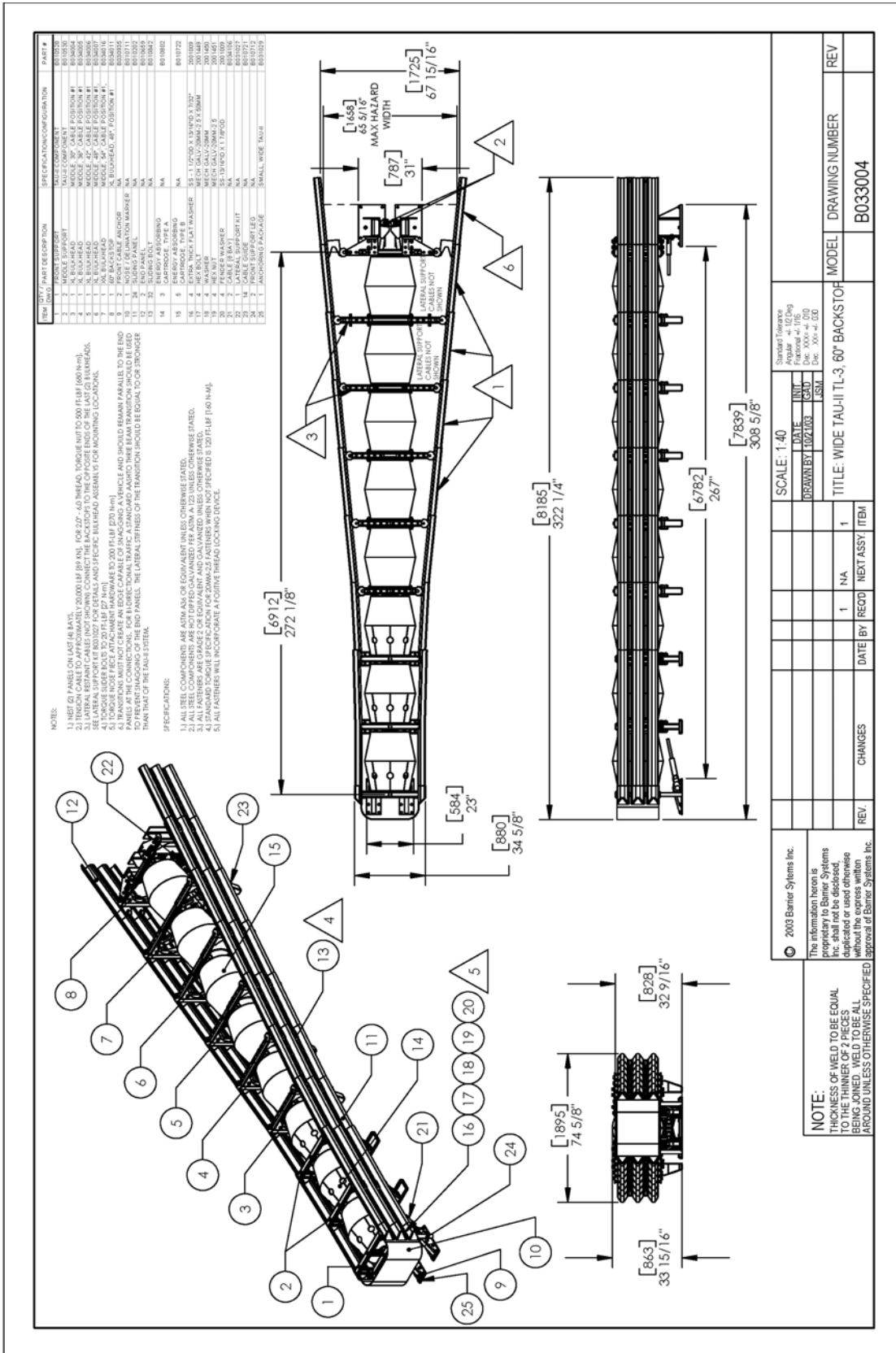
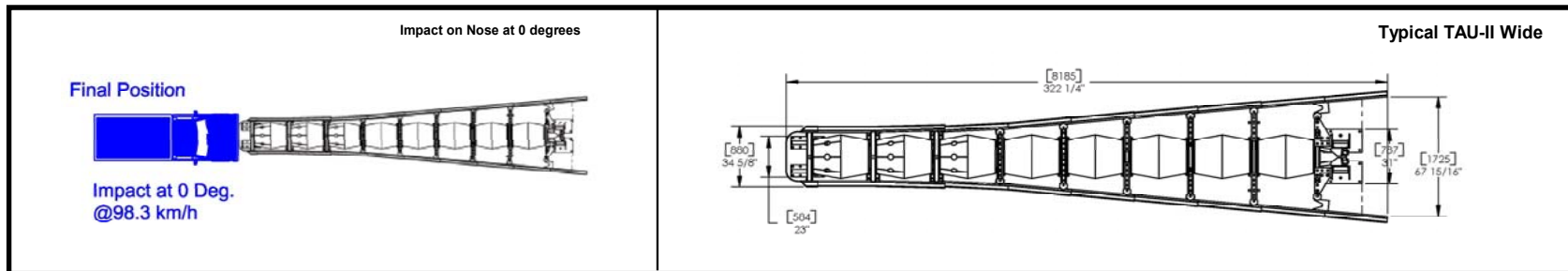
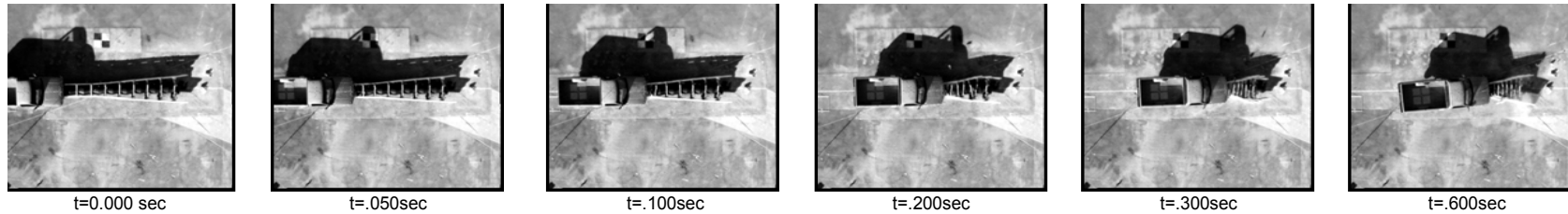


Illustration D-3



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-31**  
 Test No..... **STI Test #WTU11**  
 Date..... 10/20/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**.....

Size and/or dimension  
 of key elements..... Narrowest tested is 7.84 m (8-bay system)  
 Height 863 mm, Widest max hazard width 1.66 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1989, Chevrolet 3/4 ton pickup

**Mass (kg)**

Curb..... 1994  
 Test Inertial..... 2000  
 Dummy(s)..... n/a  
 Gross Static..... 2000

**Impact Conditions**

Speed (km/h)..... 98.3  
 Angle (deg)..... 0  
 Impact Severity (kJ)..... 749.3

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 8.8  
 y-direction..... 0.1  
 Ridedown Acceleration (g's)  
 x-direction..... -11.1  
 y-direction..... -3.0  
 THIV (km/h)..... 31.5  
 PHD (g's)..... 11.2  
 ASI..... 0.88

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 244

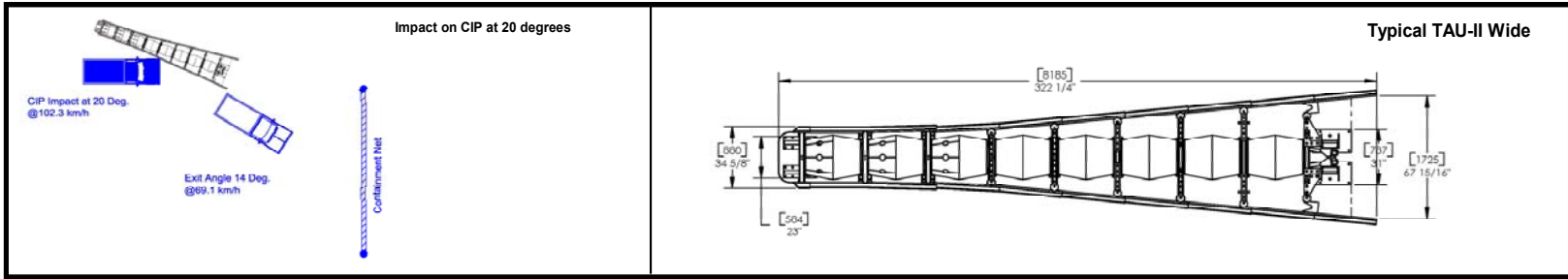
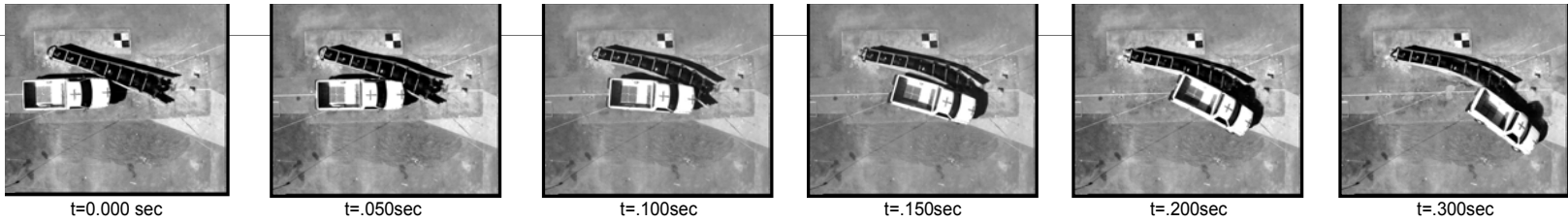
**Vehicle Damage**

Exterior  
 VDS..... FC-3  
 CDC..... 12FDEW3  
 Interior  
 OCDI..... AS0000000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -2.6  
 Maximum Pitch Angle..... -4.9  
 Maximum Yaw Angle..... -6.8

**Figure 16. Summary of Results**



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-38**  
 Test No..... **STI Test #WTU12**  
 Date..... 10/23/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**

Size and/or dimension  
 of key elements..... Narrowest tested is 7.84 m (8-bay system)  
 Height 863 mm, Widest max hazard width 1.66 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1988, GMC 3/4 ton pickup

**Mass (kg)**

Curb..... 1858  
 Test Inertial..... 1970  
 Dummy(s)..... n/a  
 Gross Static..... 1970

**Impact Conditions**

Speed (km/h)..... 102.3  
 Angle (deg)..... 20  
 Impact Severity (kJ)..... 93

**Exit Conditions**

Speed (km/h)..... 69.1  
 Angle (deg)..... 14

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 5.3  
 y-direction..... -6.9  
 Ridedown Acceleration (g's)  
 x-direction..... -7.8  
 y-direction..... 15.9  
 THIV (km/h)..... 29  
 PHD (g's)..... 16  
 ASI..... 1.27

**Test Article Deflection (mm)**

Dynamic..... 452  
 Permanent..... 0

**Vehicle Damage**

Exterior  
 VDS..... FL-5  
 CDC..... 11FYEW4  
 Interior  
 OCDI..... AS0002000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -18.6  
 Maximum Pitch Angle..... -4.8  
 Maximum Yaw Angle..... 53.0

**Figure 21. Summary of Results Test**

**Appendix D**

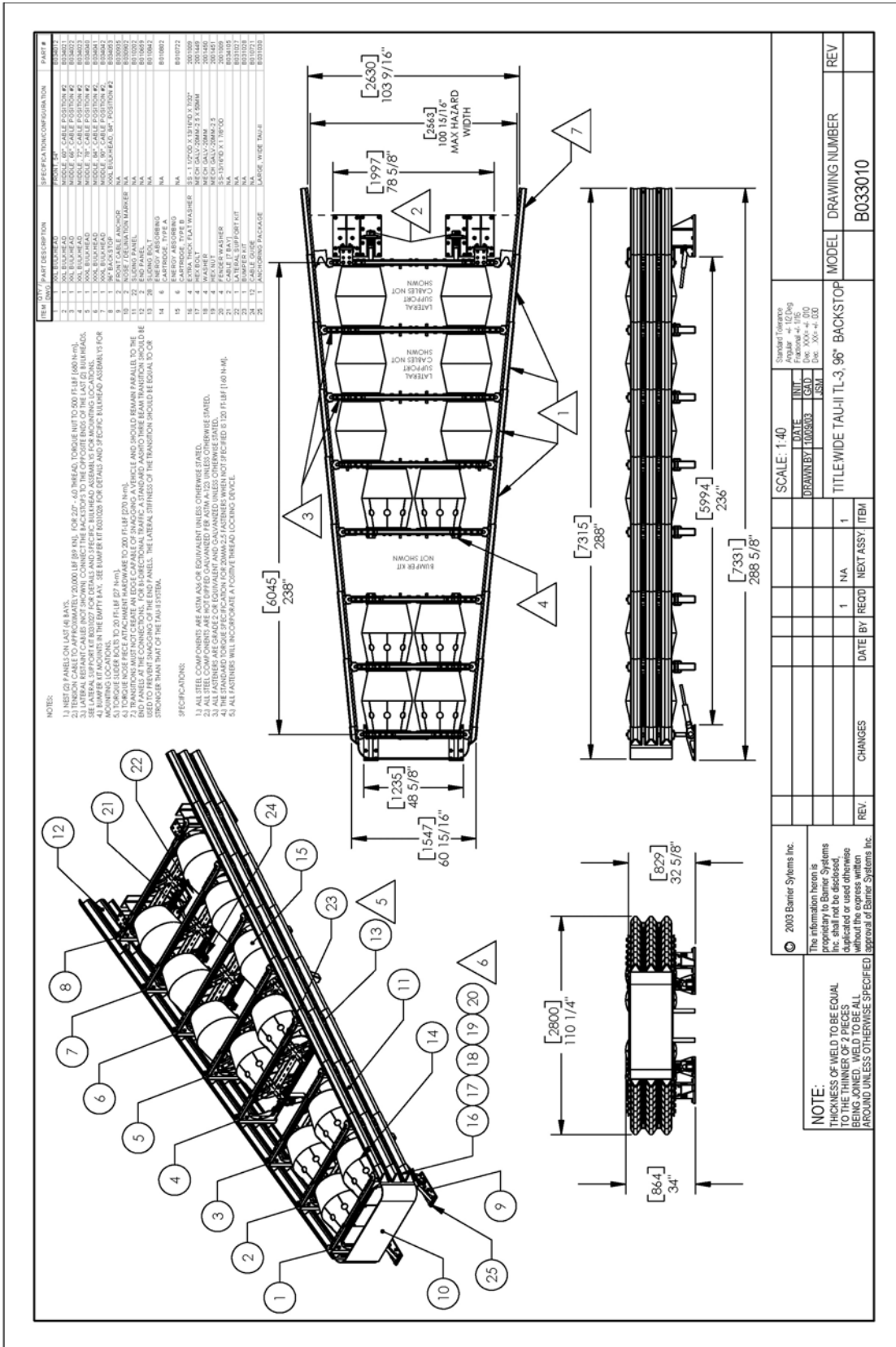
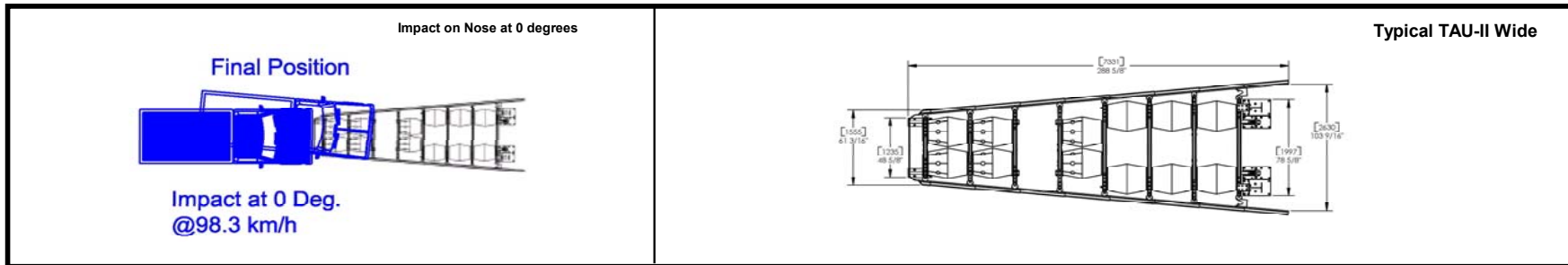
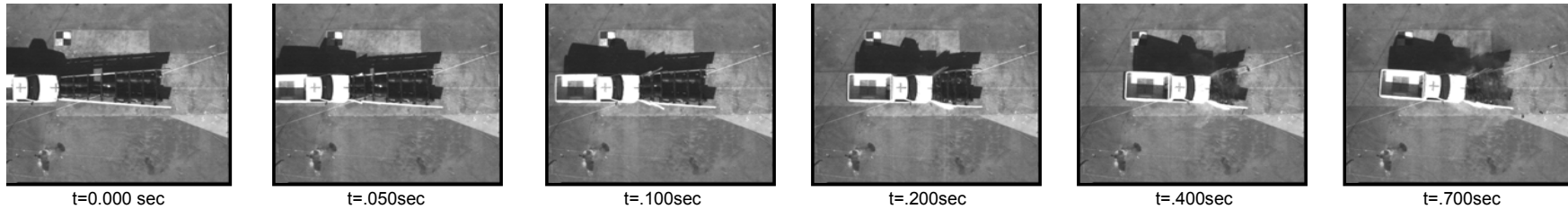


Illustration D-2



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-31**  
 Test No..... **STI Test #WTU04**  
 Date..... 8/12/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**..... Widest tested is 7.33 meters (7-bay system)

Size and/or dimension  
 of key elements..... Height 864 mm, Widest max hazard width 2.63 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1992, Chevrolet 3/4 ton pickup

**Mass (kg)**

Curb..... 1881  
 Test Inertial..... 1987  
 Dummy(s)..... n/a  
 Gross Static..... 1987

**Impact Conditions**

Speed (km/h)..... 98.8  
 Angle (deg)..... 0  
 Impact Severity (kJ)..... 748.5

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 8.8  
 y-direction..... -0.3  
 Ridedown Acceleration (g's)  
 x-direction..... -16.6  
 y-direction..... -5  
 THIV (km/h)..... 31.7  
 PHD (g's)..... 16.8  
 ASI..... 0.96

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 167

**Vehicle Damage**

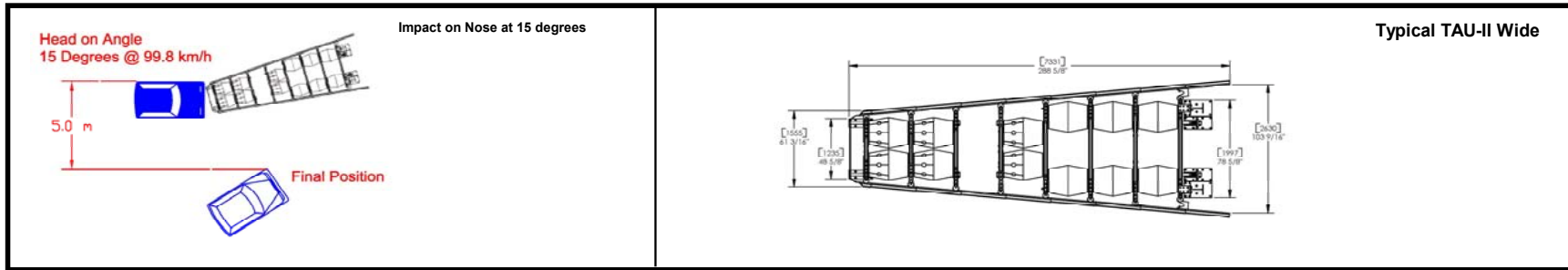
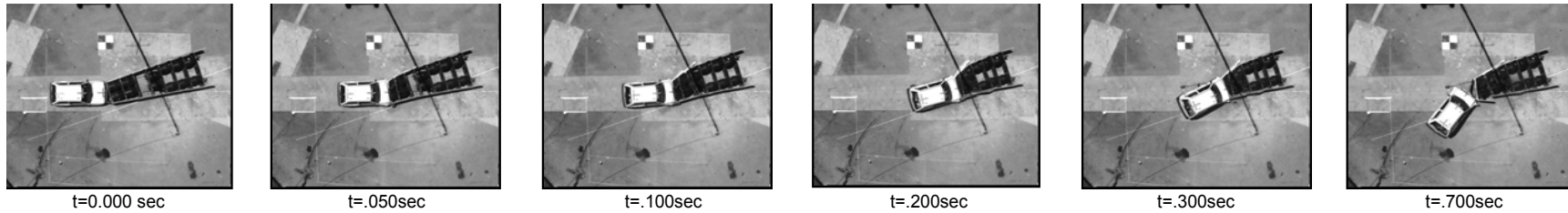
Exterior  
 VDS..... FC-3  
 CDC..... 12FDEW2  
 Interior  
 OCDI..... AS0001000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... 0.9  
 Maximum Pitch Angle..... -5.5  
 Maximum Yaw Angle..... 6.0

**Figure 6. Summary of Results**





**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-32**  
 Test No..... **STI Test #WTU03**  
 Date..... 8/8/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 Wide TAU-II Crash Cushion

**Installation Length**

..... Widest tested is 7.33 meters (7-bay system)

Size and/or dimension  
 of key elements..... Height 864 mm, Widest max hazard width 2.63  
 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 820C  
 Model..... 1990, Ford Festiva

**Mass (kg)**

Curb..... 807  
 Test Inertial..... 820  
 Dummy(s)..... 75  
 Gross Static..... 892

**Impact Conditions**

Speed (km/h)..... 99.8  
 Angle (deg)..... 15  
 Impact Severity (kJ)..... 313.9

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 11.8  
 y-direction..... -0.5  
 Ridedown Acceleration (g's)  
 x-direction..... -20.0  
 y-direction..... -6.9  
 THIV (km/h)..... 42.7  
 PHD (g's)..... 20.2  
 ASI..... 1.59

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 630 (panel)

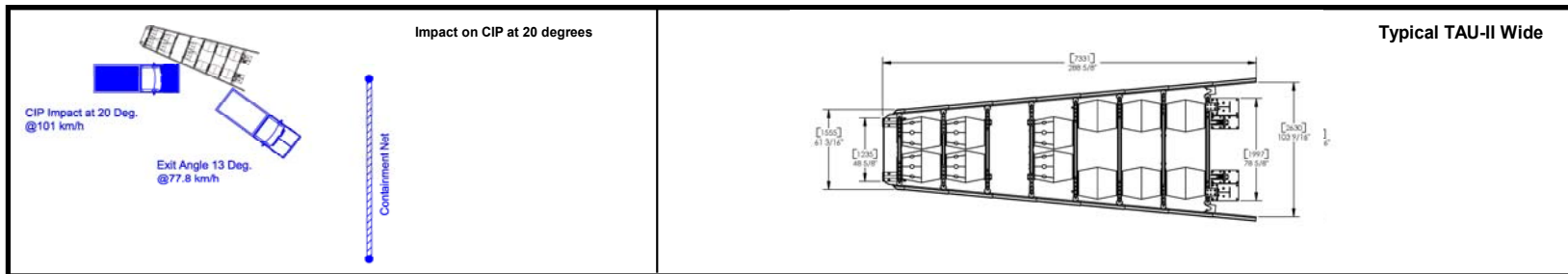
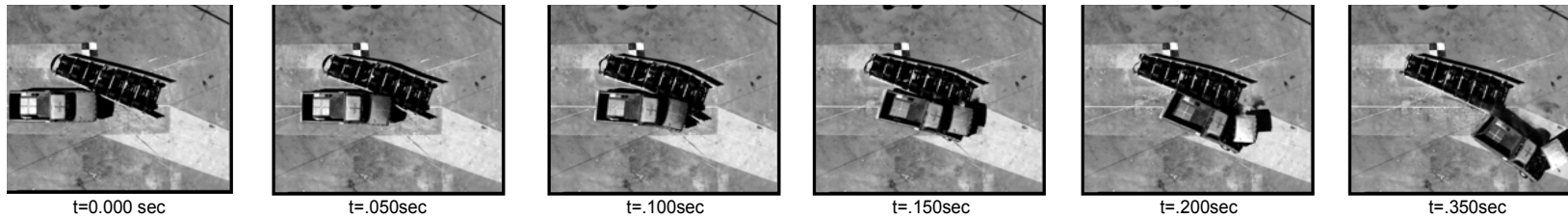
**Vehicle Damage**

Exterior  
 VDS..... LC-2  
 CDC..... 12FDEW2  
 Interior  
 OCDI..... AS0001000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... 8.1  
 Maximum Pitch Angle..... -16.9  
 Maximum Yaw Angle..... -59.0

**Figure 1. Summary of Results**



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-38**  
 Test No..... **STI Test #WTU10**  
 Date..... 10/13/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**..... Widest tested is 7.33 meters (7-bay system)

Size and/or dimension  
 of key elements..... Height 864 mm, Widest max hazard width 2.63 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000kg  
 Model..... 1976, Chevrolet 3/4 ton pickup

Mass (kg)  
 Curb..... 2149  
 Test Inertial..... 2036  
 Dummy(s)..... n/a  
 Gross Static..... 2036

**Impact Conditions**

Speed (km/h)..... 101  
 Angle (deg)..... 20  
 Impact Severity (kJ)..... 93.9

**Exit Conditions**

Speed (km/h)..... 77.8  
 Angle (deg)..... 13

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 4.8  
 y-direction..... -7.6  
 Ridedown Acceleration (g's)  
 x-direction..... -11.5  
 y-direction..... 14.5  
 THIV (km/h)..... 29.3  
 PHD (g's)..... 18.6  
 ASI..... 1.49

**Test Article Deflection (mm)**

Dynamic..... 317  
 Permanent..... 0

**Vehicle Damage**

Exterior  
 VDS..... FL-6  
 CDC..... 11FYEW5  
 Interior  
 OCDI..... AS0000100

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -14.7  
 Maximum Pitch Angle..... -5.6  
 Maximum Yaw Angle..... 54.4

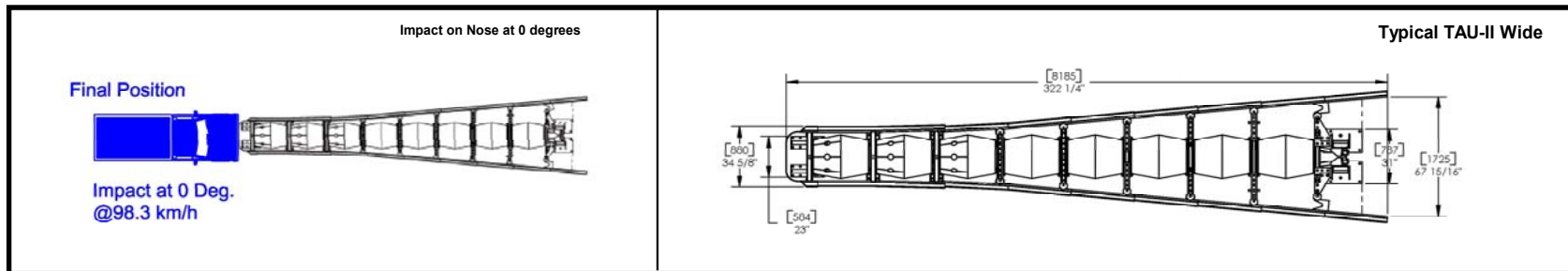
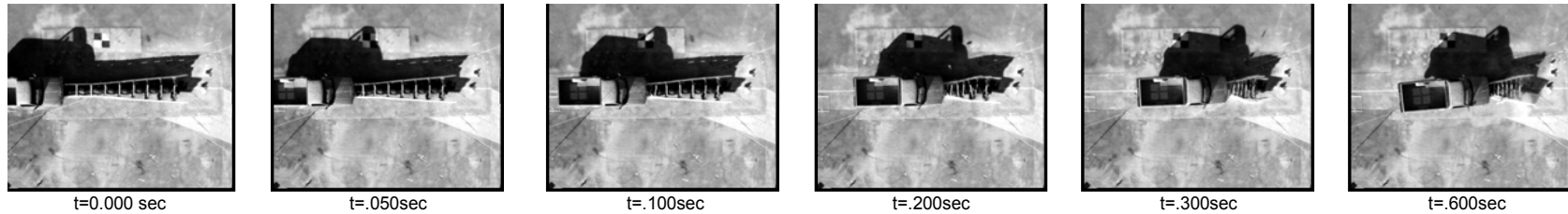
**Figure 11. Summary of Results Test**

BACKSTOP WIDTH	SYSTEM CAPACITY						
	50 KPH	60 KPH	70 KPH	80 KPH	90 KPH	100 KPH	110 KPH
PARALLEL							
42" BACKSTOP							
48" BACKSTOP							
54" BACKSTOP							
60" BACKSTOP							
66" BACKSTOP							
72" BACKSTOP							
78" BACKSTOP							
84" BACKSTOP							
90" BACKSTOP							
96" BACKSTOP							
102" BACKSTOP							

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SCALE: 1=80  
 DATE: 10/25/03  
 REVISIONS: A 50 KPH CORRECT 12/7/03  
 DATE BY RECD NEXT ASSY ITEM

TITLE: IAU-II SYSTEM CONFIGURATION MATRIX  
 MODEL DRAWING NUMBER: D031101  
 REV: A



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-31**  
 Test No..... **STI Test #WTU11**  
 Date..... 10/20/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**.....

Size and/or dimension  
 of key elements..... Narrowest tested is 7.84 m (8-bay system)  
 Height 863 mm, Widest max hazard width 1.66 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1989, Chevrolet 3/4 ton pickup

**Mass (kg)**

Curb..... 1994  
 Test Inertial..... 2000  
 Dummy(s)..... n/a  
 Gross Static..... 2000

**Impact Conditions**

Speed (km/h)..... 98.3  
 Angle (deg)..... 0  
 Impact Severity (kJ)..... 749.3

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 8.8  
 y-direction..... 0.1  
 Ridedown Acceleration (g's)  
 x-direction..... -11.1  
 y-direction..... -3.0  
 THIV (km/h)..... 31.5  
 PHD (g's)..... 11.2  
 ASI..... 0.88

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 244

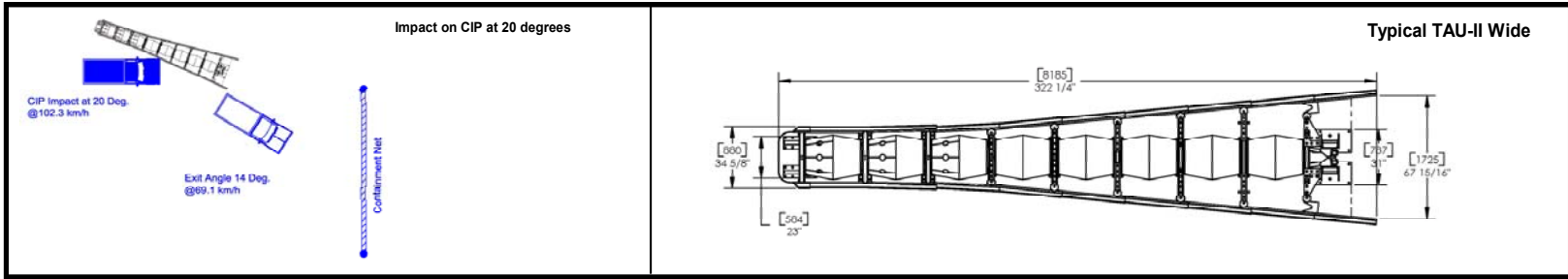
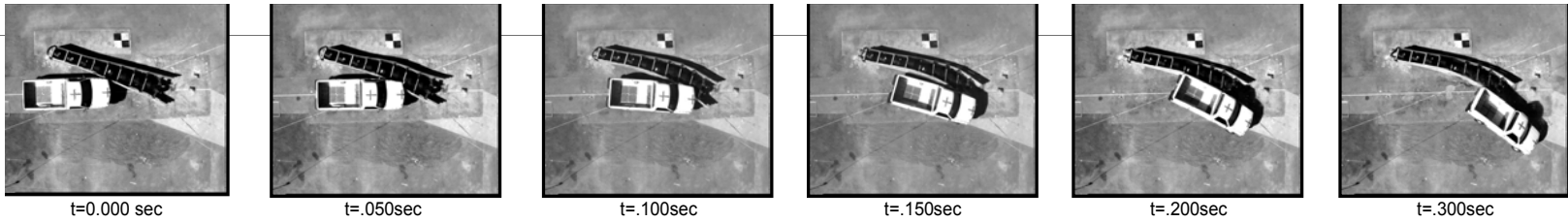
**Vehicle Damage**

Exterior  
 VDS..... FC-3  
 CDC..... 12FDEW3  
 Interior  
 OCDI..... AS0000000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -2.6  
 Maximum Pitch Angle..... -4.9  
 Maximum Yaw Angle..... -6.8

**Figure 16. Summary of Results**



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-38**  
 Test No..... **STI Test #WTU12**  
 Date..... 10/23/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**

Size and/or dimension  
 of key elements..... Narrowest tested is 7.84 m (8-bay system)  
 Height 863 mm, Widest max hazard width 1.66 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1988, GMC 3/4 ton pickup

**Mass (kg)**

Curb..... 1858  
 Test Inertial..... 1970  
 Dummy(s)..... n/a  
 Gross Static..... 1970

**Impact Conditions**

Speed (km/h)..... 102.3  
 Angle (deg)..... 20  
 Impact Severity (kJ)..... 93

**Exit Conditions**

Speed (km/h)..... 69.1  
 Angle (deg)..... 14

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 5.3  
 y-direction..... -6.9  
 Ridedown Acceleration (g's)  
 x-direction..... -7.8  
 y-direction..... 15.9  
 THIV (km/h)..... 29  
 PHD (g's)..... 16  
 ASI..... 1.27

**Test Article Deflection (mm)**

Dynamic..... 452  
 Permanent..... 0

**Vehicle Damage**

Exterior  
 VDS..... FL-5  
 CDC..... 11FYEW4  
 Interior  
 OCDI..... AS0002000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -18.6  
 Maximum Pitch Angle..... -4.8  
 Maximum Yaw Angle..... 53.0

**Figure 21. Summary of Results Test**

**Appendix D**

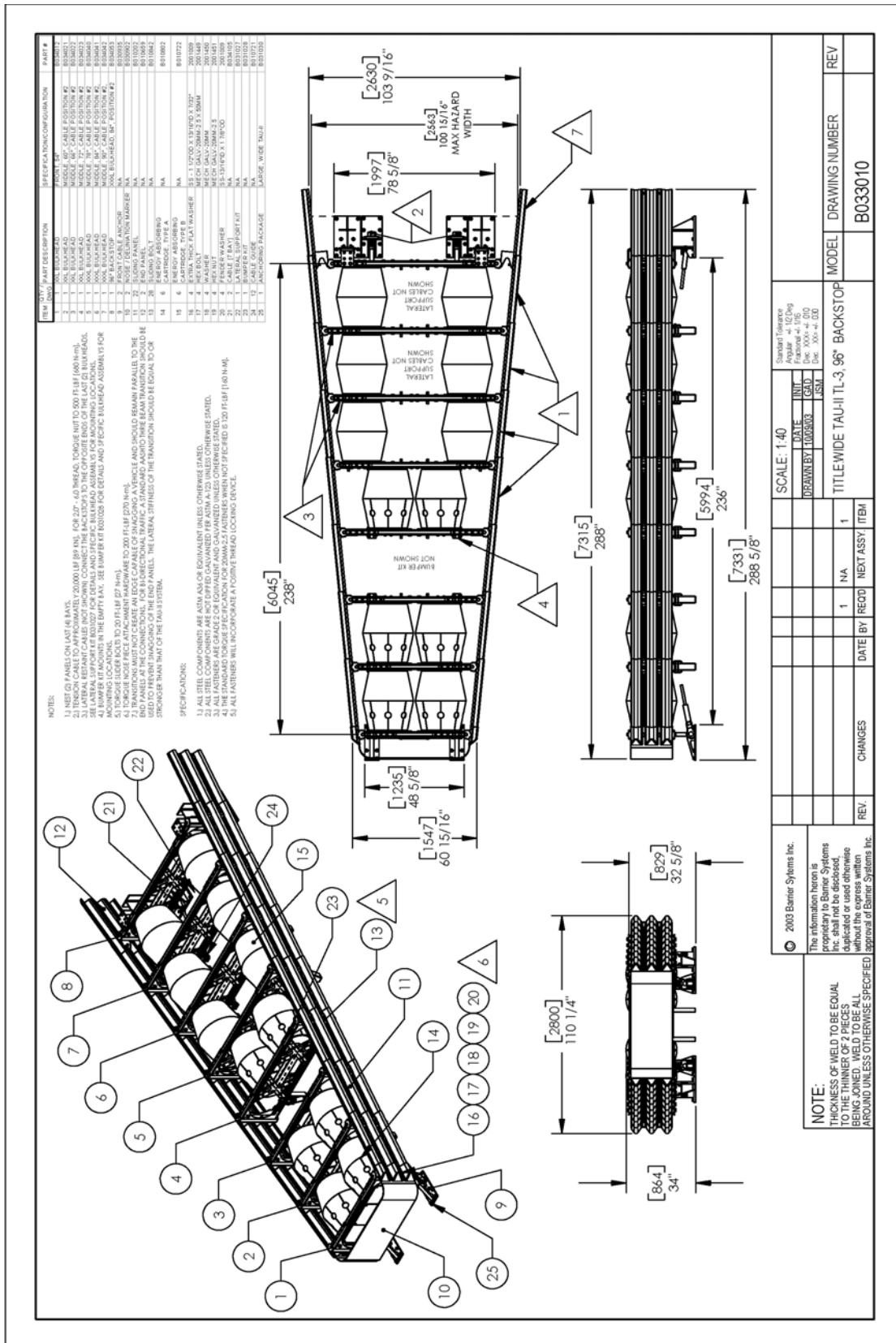
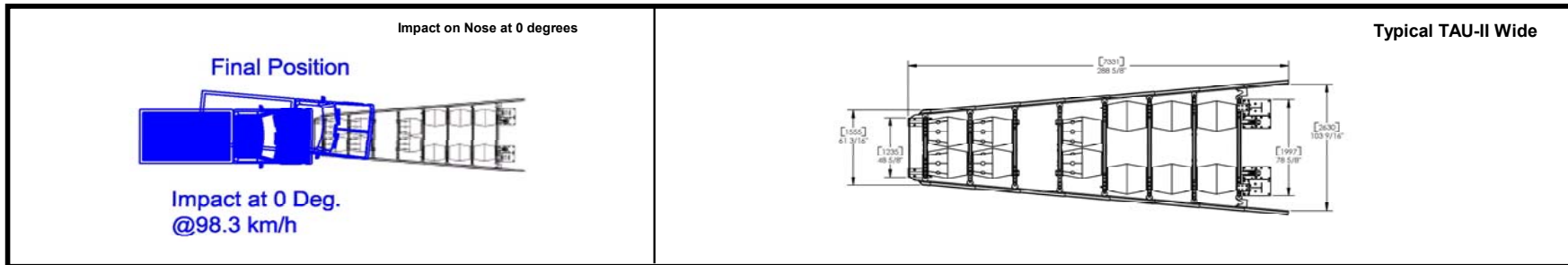
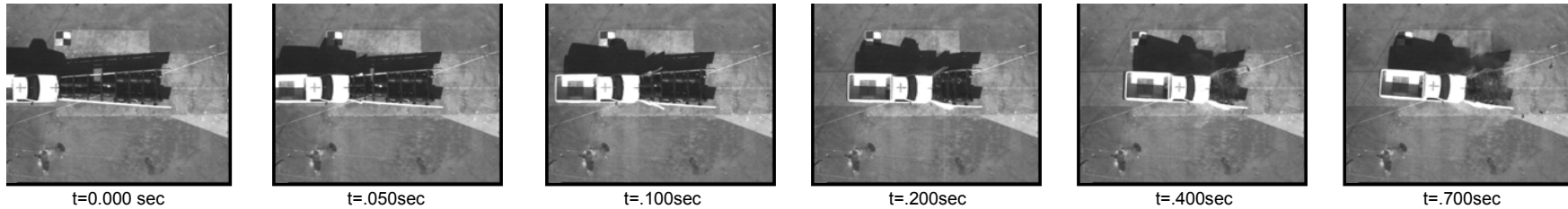


Illustration D-2



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-31**  
 Test No..... **STI Test #WTU04**  
 Date..... 8/12/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion  
 Installation Length..... Widest tested is 7.33 meters (7-bay system)

Size and/or dimension  
 of key elements..... Height 864 mm, Widest max hazard width 2.63 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 1992, Chevrolet 3/4 ton pickup

**Mass (kg)**

Curb..... 1881  
 Test Inertial..... 1987  
 Dummy(s)..... n/a  
 Gross Static..... 1987

**Impact Conditions**

Speed (km/h)..... 98.8  
 Angle (deg)..... 0  
 Impact Severity (kJ)..... 748.5

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 8.8  
 y-direction..... -0.3  
 Ridedown Acceleration (g's)  
 x-direction..... -16.6  
 y-direction..... -5  
 THIV (km/h)..... 31.7  
 PHD (g's)..... 16.8  
 ASI..... 0.96

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 167

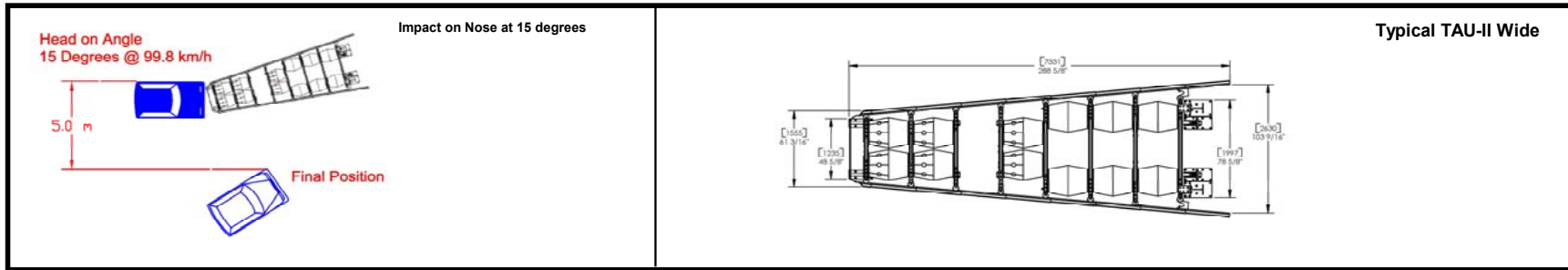
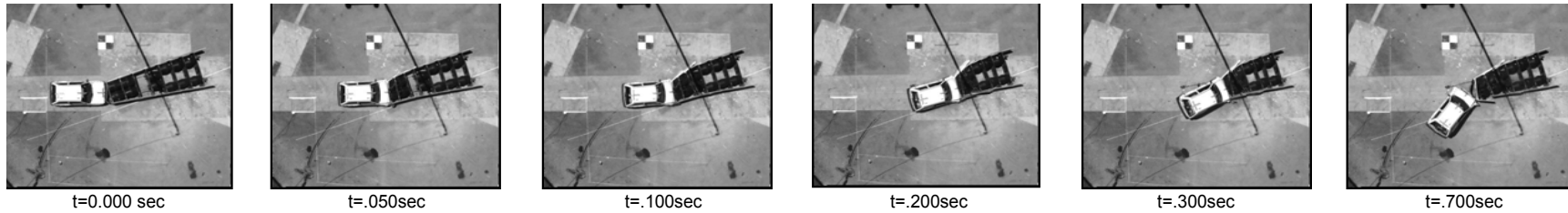
**Vehicle Damage**

Exterior  
 VDS..... FC-3  
 CDC..... 12FDEW2  
 Interior  
 OCDI..... AS0001000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... 0.9  
 Maximum Pitch Angle..... -5.5  
 Maximum Yaw Angle..... 6.0

**Figure 6. Summary of Results**



**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-32**  
 Test No..... **STI Test #WTU03**  
 Date..... 8/8/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 Wide TAU-II Crash Cushion

**Installation Length**

Size and/or dimension..... Widest tested is 7.33 meters (7-bay system)  
 of key elements..... Height 864 mm, Widest max hazard width 2.63 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 820C  
 Model..... 1990, Ford Festiva

**Mass (kg)**

Curb..... 807  
 Test Inertial..... 820  
 Dummy(s)..... 75  
 Gross Static..... 892

**Impact Conditions**

Speed (km/h)..... 99.8  
 Angle (deg)..... 15  
 Impact Severity (kJ)..... 313.9

**Exit Conditions**

Speed (km/h)..... n/a  
 Angle (deg)..... n/a

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 11.8  
 y-direction..... -0.5  
 Ridedown Acceleration (g's)  
 x-direction..... -20.0  
 y-direction..... -6.9  
 THIV (km/h)..... 42.7  
 PHD (g's)..... 20.2  
 ASI..... 1.59

**Test Article Deflection (mm)**

Dynamic..... n/a  
 Permanent..... 630 (panel)

**Vehicle Damage**

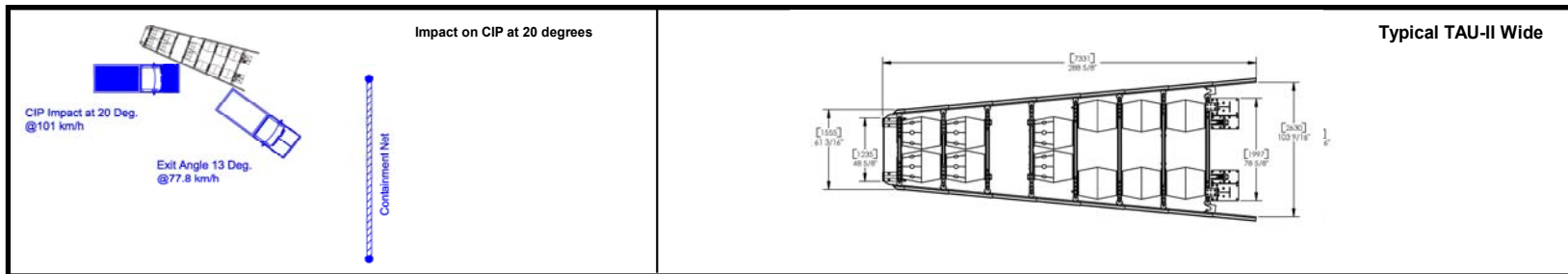
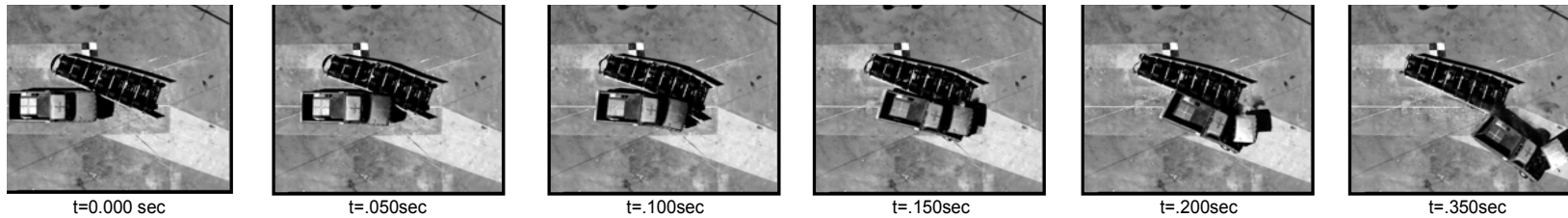
Exterior  
 VDS..... LC-2  
 CDC..... 12FDEW2  
 Interior  
 OCDI..... AS0001000

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... 8.1  
 Maximum Pitch Angle..... -16.9  
 Maximum Yaw Angle..... -59.0

**Figure 1. Summary of Results**





**General Information**

Test Agency..... **SAFE TECHNOLOGIES, INC.**  
 Test Designation..... **NCHRP Report 350 3-38**  
 Test No..... **STI Test #WTU10**  
 Date..... 10/13/2003

**Test Article**

Type..... Barrier Systems, Inc.  
 TAU-II Wide Crash Cushion

**Installation Length**..... Widest tested is 7.33 meters (7-bay system)

Size and/or dimension  
 of key elements..... Height 864 mm, Widest max hazard width 2.63 meters

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000kg  
 Model..... 1976, Chevrolet 3/4 ton pickup

Mass (kg)  
 Curb..... 2149  
 Test Inertial..... 2036  
 Dummy(s)..... n/a  
 Gross Static..... 2036

**Impact Conditions**

Speed (km/h)..... 101  
 Angle (deg)..... 20  
 Impact Severity (kJ)..... 93.9

**Exit Conditions**

Speed (km/h)..... 77.8  
 Angle (deg)..... 13

**Occupant risk Values**

Impact Velocity (m/s)  
 x-direction..... 4.8  
 y-direction..... -7.6  
 Ridedown Acceleration (g's)  
 x-direction..... -11.5  
 y-direction..... 14.5  
 THIV (km/h)..... 29.3  
 PHD (g's)..... 18.6  
 ASI..... 1.49

**Test Article Deflection (mm)**

Dynamic..... 317  
 Permanent..... 0

**Vehicle Damage**

Exterior  
 VDS..... FL-6  
 CDC..... 11FYEW5  
 Interior  
 OCDI..... AS0000100

**Post-Impact Vehicular behavior (deg - gyro @ c.g.)**

Maximum Roll Angle..... -14.7  
 Maximum Pitch Angle..... -5.6  
 Maximum Yaw Angle..... 54.4

**Figure 11. Summary of Results Test**

BACKSTOP WIDTH	SYSTEM CAPACITY						
	50 KPH	60 KPH	70 KPH	80 KPH	90 KPH	100 KPH	110 KPH
PARALLEL							
42" BACKSTOP							
48" BACKSTOP							
54" BACKSTOP							
60" BACKSTOP							
66" BACKSTOP							
72" BACKSTOP							
78" BACKSTOP							
84" BACKSTOP							
90" BACKSTOP							
96" BACKSTOP							
102" BACKSTOP							

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SCALE: 1=80  
 DATE: 10/25/03  
 REVISIONS: A 50 KPH CORRECT 12/7/03  
 DATE BY RECD NEXT ASSY ITEM

TITLE: IAU-II SYSTEM CONFIGURATION MATRIX

MODEL DRAWING NUMBER: D031101

REV: A