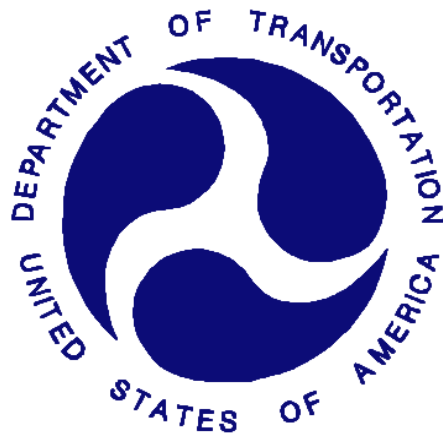


**Vehicle Research and Test Center
Eval of ATD
THOR-05F**

**Prepared By:
Transportation Research Center Inc.
10820 State Route 347
P. O. Box B-67
East Liberty, OH 43319**



Summary Report

**November 2019
January 2020**

**Prepared For
Vehicle Research and Test Center
P. O. Box 37
East Liberty, OH 43319**

SECTION 1

PURPOSE AND SUMMARY FOR THOR-05F

The purpose of the testing is to evaluate the durability and kinematics response of the THOR 5thF in frontal impacts conducted in the Mazda CX-3 rear seat sled buck.

SUMMARY

A THOR-05F seated and secured in the left rear occupant position. The THOR 5thF was seated in both the erect and the slouch position with the pelvis forward.

The THOR_05F was instrumented with head, spine (upper, middle and lower), and pelvis triaxial accelerometers, upper/lower neck, thoracic spine, ASIS and Femur force and moment load cells; acetabulum force load cells, thorax and abdomen IRTRACC voltages. During this test series the dummy was restrained with a 3-point seatbelt.

SECTION 2

Left Rear Mazda CX-3 BUCK TEST SUMMARY

TEST DUMMY INFORMATION

Description	Position # 4
ATD Type/Serial No.	THOR-05F/ ED2634
Restraint System	3-Point Seatbelt

CAMERA POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Origin	mm	0.00	0.00	0.00
Left Side Camera	mm	358.50	-707.61	36.65
Right Side Camera	mm	356.67	714.77	47.83

DUMMY POSITIONING

THOR05F ED2634 – Seated in the erect position

TRC Test Number: S191211-1

VRTC Test Number: FR_RSHS_04



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Rear Striker - Actual	mm	-0.06	-0.23	0.00
Top of Head - Actual	mm	91.80	398.44	-381.90
Right Eye - Actual	mm	-28.54	58.14	-85.86
Left Eye - Actual	mm	375.69	155.46	-475.84
Right Cheek - Actual	mm	816.12	-22.24	-74.51
Left Cheek - Actual	mm	928.80	-48.57	569.19
Mouth - Actual	mm	1066.14	140.59	-465.49
Head CG - Actual	mm	1805.89	45.87	39.48
Lower Head CG - Actual	mm	934.33	-29.79	153.53
Shoulder - Actual	mm	-0.06	-0.23	0.00
Elbow - Actual	mm	91.80	398.44	-381.90
Chest point - Actual	mm	180.65	425.55	-288.05
Rib 2 - Actual	mm	180.99	376.72	-287.64
Rib 3 - Actual	mm	178.88	424.71	-250.06
Rib 4 - Actual	mm	178.32	376.24	-250.64
Rib 5 - Actual	mm	180.17	400.22	-213.38
Rib 6 - Actual	mm	93.27	325.48	-297.53
Rib 7 - Actual	mm	95.22	331.20	-264.54
Abdomen Middle - Actual	mm	58.37	261.60	-109.62
Abdomen Bottom - Actual	mm	176.69	169.46	154.96
Seatbelt up - Actual	mm	205.41	393.58	-43.65
Seatbelt down - Actual	mm	178.44	343.22	-64.14
Lap belt up - Actual	mm	206.09	340.62	-35.39

DUMMY POSITIONING FARO MEASUREMENTS, CONTINUED

Lab belt down - Actual	mm	229.20	354.17	-8.34
H-point - Actual	mm	248.38	341.80	17.59
Outboard Knee - Actual	mm	646.53	246.55	253.52
Outboard Ankle - Actual	mm	722.74	277.08	579.54
Left knee top - Actual	mm	664.81	287.18	205.14
Right knee top - Actual	mm	663.34	504.59	201.57
Up Right Chest - Actual	mm	214.69	461.68	-35.54
Up Left Chest - Actual	mm	227.54	341.73	-32.15
Lower Right Chest - Actual	mm	257.58	467.47	45.85
Lower Left Chest - Actual	mm	256.15	333.99	49.69

DUMMY INJURY

HIC (36 ms)	1252
HIC (15 ms)	906
BrIC	1.2
NIJ Max	0.94
Neck Tension Load (N)	2042.73
Neck Comp Load (N)	-92.37
Upper Neck Fx (N)	540.79
Upper Neck Fy (N)	-68.89
Upper Neck Fz (N)	2042.73
Upper Neck Mx (Nm)	16.18
Upper Neck My (Nm)	-24.69
Upper Neck Mz (Nm)	-20.24
Lower Neck Fx (N)	-2486.38
Lower Neck Fy (N)	NA
Lower Neck Fz (N)	NA
Lower Neck Mx (Nm)	49.079
Lower Neck My (Nm)	NA
Lower Neck Mz (Nm)	NA
Right Lateral Clavicle Resultant (N)	1255.75
Right Medial Clavicle Resultant (N)	1212.98
Spine T1 Resultant (g)	67.47
Spine T8 Resultant (g)	79.64
Spine T12 Resultant (g)	89.46
Chest Left Upper Resultant(mm)	39.232
Chest Right Upper Resultant(mm)	42.993
Chest Left Lower Resultant(mm)	55.116
Chest Right Lower Resultant(mm)	76.131
Chest 3ms Clip T1 (g)	48.86
Chest 3ms Clip T8 (g)	73.37
Chest 3ms Clip T12 (g)	81.81
Thorasic Force Resultant (N)	4023.97
Thorasic Moment Resultant (Nm)	444.75

DUMMY INJURY, CONTINUED

Abdomen Pressure Left (psi)	19.74
Abdomen Pressure Right (psi)	39.39
Pelvis Resultant (g)	98.42
Acetabulum Right Force (N)	5465
Acetabulum Left Force (N)	5572
Femur Right Force (N)	2570.773
Femur Left Force (N)	2496.459
Asis Left Force (N)	3144.26
Asis Left Moment Nm)	19.83
Asis Right Force (N)	3193.09
Ais Right Moment (Nm)	22.26
Lap Belt Load (N)	9299.05
Shoulder Belt Load (N)	9274.22

DUMMY POSITIONING

THOR05F ED2634 – Seated in the slouch position

TRC Test Number: S191216-1

VRTC Test Number: FR_RSHS_02



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Rear Striker - Actual	mm	0.02	0.26	0.30
Top of Head - Actual	mm	146.83	402.35	-366.90
Right Eye - Actual	mm	222.32	422.52	-262.34
Left Eye - Actual	mm	219.14	374.49	-262.16
Right Cheek - Actual	mm	214.69	424.68	-225.29
Left Cheek - Actual	mm	211.20	375.10	-225.03
Mouth - Actual	mm	209.31	400.19	-188.73
Head CG - Actual	mm	129.87	330.89	-284.29
Lower Head CG - Actual	mm	127.41	338.01	-251.84
Shoulder - Actual	mm	67.17	267.57	-101.45
Elbow - Actual	mm	216.88	187.49	159.90
Chest point - Actual	mm	218.68	400.85	-21.18
Rib 2 - Actual	mm	182.69	343.16	-40.41
Rib 3 - Actual	mm	206.21	339.52	-8.34
Rib 4 - Actual	mm	226.28	353.23	21.87
Rib 5 - Actual	mm	239.62	340.30	50.70
Rib 6 - Actual	mm	237.37	329.48	76.68
Rib 7 - Actual	mm	227.86	325.82	102.33
Abdomen Middle - Actual	mm	286.04	402.56	139.27
Abdomen Bottom - Actual	mm	351.63	400.33	220.89
Seatbelt up - Actual	mm	189.71	402.26	-49.64
Seatbelt down - Actual	mm	234.43	400.57	14.02
Lap belt up - Actual	mm	337.85	400.83	171.09

DUMMY POSITIONING FARO MEASUREMENTS, CONTINUED

Lab belt down - Actual	mm	359.93	401.41	212.76
H-point - Actual	mm	280.06	198.37	281.48
Outboard Knee - Actual	mm	652.12	251.55	239.37
Outboard Ankle - Actual	mm	692.03	256.93	570.50
Left knee top - Actual	mm	667.23	294.30	193.78
Right knee top - Actual	mm	672.19	506.03	193.79
Up Right Chest - Actual	mm	231.71	460.12	5.15
Up Left Chest - Actual	mm	240.72	338.80	-4.39
Lower Right Chest - Actual	mm	253.19	466.79	75.44
Lower Left Chest - Actual	mm	253.87	329.28	76.52

DUMMY INJURY

HIC (36 ms)	1378
HIC (15 ms)	961
BrIC	1.3
NIJ Max	0.91
Neck Tension Load (N)	3273
Neck Comp Load (N)	-609
Upper Neck Fx (N)	-872.861
Upper Neck Fy (N)	-245.87
Upper Neck Fz (N)	3272.59
Upper Neck Mx (Nm)	-23.262
Upper Neck My (Nm)	16.76
Upper Neck Mz (Nm)	-6
Lower Neck Fx (N)	-1769.72
Lower Neck Fy (N)	-2059.38
Lower Neck Fz (N)	-437.4
Lower Neck Mx (Nm)	-98.91
Lower Neck My (Nm)	67.67
Lower Neck Mz (Nm)	-13.748
Right Lateral Clavicle Resultant (N)	1042.93
Right Medial Clavicle Resultant (N)	1073.9
Spine T1 Resultant (g)	56.2
Spine T8 Resultant (g)	72.53
Spine T12 Resultant (g)	80.42
Chest Left Upper Resultant(mm)	39.23
Chest Right Upper Resultant(mm)	58.31
Chest Left Lower Resultant(mm)	39.02
Chest Right Lower Resultant(mm)	61.64
Chest 3ms Clip T1 (g)	56.2
Chest 3ms Clip T8 (g)	72.53
Chest 3ms Clip T12 (g)	80.42
Thoracic Force Resultant (N)	3437.49

DUMMY INJURY, CONTINUED

Thoracic Moment Resultant (Nm)	400.03
Abdomen Pressure Left (psi)	23.79
Abdomen Pressure Right (psi)	48.64
Pelvis Resultant (g)	87.19
Acetabulum Right Force (N)	6235
Acetabulum Left Force (N)	6042
Femur Right Force (N)	3662.125
Femur Left Force (N)	3412.996
Asis Left Force (N)	3314.83
Asis Left Moment Nm)	26.38
Asis Right Force (N)	3448.26
Ais Right Moment (Nm)	29.59
Lap Belt Load (N)	8502.74
Shoulder Belt Load (N)	9445.14

DUMMY POSITIONING

THOR05F ED2634 – Seated in the pelvis forward position

TRC Test Number: S200117-1

VRTC Test Number: FR_RSHS_06



DUMMY POSITIONING FARO MEASUREMENTS

Description	Units	X	Y	Z
Rear Striker - Actual	mm	0.48	-0.26	0.18
Top of Head - Actual	mm	127.88	409.67	-358.03
Right Eye - Actual	mm	214.36	426.98	-257.77
Left Eye - Actual	mm	210.72	378.54	-258.14
Right Cheek - Actual	mm	209.04	427.06	-220.13
Left Cheek - Actual	mm	205.58	377.91	-220.86
Mouth - Actual	mm	206.09	401.82	-183.42
Head CG - Actual	mm	119.72	336.61	-276.29
Lower Head CG - Actual	mm	120.17	342.61	-243.18
Shoulder - Actual	mm	63.25	271.67	-86.98
Elbow - Actual	mm	253.43	187.68	143.09
Chest point - Actual	mm	225.35	403.65	-17.26
Rib 2 - Actual	mm	188.82	348.31	-34.95
Rib 3 - Actual	mm	214.36	343.10	-4.60
Rib 4 - Actual	mm	236.31	357.56	24.27
Rib 5 - Actual	mm	251.26	344.07	52.29
Rib 6 - Actual	mm	249.62	332.66	79.95
Rib 7 - Actual	mm	241.82	327.64	104.02
Abdomen Middle - Actual	mm	305.88	398.48	132.04
Abdomen Bottom - Actual	mm	376.87	395.83	208.31
Seatbelt up - Actual	mm	175.76	400.82	-63.28
Seatbelt down - Actual	mm	232.58	400.44	-8.99
Lap belt up - Actual	mm	322.53	399.33	134.43

DUMMY POSITIONING FARO MEASUREMENTS, CONTINUED

Lab belt down - Actual	mm	360.17	400.28	162.78
H-point - Actual	mm	307.58	196.72	279.63
Outboard Knee - Actual	mm	678.60	253.68	211.42
Outboard Ankle - Actual	mm	734.84	264.97	539.95
Left knee top - Actual	mm	692.41	293.58	163.88
Right knee top - Actual	mm	701.42	496.95	161.34
Up Right Chest - Actual	mm	242.33	460.96	-0.44
Up Left Chest - Actual	mm	247.50	348.58	-2.63
Lower Right Chest - Actual	mm	269.57	467.11	82.15
Lower Left Chest - Actual	mm	265.87	336.70	81.00

DUMMY INJURY

HIC (36 ms)	1933
HIC (15 ms)	1102
BrIC	1.1
NIJ Max	0.987
Neck Tension Load (N)	3286
Neck Comp Load (N)	-1124
Upper Neck Fx (N)	-2263.89
Upper Neck Fy (N)	-230.01
Upper Neck Fz (N)	3286.54
Upper Neck Mx (Nm)	-18.967
Upper Neck My (Nm)	19.877
Upper Neck Mz (Nm)	9.815
Lower Neck Fx (N)	-3684.76
Lower Neck Fy (N)	-1610.86
Lower Neck Fz (N)	-2177.24
Lower Neck Mx (Nm)	-86.029
Lower Neck My (Nm)	173.516
Lower Neck Mz (Nm)	24.032
Right Lateral Clavicle Resultant (N)	757.5
Right Medial Clavicle Resultant (N)	886.14
Spine T1 Resultant (g)	109.58
Spine T8 Resultant (g)	78.9
Spine T12 Resultant (g)	95.972
Chest Left Upper Resultant(mm)	NA
Chest Right Upper Resultant(mm)	NA
Chest Left Lower Resultant(mm)	NA
Chest Right Lower Resultant(mm)	NA
Chest 3ms Clip T1 (g)	64.9
Chest 3ms Clip T8 (g)	57.83
Chest 3ms Clip T12 (g)	61.6

DUMMY INJURY, CONTINUED

Thorasic Force Resultant (N)	7528.492
Thorasic Moment Resultant (Nm)	400.92
Abdomen Pressure Left (psi)	39.36
Abdomen Pressure Right (psi)	54.056
Pelvis Resultant (g)	83.266
Acetabulum Right Force (N)	5469
Acetabulum Left Force (N)	4654
Femur Right Force (N)	2838.423
Femur Left Force (N)	2495.615
Asis Left Force (N)	2531.131
Asis Left Moment Nm)	36.325
Asis Right Force (N)	1348.375
Ais Right Moment (Nm)	25.278
Lap Belt Load (N)	7310.699
Shoulder Belt Load (N)	9917.495