

# ***Investigation of the BioRID-II Dummy for GTR7-Phase2 / MR1***

JAMA / JARI

# - Part 1 -

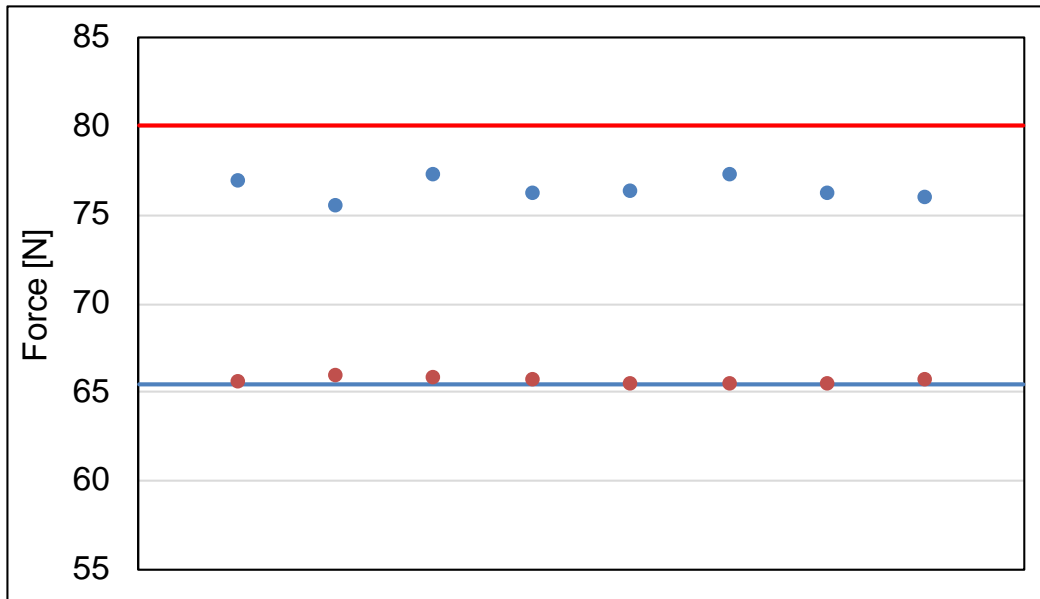
## Certification Test Without Headrest

- Test facilities
  - HIS-J ; Humanetics Innovative Solutions - Japan
- Dummies
  - One BioRID-II dummy (produced 2014 · S/N:DP1998)

Purpose of this investigation is to:

- confirm the effect of differences in hardness of ARA-220 bumpers on the results of the certification test without headrest.
- reconsider the corridor of Pot.A.

# Characteristic of ARA-220 bumpers used in this test series

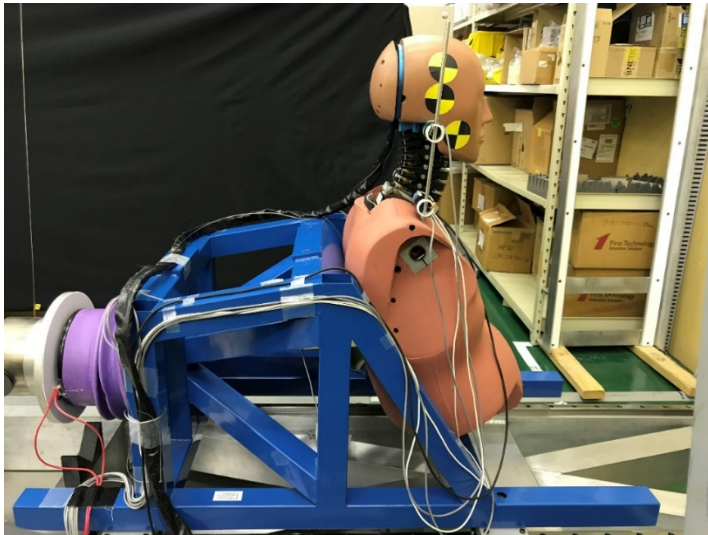


- As for the ARA-220 bumpers used in this test series,
  - the harder bumper was manufactured on 2018
  - the softer bumper was manufactured on 2019.

Harder Bumper		
Lot.No	Peak Value[N]	ShoreA
C6803	76.9	46
C6812	75.6	47
C6813	77.3	47
C6814	76.2	47
C6830	76.4	48
C6861	77.3	45
C6864	76.3	45
C6872	76.0	47
Ave.	76.5	46.5
S.D.	0.6	1.1

Softer Bumper		
Lot.No	Peak Value[N]	ShoreA
C8168	65.6	41
C8170	66.0	42
C8232	65.9	42
C8254	65.7	40
C8256	65.5	42
C8261	65.5	42
C8262	65.5	44
C8269	65.7	43
Ave.	65.7	42.0
S.D.	0.2	1.2

# Certification Test without Headrest



- Certification test without headrest was conducted according to Certification Manual.
- The corridor of Pot.A needs to be reconsidered. Therefore, the responses on the requirements other than Pot.A were adjusted to pass the corridor of certification manual.
- In order to confirm the repeatability of the test results, the certification test was conducted three times.

DP1998	unit	Corridor	Harder Bumper	Softer Bumper
OC angle	deg	29~30	29.4	29.5
T2 angle	deg	36.5~37.5	37.3	37.2
OC-HP demension	mm	199~209	208	201
OC-Ground dimension	mm	570~580	575	575
Oil damper	deg	—	360	360
OC Plate adjustment	—	-6(Ext.) ~ +6(Flx.)	+2	+2

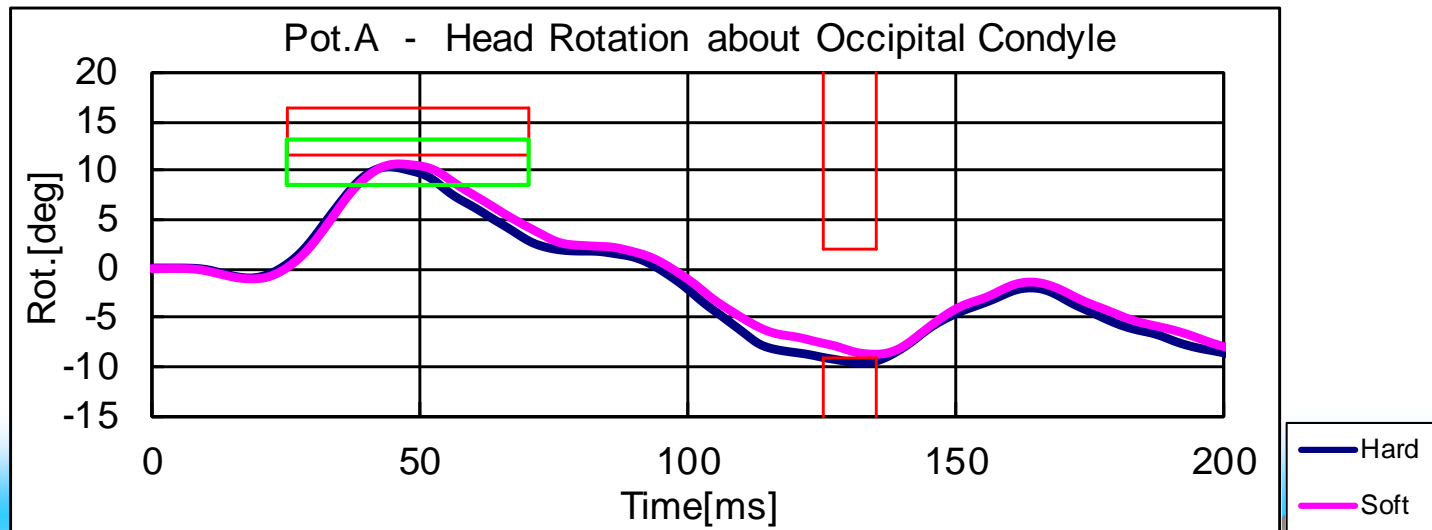
# Results of Certification Test without Headrest

- Regarding the test results, all but Pot.A passed the corridor.
- Repeatability was good.

Measurement	Requirement	Unit	Time[ms]	Harder Bumper	Softer Bumper
Temperature	19-25	°C	-	20.0	20.0
Humidity	10-70	%	-	50.0	50.0
Pendulum Velocity	4.70-4.80	m/s	-	4.77	4.77
Peak Impactor Force	8000-9700	N	-	8581	8472
Peak Sled Acceleration	137-170	m/s <sup>2</sup>	-	149	145
Peak Sled Velocity 1	2.25-2.50	m/s	20-30	2.43	2.40
Peak Sled Velocity 2	2.10-2.50	m/s	135.00	2.42	2.44
	2.00-2.40	m/s	140.00	2.34	2.36
Peak T1 Acceleration	183-267	m/s <sup>2</sup>	18.5-30.5	225	222
Peak Head Rotation about OC (Pot.A)	11.5-16.5	deg	25-70	10.3	10.8
Peak Neck Link Rotation 1 (Pot.B)	4.00-6.50	deg	18.5-28.5	5.0	5.2
Peak Neck Link Rotation 2 (Pot.B)	-36 - -30	deg	98-108	OK	OK
Peak Neck Link Rotation 3 (Pot.B)	-36 - -29	deg	165-175	OK	OK
T1 Rotation (Pot.C)	-19 - -16.5	deg	73-78	OK	OK
Total Head Rotation (Pot.A+B)	-41 - -25	deg	100-110	OK	OK
Total Head Rotation (Pot.A+B)	-41 - -25	deg	170-190	OK	OK
Total Thoracic Rotation (Pot.C)	-21 - -10	deg	125-135	OK	OK
UpperNeck-MY Flexion	7.7-17.8	Nm	20-35	13.1	12.7
UpperNeck-MY Extension	-23.5 - -15	Nm	66-83	-17.3	-17.1

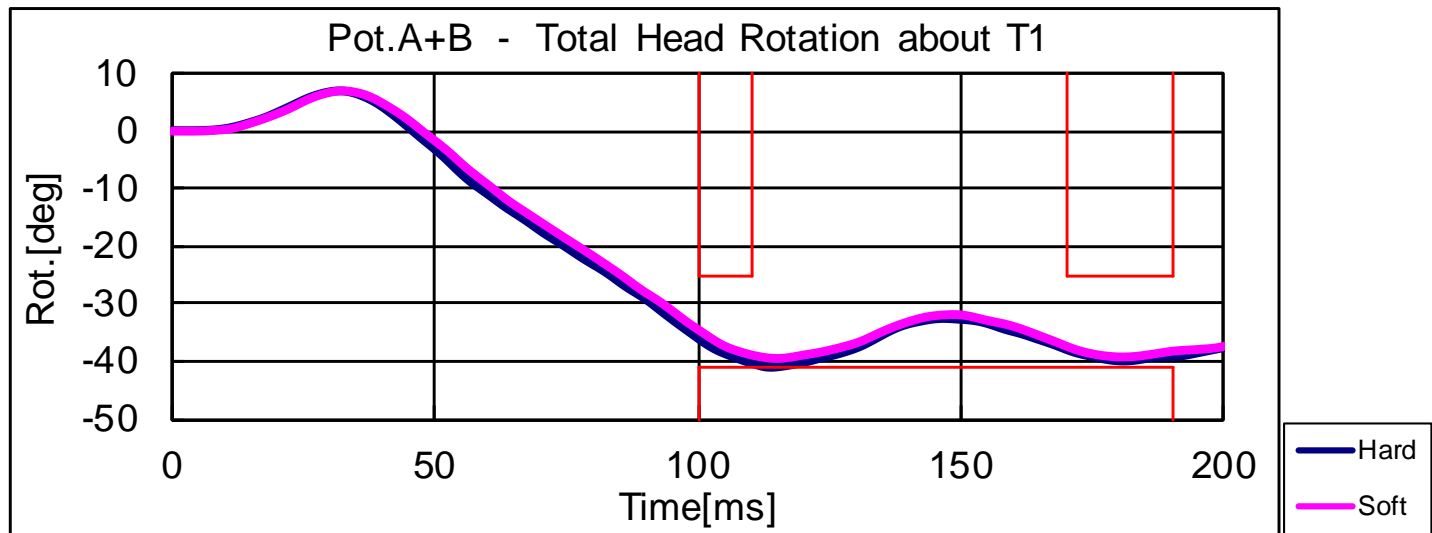
# Proposal for the corridor of Pot.A (1)

- The bumper of ARA-220 used in this test series passed the compression test, but only Pot.A was deviated from the corridor in certification test. Therefore, it is necessary to reconsider the corridor of Pot.A.
- Considered the test results, it proposes that new Pot.A corridor (Figure : green line) is changed  $14.0^\circ \pm 2.5^\circ$  to  $10.5^\circ \pm 2.5^\circ$  (corridor width is not changed (median  $\pm 2.5^\circ$ )).
- It is also necessary to change the second corridor of Pot.A, but it is possible to pass the current corridor by adjusting the damper. Therefore, it is necessary to consider whether to change the second corridor of Pot.A.



# Proposal for the corridor of Pot.A (2)

- Pot.A+B was near the lower limit of the corridor because Pot.A did not pass the corridor.
- Since Pot.A+B uses data from Pot.A, it is also necessary to reconsider the corridor of Pot.A+B. (corridor width is not changed ( $\text{median} \pm 8^\circ$ )).



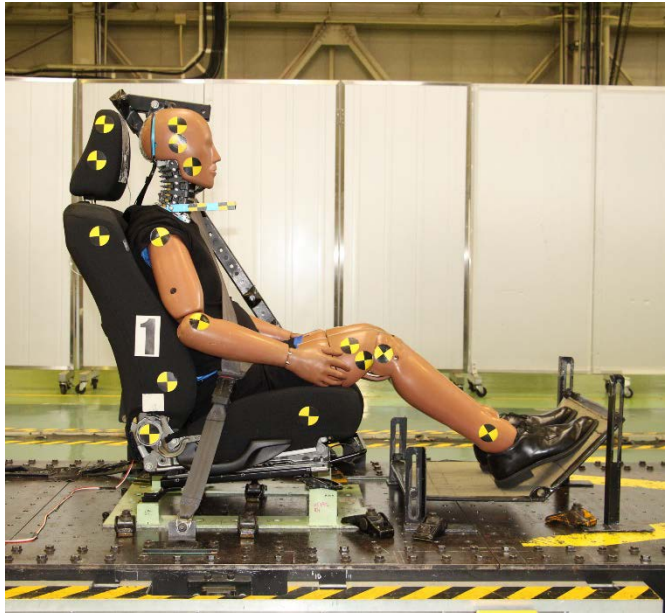
# - Part 2 - Dynamic Sled Test

- Test facilities
  - JARI ; Japan Automobile Research Institute
- Dummies
  - One BioRID-II dummy (produced 2014 · S/N:DP1998)
- Seat
  - One type of production seat for passenger car (passive type)

Purpose of this investigation is to:

- confirm the effect of difference in hardness of the bumper (ARA-220) on the injury values in the dynamic sled test.





- Dynamic sled test was conducted according to Annex 8 in GTR7 document. However, in order to minimize the variation in test results due to individual differences among seats, the seat height was set to the lowest position.
- In order to confirm the repeatability of the test results, the dynamic sled test was conducted two times.

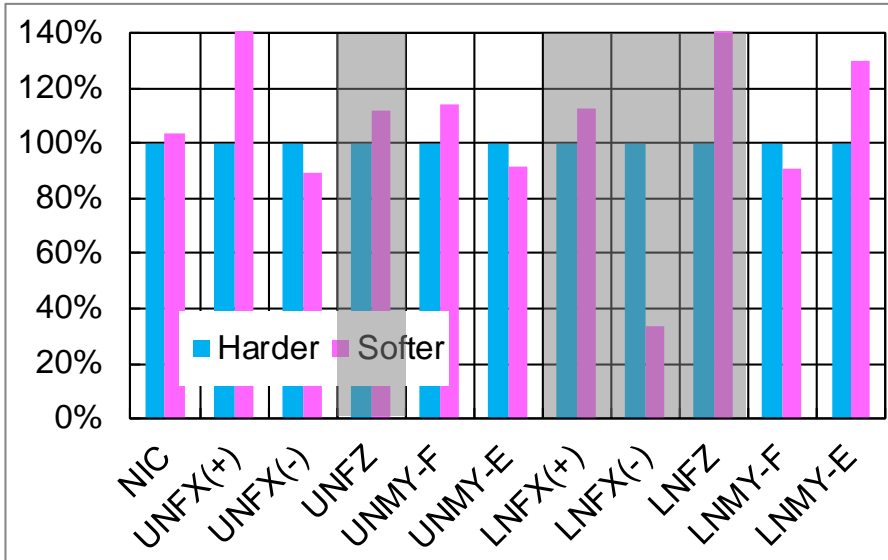
Test No.	ARA-220 Bumper hardness
T-01	Harder
T-02	Harder
T-03	Softer
T-04	Softer

<Seating position of BioRID-II>

	ARA-220 Bumper	HP-X	HP-Z	Pelvis Angle	Backset	Height
Target	-	258.2	220.1	24.2	37.4	6.2
T-01	Harder	257.2	221.7	26.0	37.5	6.9
T-02	Harder	257.4	223.9	26.0	37.4	7.0
T-03	Softer	256.5	224.7	25.7	37.6	11.2
T-04	Softer	259.1	227.6	25.7	37.6	12.5

# Results of Dynamic Sled Test

## Injury measures (Ratio of Softer relative to Harder)



- UNFX and LNM-E have a large in ratio of Softer relative to Harder, but injury absolute value is small.
- Difference in UNMY-Fix was 14% (difference in injury value was 2Nm).

※ UNFZ, LNF(+), LNF(-) and LNFZ are non evaluation items in GTR7

Test.No	ARA-220 Bumper	ΔV	NIC (m <sup>2</sup> /s <sup>2</sup> )	UpperNeck					LowerNeck				
				FX(+) (N)	FX(-) (N)	FZ (N)	MY-Fix. (Nm)	MY-Ext. (Nm)	FX(+) (N)	FX(-) (N)	FZ (N)	MY-Fix. (Nm)	MY-Ext. (Nm)
T-01	Harder	17.6	16.5	0.2	-144.9	451.9	13.4	-3.5	217.2	-14.8	165.2	1.3	-3.4
T-02	Harder		15.5	0.1	-139.5	415.2	13.8	-3.7	204.6	-18.5	117.3	1.4	-3.2
T-03	Softer		17.6	0.8	-133.3	478.4	14.8	-4.0	232.6	-9.6	232.6	1.2	-4.2
T-04	Softer		15.6	0.0	-121.8	489.9	16.4	-2.5	243.6	-1.5	181.8	1.2	-4.4
Ave.	Harder		16.0	0.2	-142.2	433.5	13.6	-3.6	210.9	-16.7	141.3	1.3	-3.3
Ave.	Softer		16.6	0.4	-127.6	484.1	15.6	-3.3	238.1	-5.6	207.2	1.2	-4.3

## <Certification Test>

- The bumper of ARA-220 used in this test series passed the compression test, but only Pot.A was deviated from the corridor in certification test. Therefore, it is necessary to reconsider the corridor of Pot.A.
- Considered the test results, it proposes that new Pot.A corridor is changed  $14.0^\circ \pm 2.5^\circ$  to  $10.5^\circ \pm 2.5^\circ$  (corridor width is not changed (median  $\pm 2.5^\circ$ )).
- ← However, when reconsidering the corridor of Pot.A, it is also necessary to consider the results from other test laboratories.

## <Dynamic Sled Test>

- UNFX and LNMV-Ext have a large in ratio of Softer relative to Harder, but injury value is too small.
- Difference in UNMV-Flx was 14%(difference in injury value was 2Nm).
- ← In this research, because of the test results using one type of seat, it is necessary to consider the test results with other types of seat also.