

KNCAP results of Micro-Mobility (L7 Category vehicles)

● Statistics of Micro-Mobility in Korea

- **Registration : 6,678 vehicles** (As of 28.Oct. 2020)
 - From Spain, China, Domestic (7 Manufacturers, all electronic vehicles)

● Dimensions and Vehicle Type under the Korean Safety Requirements

- Dimensions :
 - Length : 3.6m or less
 - Width : 1.5m or less
 - Height : 2.0m or less
- EU
 - L : 3.7m or less
 - W: 1.5m or less
 - H : 2.5m or less
- India
 - L : 3.0m or less
 - W: 1.5m or less
 - H : 2.5m or less
- Vehicle Type : passenger vehicle(600kg or less), vehicle for the carriage of goods(750kg or less)

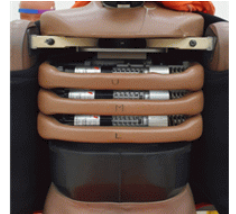
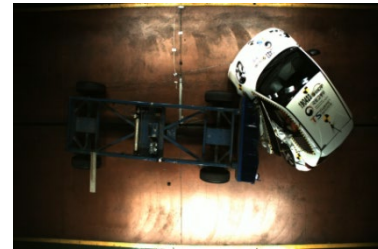


<Passenger vehicles>

<Freight vehicles>

- **KNCAP Test for Micro-Mobility** (Euro NCAP Test protocols)





- **Test : Frontal and Side impact Test** (50km/h), 50%ile Hybrid III & ESII



<Frontal impact Test (50km/h), 50%ile Hybrid III >

< Side impact Test (50km/h), ESII >

- **Test vehicle : 4 models**

Vehicle Type	Domestic (1 models)	Foreign(3 models)		
Passenger vehicle	 <Case 1>	 <Case 2>	 <Case 3>	 <Case 4>

- Overall rating Calculation (Euro NCAP Test protocols)

- Overall weighted score : $100 \times (3 \times \text{Frontal integer} + \text{Side integer}) / 64 = \% \text{ overall score}$
- Rating bands (%)

★★★★★	75-100
★★★★	60-74.9
★★★	45-59.9
★★	35-44.9
★	25-34.9
-	0-24.9

- **Body Regions assessed in Frontal Impact**

Head : 4 point
 Neck : 4 point
 Chest : 4 Point
 Knee & Femur : 4 point

- **Body Regions assessed in Side Impact**

Head : 4 point
 Chest : 4 Point
 Abdomen : 4 point
 Pelvis : 4 point

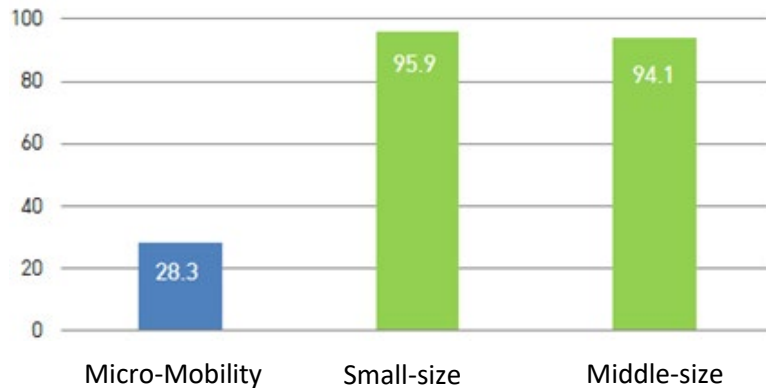
● KNCAP Overall rating Results

Vehicle Type		Overall Rating	Star Rating	Frontal	Side
Domestic	Case 1	27	★	5	2
Foreign	Case 2	39	★★	7	4
	Case 3	36	★★	5	8
	Case 4	11	-	0	7

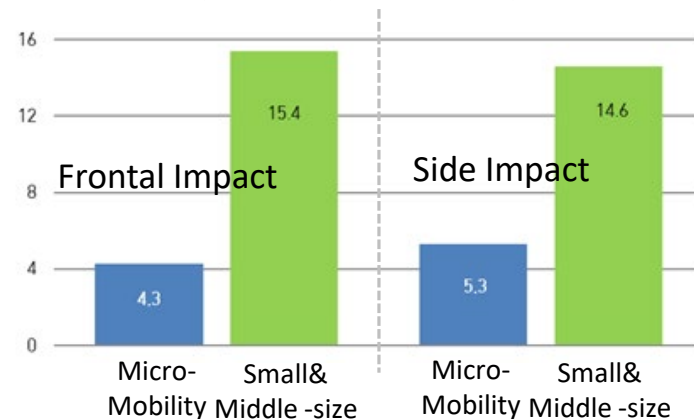
● Comparison with other types in KNCAP

Passenger Vehicle Type	Overall Rating	Star Rating	Frontal ()/16	Side ()/16
Small-Size	95.9	★★★★★	15.5	14.9
Middle-size	94.1	★★★★★	15.3	14.3
Micro-Mobility(L7 category)	28.3	★★	4.3	5.3

▪ Average Overall Rating(%)



▪ Average Rating of each impact test



● Frontal Impact Test Results

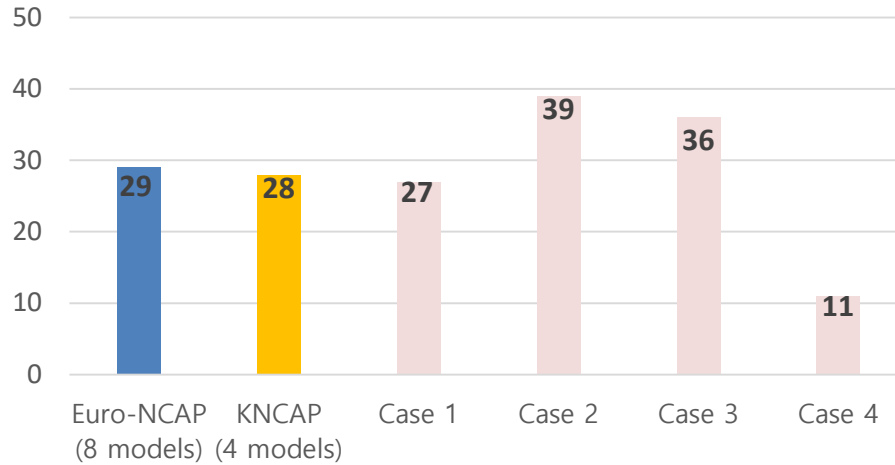
		Case 1	Case 2	Case 3	Case 4	
Head	HIC36	732.7	929.7	886.2	941.1	
	Resultant Acceleration(3ms)	76.7	72.5	76.4	93.1	
	Unstable Contact on Airbag	None	None	None	None	
	Incorrect Airbag Deployment	None	None	None	None	
	Unstable Contact on a Steering (In the case of w/o Airbag)	None	1	3.466	1	0
	Displacements of the Steering	Z (mm)	169.42	80.54	151.1	118.86
		Y (mm)	86.34	23.37	63.82	143.31
		X (mm)	15.11	1.55	0.11	31.55
Failure of Restraint system	None	None	None	None		
Neck	Shear Force (kN)	1.9	21.72	1.471	0.63	
	Tension Force (kN)	4.45	3.07	3.068	4.703	
	Extension (Nm)	159.54	50.13	31.825	61.88	
	Failure Restraint system	None	None	None	None	
Chest	Lateral Compression (mm)	9.2	35.29	32.085	30.04	
	Viscous Criterion (m/s)	0.03	0.45	0.247	0.255	
	Displacements of the A Pillar (mm)	22.6	26.52	13.36	147.38	
	Integrity of the Passenger Compartment	None	4	2	2	0.05
	Steering Wheel Contact	None	None	None	-1	
	Failure of Restraint system	None	None	None	None	
Knee, Femur & Pelvic	Femur compression (kN)	13.42	13.4	3.364	12.19	
	Knee slider compressive displacement (mm)	10.84	-	18.135	7.98	
	Concentrated Loading	None	-1	-1	-1	
	Failure of Restraint system	None	None	None	None	
High Voltage Safety (Pass/Fail)		Pass	Pass	Pass	Pass	
Total			5	7	5	0

● Side Impact Test Results

		Case 1		Case 2		Case 3		Case 4		
Head	HIC36	1256.3	0	2006.5	0	502.1	0	511.3	1	
	Resultant Acceleration(3ms)	123.8		173		93.7		86.1		
	Head Partial Ejection	None		None		None		-1		
	Failure Restraint system	None		None		None		None		
Chest	Lateral Compression (mm)	226.39	0	26.36	0	33.94	1.882	25.94	0	
	Viscous Criterion (m/s)	0.14		0.31		0.44		0.22		
	BackPlate (kN)	0.48		0.71		0.33		0.255		
	T12	Fy (kN)		4		3.29		1.49		2.21
		Mx (Nm)		160.4		156.14		152.94		189.3
	Chest Partial Ejection	-1		None		None		-1		
	Failure Restraint system	-1		None		None		None		
Abdomen	Total Abdominal Force (kN)	2.44	1	2.19	2	1.51	2	1.18	2	
	Failure Restraint system	-1		None		0		None		
Pelvic	Pubic Symphysis Force (kN)	3.21	1	1.81	2	1.81	4	2.47	4	
	Failure Restraint system	-1		None		None		None		
High Voltage Safety (Pass/Fail)		Pass		Pass		Pass		Pass		
Total			2		4		8		7	

● Comparison with Euro-NCAP

Overall Rating for Crash Safety



● Comparison of CPI*

* Combined Probability of Injury

		Micro-Mobility CPI(Star rating)	Motorcycle CPI
Domestic	Case 1	44% (★)	36%
Foreign	Case 2	26% (★★)	
	Case 3	24% (★★)	
	Case 4	66%(-)	

● Motorcycle to Vehicle impact test

- Test velocity : 50km/h side impact to B-pillar
- Dummy : 50%ile wearing helmet
- Measuring HIC(head, neck, Chest deflect.)



	Test results	FMVSS 208	UN R137
Head(HIC)	1,105	1,000	1,000
Neck(Nij)	0.53	1.00	-
Chest(Deflection)	24.2	62.0	42.0
Combined Probability of Injury	36%	-	-

● Test Results on Electrical Safety of High voltage system

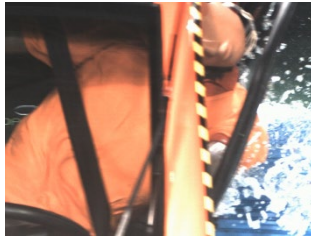
- After impact test*, Check the safety insulation & prevention against electrical shock

* Frontal : 48.3km/h, Side : 50km/h

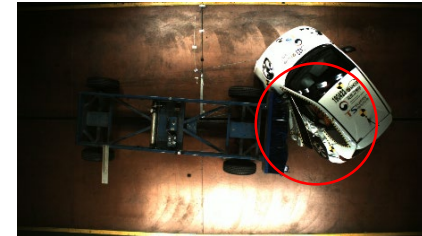
Vehicle Type		Frontal	Side
Domestic	Case 1	Pass	Pass
Foreign	Case 2	Pass	Pass
	Case 3	Pass	Pass
	Case 4	Pass	Pass

● Test pictures

-Side Impact



< Case 1, 4 : Release Belt, Separate Head & Torso >



< Case 3 Door open >

● Other Tests : All Pass

- **Door latch & hinge** : similar to UN R11, apply about 80% of load

Applied Load	Striker & Latch (direction)	Hinge (direction)
UN R11	1,130 kg (Vertical) 905 kg (Width)	1,130 kg (Longitudinal) 905 kg (Width)
Korean Requirements	910 kg (Vertical) 730 kg (Width)	910 kg (Longitudinal) 905 kg (Width)



< Door Hinge Test >

- **Seatbelt Anchorage**

- 2 points-seatbelt : 1,820kg (0.2s or more)
- 3 points-seatbelt : 1,100kg (0.2s or more at pelvic & torso)

Applied Load	2 points-seatbelt	3 points-seatbelt
UN R14 (Seatbelt anchorage)	2,270 kg (pelvic)	1,360 kg (pelvic & torso)
Korean Requirement	1,820 kg (pelvic)	1,100 kg (pelvic & torso)



< Seatbelt Anchorage Test >

- **Seat Anchorage**

- Applied load : 20 times of seat weight

- **Electrical Safety of high voltage system**

- After collision test*, Check the safety insulation & prevention against electrical shock

* Frontal : 48.3km/h, Rear : 48.3km/h, Lateral : 50km/h

- **Frontal & Side impact tests were performed using Euro-NCAP Heavy-Quadricycles Assessment Protocol in 2019**

- **Overall Rating was 1~2 stars(Ave. 28.3%),**
Compare with small & medium passenger vehicles(95%), 30% of those of vehicles.
- **CPI of 2 models of all test vehicles was low than that of motorcycle**

➔ **It would be difficult to make new impact test requirements for Micro-Mobility to ensure crash safety as equivalent level with small passenger vehicles at this moment, More consideration would be needed**

- **It was confirmed Micro-Mobility can comply with other requirements in KMVSS such as Door latch, Seat & seatbelt anchorage and electrical safety after impact**

➔ **GRSP would consider to make some requirements for major components of Micro-Mobility as a first step**



Thank you for your attention