

Mitsubishi's ASV-2 Passenger Car Obtained Japan's Land, Infrastructure and Transport Ministerial Approval – Testing on Public Roads Prior to Commercialization –

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In 2000, Mitsubishi Motors Corporation (MMC) developed a group of Advanced Safety Vehicle-2 (ASV-2)⁽¹⁾ passenger cars employing its vast safety-technology resources. In November of the same year, these vehicles played a part in Smart Cruise 21 Demo 2000, an open demonstration that was jointly organized by Japan's former Ministry of Transport and former Ministry of Construction at that time. One of the ASV-2 vehicles is the ITS-ASV, whose design focuses on intelligent transport systems (ITS). MMC slightly modified the ITS-ASV, and in August 2001 Japan's Minister of Land, Infrastructure and Transport (subsequent ministry) granted the approval that MMC needed to use the ITS-ASV in a wide range of tests (all aimed at commercialization of new technologies) on public roads without violating safety regulations. Subsequently, MMC pursued a program of proving and evaluation tests and was able, as a corollary, to help the Ministry of Land, Infrastructure and Transport establish standards for ITS technologies⁽²⁾. The ministerial approval effectively relaxed the safety regulations applied to three technologies: light distribution control headlight; advanced high-mount stop lamp; and a lane trace assist. In all, MMC used the ITS-ASV to test eight driver support technologies (including the three aforementioned ones) on public roads.

1. Introduction

Japan's ASV project began in 1991 under the leadership of the former Ministry of Transport. MMC was actively involved in the project's first phase (1991 – 1995) and second phase (1996 – 2000) and thus made possible the commercial adoption of numerous world-first driver support technologies including the Mitsubishi Driver Support System⁽²⁾, which combines three technologies (adaptive cruise control; lane departure warning system; and side-rear monitor) and was commercially adopted by MMC in February 2000. Efforts to commercialize new ITS technologies (including those developed by MMC) are likely to expand significantly in the years ahead. Evaluation on public roads of ITS technologies that are still in development will be hugely important.

In Japan, the Minister of Land, Infrastructure and Transport has the power to relax the safety regulations applied to new ITS technologies, thereby enabling man-



Fig. 1 ITS-ASV

ufacturers to conduct tests on public roads. Manufacturers can thus boost the efficiency of their development efforts. Ministerial approval for relaxation of safety regulations is typically limited to technologies that potentially offer great benefits in terms of safety and/or environmental protection. The results of any test conducted on public roads with such ministerial approval are, of course, used commercially by the manufacturer that conducts the tests. In addition, the manufacturer is required to report the results to the ministry. Thus, the ministry gains valuable information that it can use whenever it revises safety regulations to meet changing environmental and social circumstances.

Many new ITS technologies (for example, any system that helps drivers lane keeping operation by generating slight torque in the steering wheel) were not anticipated when the current safety regulations were established, so they cannot legally be tested on public roads without special ministerial approval. MMC received such approval for technologies employed in its ITS-ASV passenger car. Consequently, MMC was able to conduct proving and evaluation tests (all aimed at commercialization of the new technologies) on public roads and was additionally able to help the Ministry of Land, Infrastructure and Transport establish standards for ITS technologies.

2. The ITS-ASV approved by the Minister of Land, Infrastructure, and Transport

With the ITS-ASV (Fig. 1), MMC conducted tests on public roads of eight technologies (Table 1) including three technologies for which the Minister of Land, Infrastructure, and Transport granted specific approval.

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Table 1 Main technologies of ITS-ASV

Active safety technologies	
Light distribution control headlight (Variable light distribution headlight) (Fig. 2)	The distribution of light from the headlights is optimized in accordance with driving conditions (vehicle speed), driver inputs (steering wheel angle), and the road shape (from navigation data) for maximal nighttime visibility.
Advanced high-mount stop lamp (Deceleration-rate-dependent braking warning system) (Fig. 3)	The illuminated width of the high-mount stop lamp is altered in accordance with the vehicle's deceleration rate. Indication of the deceleration rate to the drivers of following vehicles helps prevent a rear collision.
Lane trace assist (Lane trace assisting system) (Fig. 4)	White lane marking on the road surface are detected using a CCD camera mounted on the rearview mirror, and slight torque is constantly generated in the steering wheel to help the drivers lane keeping operation. Thus, effort for the driver is reduced and safety is enhanced.
Driver alertness monitor (Anti-doze warning system)	The frequency with which the driver blinks and the durations of periods when the driver's eyes are closed are monitored using a compact camera mounted on the instrument panel. The driver's level of alertness is inferred from these variables. When the driver is deemed to be asleep at the wheel or otherwise insufficiently alert, audible and visual warnings are issued.
Night pedestrian monitor (System for providing information on presence of pedestrians in front of vehicle at night)	Road conditions in front of the vehicle are monitored using an infrared camera mounted in the center of the front grille, and information on the presence of pedestrians is provided to the driver audibly and visually.
Head-up display (Advanced information display system)	Low-alertness warnings and other warnings and information are projected onto the windshield and thus conveyed to the driver with great efficiency.
Passive safety technologies	
Pedestrian injury mitigating body (Shock-absorbing body structure for reduced collision on pedestrian)	In case a vehicle-to-pedestrian collision cannot be avoided using active safety technologies, the front of the body is given a shock-absorbing structure to minimize the extent of pedestrian injuries.
Fundamental automotive technologies	
Voice-control system (Human interface technology for reduced driver's effort)	The driver is able to control major navigation, audio, and climate-control functions by means of spoken commands and without taking his/her eyes off the road. Thus, effort for the driver is reduced and safety is enhanced.

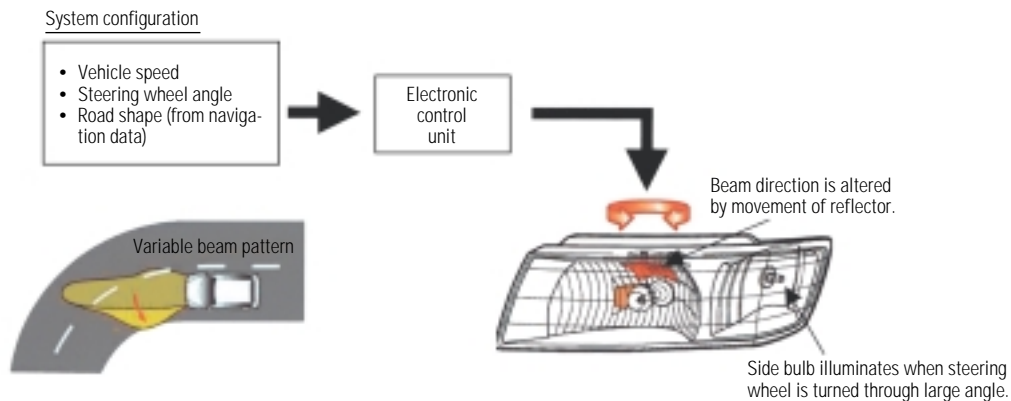


Fig. 2 Light distribution control headlight

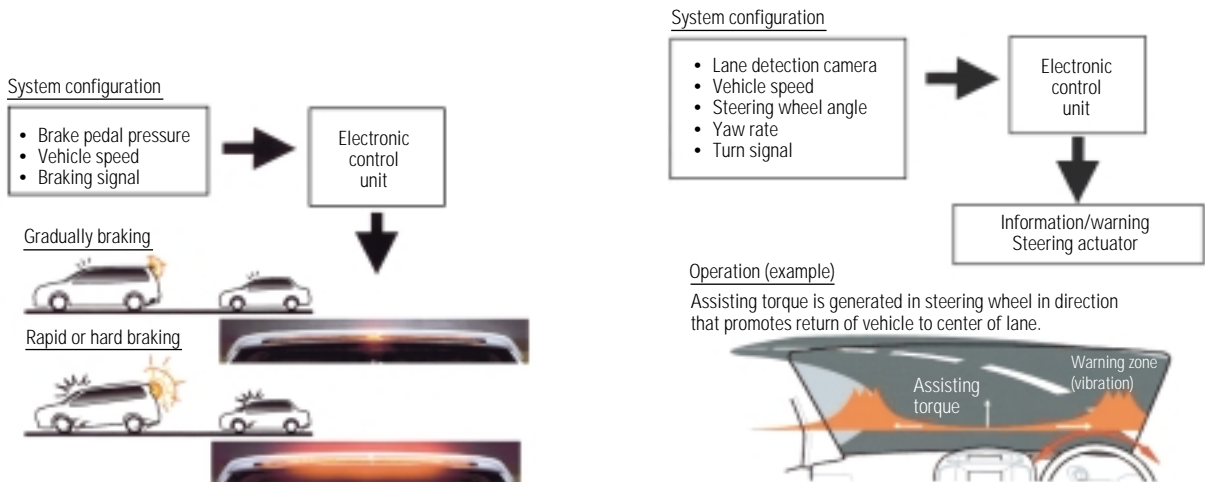
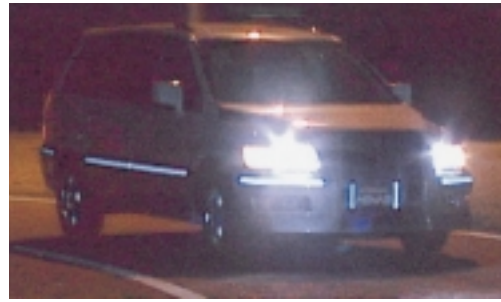


Fig. 3 Advanced high-mount stop lamp

Fig. 4 Lane trace assist

Table 2 Relaxed items of safety regulations

Approved technology	Relaxed items of safety regulations
Light distribution control headlight (Variable light-distribution headlight)	Article 32 (headlights), items 1, 3, 4, 8
Advanced high-mount stop lamp (Deceleration-rate-dependent braking warning system)	Article 39, item 2 (auxiliary stop lamps) Article 42 (restrictions on lamp colors, etc.), items 5, 7
Lane trace assist (Lane trace assisting system)	Article 11, item 1 (steering systems) Article 20, item 5 (drive control systems)

**Fig. 5 Nighttime test scene**

In the tests, MMC evaluated the functionality and practicality of the technologies on urban roads, mountain roads, and in various other public road environments that cannot be replicated on a test track. A wide range of drivers of both sexes took part in the tests.

3. Relaxed items of safety regulations (Table 2)

Japan's current safety regulations do not make sufficient provision for new ITS technologies, so MMC was initially unable to conduct tests on public roads without violating or potentially violating nine items pertaining to headlights, steering systems, and other systems. These nine items were relaxed by the ministerial approval obtained by MMC.

4. Overview of tests conducted on public roads

The test vehicle carries control devices (including numerous general-purpose microcomputers) and measuring instruments, so its weight, current consumption, and other specifications differ from those of the base vehicle. In contrast to operation on a closed test track, operation on public roads is accompanied by the risk of unexpected obstacles. Consequently, MMC was required to submit general plans and detailed plans of its public-road tests to the Ministry of Land, Infrastructure and Transport and to effect strict control over the tests.

MMC conducted some of the tests at night. In the nighttime tests (Fig. 5), which dealt mainly with the light distribution control headlight, MMC was able to verify the practical benefits of new technologies to a much greater extent than would have been possible on a test track.

5. Summary

Numerous driver support systems potentially offer increased automotive safety and convenience, but their commercialization will require successful solutions to numerous technological and social issues (applicability to different environments; suitable human interfaces; compatibility with existing transport systems; the ease with which drivers can familiarize themselves with new systems and accept them as part of their usual driving experience; and so on). As driver support systems become more advanced, evaluation and proving by means of tests conducted on public roads will become increasingly important if solutions are to be found.

MMC will continue working hard on new ITS technologies with a view to enabling commercial adoption of driver support systems that deliver increased safety and convenience to automobile users everywhere.

References

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