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(R) Design Criteria—Driver Hand Controls Location for Passenger Cars, Multipurpose Passenger Vehicles, and Trucks (10 000 GVW and Under)

Foreword—The question of driver hand control location is a complex one. Past research (References SAE SP407, SAE J1139, 2.1.2.1, and 2.1.2.2) indicates that errors and response times increase when hand controls are not located in their expected location. There is no solid evidence linking accidents with the inability to locate a control in a timely manner or to the inadvertent operation of automotive controls.

Nevertheless, to enhance ease of use, the location of controls should be based, insofar as possible, on performance rather than aesthetic considerations and must be governed by human engineering practice as it pertains to hand reach, visibility, identification, and operating mode. These considerations may be mutually exclusive, in certain vehicles, because of conflicting design requirements. In these cases, the recommended practice should be followed starting with the highest priority considerations until all available control location space has been used.

Any restriction in the location of controls and displays must respect the need to accommodate not only safety requirements and serviceability, but also the spatial requirements necessary to package the components behind the control and display surface. These restrictions in control locations are not intended to preclude the adoption of control innovations or inventions that may be superior to known technology and which could result in safer, more efficient operation of the vehicle. It should be recognized that different classes of vehicles such as heavy trucks may require different control locations because of their distinct environment.

- 1. Scope**—The purpose of this SAE Recommended Practice is to describe design criteria pertaining to the location and labeling of hand controls, including embedded displays and controls when displayed, necessary to or frequently used during the operation of passenger cars, MPVs, and trucks 10 000 GVW and under designed for left-hand drive operation. The results of SAE human factors research have strongly influenced these recommendations, specifically in the area of driver reach, control-locating performance, and control location expectancies. Deviations from this recommended practice should be made only after careful study of the various SAE publications on these subjects. This document does not include hand-held devices such as remote controls or cellular phones.

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2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J287—Driver Hand Control Reach

SAE J1050a—Describing and Measuring Driver's Field of View

SAE J1139—Direction -of-Motion Stereotypes for Automotive Hand Controls

SAE SP 407—"Driver Expectancy and Performance in Locating Automotive Controls," McGrath, J. J., presented at SAE Congress, February 23-27, 1976

2.1.2 OTHER PUBLICATIONS

2.1.2.1 J. J. McGrath, "Analysis of Expectancies of European Drivers and Commonality of Automotive Controls Location on European Cars," Technical Memo. 247-1, Anacapa Sciences, September 26, 1974

2.1.2.2 UMTRI-89-15—"Instrument Panel Controls in Sedans: What Drivers Prefer and Why," Green, P., Paelke, G., and Clack, K. (1989), Ann Arbor: The University of Michigan Transportation Research Institute (NTIS No. PB 90 184235/AS)

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

SAE J1100—Motor Vehicle Dimensions

SAE J2402—Symbols for Motor Vehicle Controls, Indicators, and Tell-Tales

3. Definitions—Term Definitions for Driver Hand Controls

3.1 Control Reference Plane—A vertical longitudinal plane through the steering wheel center Y coordinate.

3.2 Control Operational Area—The area or region swept by those parts of a control which are activated or contacted by the hand while the control is in all the possible modes or positions. (See Figure 1.)

3.3 Control Display Area—The area which includes the identification of the control and those portions required to determine its position at any point within its range. It includes any indicators or tell-tales that are at a location remote from the control. It does not include, for example, bezels or manufacturers' type numbers. (See Figure 2 and SAE J1050a.)

3.4 Higher Priority Controls—Those hand operated controls which may need to be quickly accessed or are frequently used by the driver when the vehicle is in motion, or which should be operated while keeping the eyes and head in the normal driving position.

3.5 Lower Priority Controls—Those hand controls which are used at the driver's discretion or which are used infrequently.

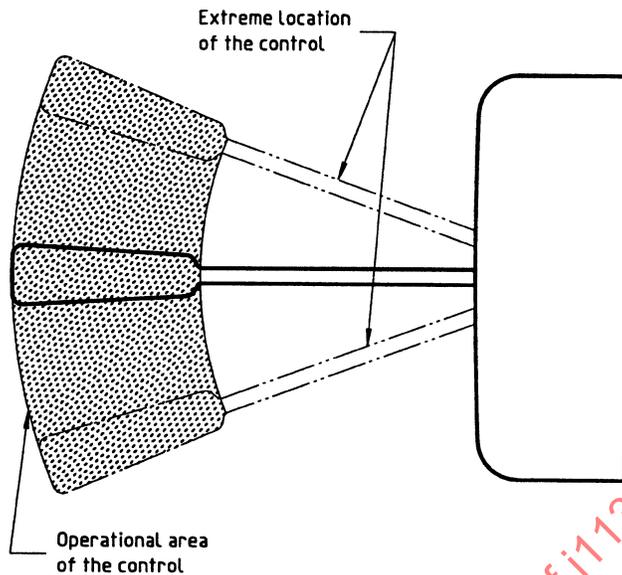


FIGURE 1—OPERATIONAL AREA OF A CONTROL

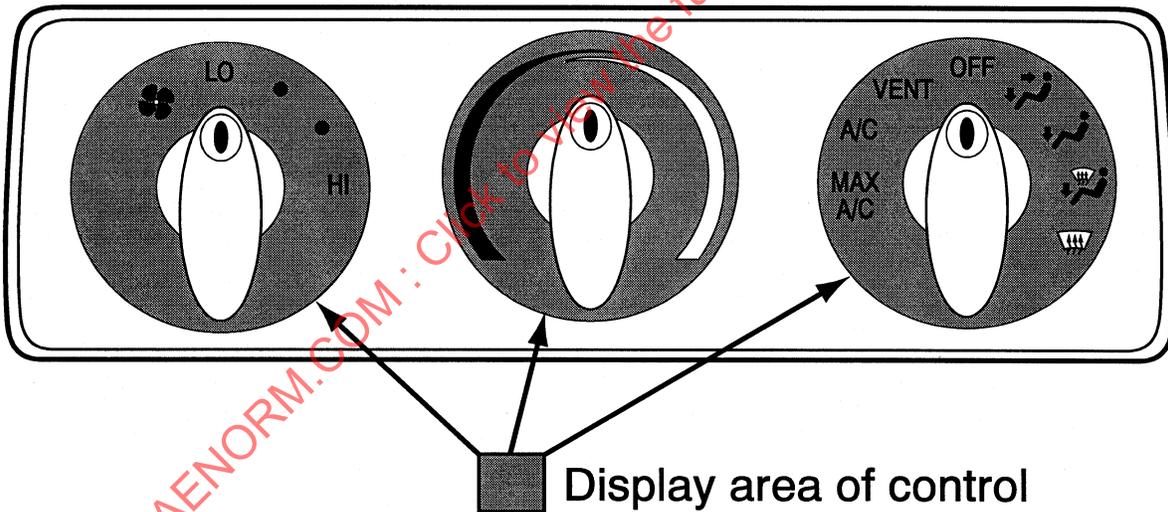


FIGURE 2—DISPLAY AREA OF A CONTROL

4. Design Criteria in Order of Priority

4.1 Control Location Priority—The operational area of the following higher priority hand controls should be within reach of a driver wearing a lap and shoulder restraint and the following lower priority hand controls should be within reach of a driver wearing a lap belt only. SAE J287 defines reach capability under specific conditions of finger grasp control operation for two restraint conditions; a diagonal non-extending shoulder strap with lap belt and lap belt only. Fingertip operated controls may permit greater reach, while full hand grasp operated controls may result in lesser reach. In addition, a diagonal extending shoulder strap may permit greater reach than a non-extending shoulder strap. See Table 1.

TABLE 1—CONTROL PRIORITY

Higher Priority Driver Hand Controls	Lower Priority Driver Hand Controls
Audible Horn	2-to-4 Wheel Drive Transfer
Audio (i.e., Volume, Selection Devices)	Airbag Disable
Climate Controls (Temp., fan)	Ashtray
Cruise Controls	Cigarette Lighter
Day/Night Mirror	Clock
Gearshift	Dome/Map Lights
Hand Brake	Electronic Transmission Shift Point
Hazard Flasher	Fog/Driving Lamps
Headlamp	Hood Release
Headlamp Dimmer/Flasher	Overdrive On/Off
Ignition	Panel Illumination Intensity
Power Door Lock	Power Seat Adjusters
Power Mirror	Remote Fuel Door Release
Power Windows	Remote Trunk Release
Rear Defroster	Steering Wheel Tilt/Telescope
Rear Washer/Wiper	Telephone Handset
Steering	Traction Assist
Turn Signal	Trip Odometer
Windshield Defroster	
Windshield Washer/Wiper	

- 4.2 Display Viewing Area**—The display area of the following driver hand controls, as defined in 3.3, should be within view of the restrained driver with head movement so as to permit identification. If redundant information is displayed in two different display areas, the redundant information should be within view of the driver in at least one of the display areas. Areas obscured by the steering control are defined in SAE J1050a. See Table 2.

TABLE 2—CONTROLS WHO'S DISPLAY AREA SHOULD BE IN VIEW

Higher Priority Driver Hand Controls	Lower Priority Driver Hand Controls
Audible Horn	2-to-4 Wheel Drive
Audio Controls	Airbag Disable
Climate Controls	Ashtray
Cruise Controls	Cigarette Lighter (except in the ashtray)
Hazard Flashers	Clock
Headlamp	Dome Map Lights
Manual Gearshift Pattern	Electronic Transmission Shift Point
Power Door Lock	Fog/Driving Lamps
Power Mirror	Overdrive On/Off
Power Windows	Panel Illumination Intensity
PRNDL Display	Traction Assist
Rear Defroster	Trip Odometer
Rear Washer/Wiper	
Windshield Defroster	
Windshield Washer/Wiper	

4.3 Labels—The following driver hand controls should be labeled with printed words or symbols or both. The label may identify the function of the control or may describe its settings. In general, controls should have both identification and setting labels. However, in some cases, setting labels alone are adequate to identify the control function, or the uniqueness (shape, etc.) of the control is so widely recognizable that identification labels are not needed (e.g., ignition, if key cylinder). The driver hand controls shown in Table 3 are based on the following application of human factors principles.

- a. Control functions should be identified with words, symbols, or both when they are:
 - 1. High priority
 - 2. Designed in such a way that visual, spatial, or location cues from the control itself, or its settings, are not sufficient for identifying them
 - 3. In unexpected locations
 - 4. Highly similar to adjacent controls
 - 5. New or unfamiliar
- b. Controls settings should be identified with words, symbols, or other perceptible indicators when they are:
 - 1. Associated with high priority functions
 - 2. Not apparent from the shape of the control or the operation of the control

TABLE 3—CONTROLS THAT SHOULD BE LABELED

Identification	Both Identification and Setting	Setting (Identification Optional)
Audible Horn	Airbag Disable	2-to-4 Wheel Drive Transfer
Hand Release for Foot Operated Parking Brake	Climate Control Fan	Audio Controls
Hazard Flasher	Electronic Transmission Shift Point	Automatic Transmission
Hood Release	Fog/Driving Lamps	Climate Control Air Distribution
Power Seat Adjusters	Instrument Illumination	Clock
Remote Fuel Release	Master Lighting Control	Cruise Controls
Remote Trunk Release	Overdrive On/Off	Dome Light
Windshield Defroster	Power Mirror	Power Door Lock
	Rear Defroster	Power Windows
	Rear Washer/Wiper	
	Traction Assist	
	Windshield Washer/Interval Wipe	

4.4 Control Location Relative to Reference Plane—Driver hand controls should be located in the standard locations (shown in Table 4) if they meet one of the following conditions:

- a. They are classified as high-priority driver hand controls (under 4.1) or
- b. There is a very clear population stereotype for their location, or
- c. They are controls which must be accessed from more than one occupant position (e.g., must be accessed when the occupant is standing outside the vehicle)
- d. They are controls which must be accessed by both driver and passenger

The following driver hand controls should be located to the side of the reference plane indicated in Table 4 for left-hand drive vehicles (or in the location specifically called out in the subparagraphs which follow the table).

TABLE 4—CONTROL LOCATIONS

Left of Reference Plane	Right of Reference Plane
Hand release for foot operated parking brake	2-to-4 Wheel Transfer
Headlamp	Airbag Disable
Headlamp Dimmer/Flasher	Ashtray
Hood Release	Audio Controls (all except redundant controls)
Power Door Lock	Cigarette Lighter
Power Mirror	Climate Controls (all except redundant controls)
Power Seat Adjusters	Clock
Power Windows	Electronic Transmission Shift Point
Remote Fuel Door Release	Gearshift
Remote Trunk Release	Hand Brake
Turn Signal	Ignition
	Interior Day/Night Mirror
	Overdrive On/Off
	Telephone
	Windshield Defroster

4.4.1 The audible horn control should be located on the steering control, preferably in the center.

4.4.2 The hazard flasher should be located on or to the right of the reference plane.

4.4.3 The washer/wiper control(s) may be located either to the right or left of the reference plane. When both the gearshift and wiper controls are stalk mounted on the same side of the steering column, the washer/wiper should be physically differentiated from the gearshift and have an operational area that is closest to the steering wheel rim.

A differentiation between the operating modes of the washer/wiper control(s) and the headlamp control should exist when they are on the same side of the reference plane.

4.5 After meeting the criteria given in 4.1 through 4.4, other criteria for arranging controls may be applied. These include frequency of use, sequence of use, functional grouping, importance, user expectancy, and user preference. Information about driver preferences is given in 2.1.2.2.

4.6 There is a clutter effect if too many or varied controls are located in a given area. As the number of controls increase, so do the errors and response times. Care should be exercised in the design of the controls to provide differences in: appearance, tactile recognition, and the modes of operation. Examples of the types of conditions to be avoided include:

4.6.1 Climate control which is designed in such a way as to have the appearance of a radio.

4.6.2 Parking brake and hood release which are located side by side, and look alike.

4.7 **Other Controls**—Controls not specifically mentioned in this document should be located insofar as possible in accordance with SAE publications concerning driver reach, control-locating performance, and expectancies (References SAE J287, SAE J1050a, and SAE J1139).