

	SURFACE VEHICLE RECOMMENDED PRACTICE	
	SAE	J1139 MAR2010
	Issued Revised	1977-09 2010-03
Superseding J1139 JUL1999		
Direction-of-Motion Stereotypes for Automotive Hand Controls		

RATIONALE

This revision adds a recommended direction of motion for rotation of stalks mounted on the right side of the steering column, based on data provided by Japan. Unique motion stereotypes for Japan were noted in the figures. Direction-of-motion conventions were added for door-mounted power door lock controls, which are illustrated in a new Figure 6. Also, one subfigure in Figure 4 was redrawn for improved clarity.

1. SCOPE

The purpose of this SAE Recommended Practice is to present design recommendations for the direction-of-motion of hand controls found in passenger vehicles, multipurpose vehicles, and trucks. These recommendations are based on recent and past human factors research and are important considerations in the design of control layouts.

1.1 Background

Drivers develop expectations regarding the operating motions of various types of controls as a result of their accumulated experience with automotive and nonautomotive controls. To simplify the operation of controls for drivers, the direction-of-motion to operate these controls should conform to these expectations or stereotypes. Failure to conform to direction-of-motion stereotypes can lead to actuation errors, longer operating times, and an increase in driver workload.

A number of past studies have addressed the issue of direction-of-motion stereotypes for various automotive hand controls (1, 2, 3, 4, 8). These results indicate that the strength of a stereotype varies with the control configuration (control type, location, orientation, and mounting plane). SAE has recently completed research (6,7) aimed at broadening the scope and generality of the previous findings by addressing other control orientations, including controls mounted on stalks and on inclined surfaces. Some specific control functions such as power windows and power mirrors were also studied. The SAE study demonstrated that stereotype strength is not related to driver age, gender, or handedness. This document is based on the SAE study, past research, and general human factors principles (10). This document supersedes Figure 1 of SAE J1139 (9).

Control labeling and tactile or shape coding are not addressed in this document; however, previous research (5) has shown that appropriate labeling and coding can improve the accuracy of control use.

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2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes and are not a required part of this document.

- [1] McGRATH, J.J. *SAE study of vehicle controls location*, Report No. 182-11, Anacapa Sciences, Inc., USA, 1974
- [2] McGRATH, J.J. *Driver expectancy and performance in locating automotive controls*, SAE SP-407, Society of Automotive Engineers, USA, 1976
- [3] BLACK, T.L., WOODSON, W.E., and SELBY P.H. *Development of recommendations to improve controls operability*, Report No. DOT-HS-6-01445, U.S. Department of Transportation, 1977
- [4] GREEN, P., KERST, J., OTTENS, D. GOLDSTEIN, S. and ADAMS, S. *Driver preferences for secondary controls*, Tech. Report UMTRI-87-47 (NTIS No. PB 90 150541/AS), University of Michigan Transportation Research Institute, 1987
- [5] JACK, D.D. *Rocker switch tactile coding and direction-of-motion stereotypes*, Proceedings of 29th Annual Meeting, Human Factors Society, 1985
- [6] MCFARLANE, J. and WIERWILLE, W.W. *Overview of a study on direction-of-motion stereotype strengths for automobile controls*, SAE Paper 910115, Society of Automotive Engineers, USA, 1991
- [7] MCFARLANE, J. and WIERWILLE, W.W. *Study of direction-of-motion stereotypes for automobile controls*, ISE Report 90-02, Virginia Polytechnic Institute and State University, USA, 1990
- [8] McGRATH, J.J. *Analysis of the expectancies of European drivers and the commonality of automotive control locations in European cars*, Report TM 247-1, Anacapa Sciences, Inc., USA, 1974
- [9] SAE J1139:1977, *Supplemental Information — Driver Hand Controls Location for Passenger Cars, Multi-Purpose Passenger Vehicles, and Trucks (10,000 GVW and Under)*, 4, Society of Automotive Engineers, USA
- [10] JSAE:1995, *Overview of a study on direction-of-motion stereotype strengths for automobile controls*, ISO/TC22/SC13/WG3 N167

3. DEFINITIONS

3.1 Control Configuration

A particular combination of control type, location, orientation, and mounting plane.

3.2 Direction-of-Motion Stereotype

For a given control configuration, the direction of control motion expected by a majority of people to achieve a given effect.

3.3 Stereotype Strength

Percentage of people who activate the control in a particular direction.

3.4 Controls for ON or INCREASE

Controls whose function is to turn something on/off or to increase/decrease some unspecified effect.

3.5 Controls for Specific Functions

Controls used to activate some specific function or achieve a specific effect such as: lock or unlock doors, raise or lower windows, and turn on headlamps, headlamp high beams, or windshield wipers.

4. DESIGN RECOMMENDATIONS

4.1 Introduction

Figures 1 to 6 show the recommended direction of motion and control orientation for controls mounted on each of three orthogonal planes: Horizontal (X-Y plane), Vertical-Transverse (Y-Z plane), and Vertical-Longitudinal (X-Z plane). Some of the figures also include inclined mounting planes. The direction-of-motion stereotypes are indicated by the solid arrows on each control configuration. Those control configurations which exhibited an exceptionally strong stereotype are identified in each figure. A few control configurations were found to have weak stereotypes. These are shown in the figures with an X drawn through them to indicate that they are not recommended control configurations.

4.2 Controls for ON or INCREASE (Figures 1 and 2)

Generally, for the control configurations shown, the direction stereotypes for ON or INCREASE are:

- up,
- forward,
- right,
- pull toward (push/pull knob or stalk), and
- rotate over the top.

Avoid rockers mounted in a fore/aft orientation on a surface sloping down and away from drivers, and toggles mounted in a fore/aft orientation on a vertical-longitudinal (X-Z) plane.

See Figure 1 for thumb wheel, toggle, lever and linear-slide controls, rotary and push/pull knobs, and rocker switches.

See Figure 2 and 4.3.5 for stalk-mounted controls.

4.3 Controls for Specific Functions

4.3.1 General

A variety of controls have been used for controlling specific functions in motor vehicles. Some controls in common use for specific functions are discussed here. Other controls may also be appropriate for these functions. It is not the intent of this document to restrict the type of control which may be used for a specific function.

Recommendations for controls which regulate a component movement (e.g., power mirror control) are given in Figures 3 to 5. Stalks which control turn signal, headlamp, and wiper functions are discussed in 4.3.5.

As a general rule, stereotypes are strongest when the orientation and motion of the control correspond to the orientation and motion of the controlled element. For example, a strong stereotype exists for a toggle control mounted in the X-Z plane that, when toggled fore/aft in X, controls the fore/aft motion of a seat; the same control if toggled up/down in Z could control the up/down motion of the seat.

4.3.2 Power Mirror Controls (Figure 3)

Direction labels on the 4-way pad control and arrows on the joystick control indicate stereotypes for moving the mirror field of view up, down, left, or right. These labels are used for illustration purposes only and are not part of this document. Stereotypes are very strong for mounting planes angled 30 degrees or more out from the door plane so the switch faces the driver. Mirror switches mounted in a vertical-transverse plane also have very strong stereotypes. It is likely that mounting planes inclined as much as 45 to 60 degrees from vertical-transverse toward horizontal would also produce very strong stereotypes, but these mounting planes were not included in the SAE study. The 4-way pad switch should not be mounted in the door plane (vertical-longitudinal).

Avoid mounting power mirror switches on surfaces that slope down and away from drivers.

4.3.3 Power Window Controls (Figure 4)

In Figure 4, the solid arrows indicate the control and the direction to lower the left front window. Toggle or rocker controls which are mounted on surfaces that are horizontal or angled up from horizontal (0 to 60 degrees) and with a 2x2 fore-aft switch configuration, have a very strong stereotype for both window selection (left, right, front, rear) and direction of operation. A 2x2 switch configuration mounted on a vertical plane parallel with the door panel and all 1x4 switch configurations are not recommended, because the switch layout does not correspond to the window layout (in plan view).

Avoid mounting power window switches on surfaces that slope down and away from drivers.

4.3.4 Window Regulators (Crank) (Figure 5)

Window cranks on both the left and right side should be oriented so that the handle points forward and is about 45 degrees above horizontal when the window is fully raised. Angles from 15 to 75 degrees above horizontal are acceptable. It is also desirable that the handle points forward when the window is fully lowered, however other concerns such as rotational effort and travel must be considered.

To lower a left-side window, the crank on the left-side door should be rotated clockwise. To lower a right-side window, the crank on the right-side door should be rotated counterclockwise.

4.3.5 Stalk-Mounted Controls (Figure 2)

4.3.5.1 Turn Signal

Raising or lowering the left stalk on left-hand drive vehicles is the expected motion for signaling a right or left turn respectively.

4.3.5.2 Wipers

Rotating the left stalk over the top is the direction stereotype for turning on windshield wipers. The expected motion to turn on windshield wipers mounted on the right stalk is either raising the stalk or rotating it over the top.

4.3.5.3 Headlamps

Rotating the left or right stalk over the top is the direction stereotype for turning on the headlamps. Pulling the left or right stalk is the expected motion for turning the headlamp high beam on.

4.3.6 Power Door Locks (Figure 6)

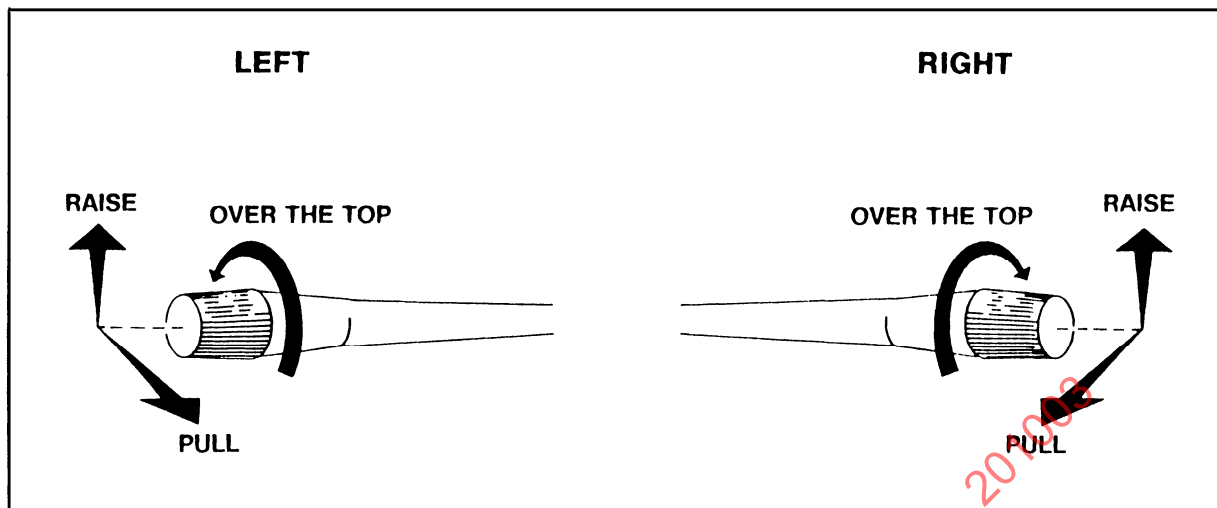
No stereotype has been found for commonly used configurations of rocker switches. However, the conventions shown in Figure 6 are widely used by vehicle manufacturers (per 2010 North American International Auto Show benchmarking), and should be followed.

Because there is no stereotype, labels should be used to identify the lock and unlock settings of rocker or toggle switches that control power door locks. Tactile coding should be considered (5).

CONTROL TYPE	MOUNTING PLANE		
	Horizontal (X-Y)	Vertical/Transverse (Y-Z)	Vertical/Longitudinal (X-Z)
THUMB WHEEL			
TOGGLES AND LEVERS			
LINEAR SLIDE			
ROTARY KNOB			
PUSH PULL			
ROCKER SWITCHES			
Inclined Downward			

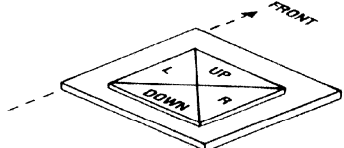
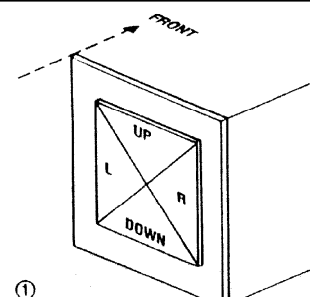
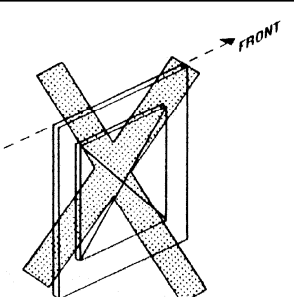
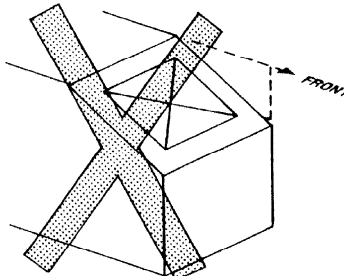
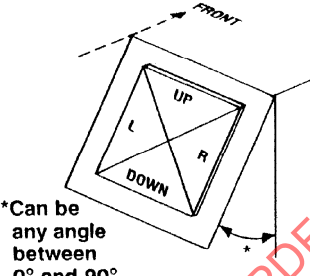
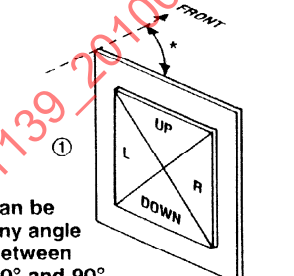
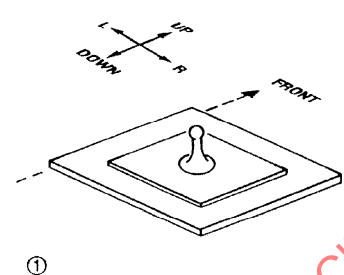
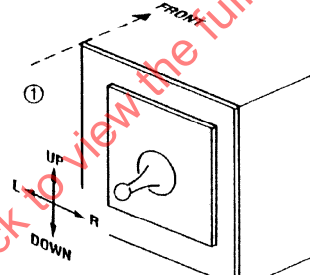
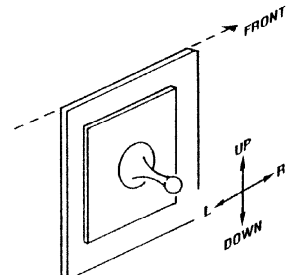
- Solid arrows indicate direction of motion for ON or INCREASE.
- The dashed reference line pointing to the front is parallel to the vehicle x-axis.
- Crossed-out configurations are not recommended.
- ① Indicates a very strong stereotype.
- ② Indicates a very strong stereotype when mounted to the right of the steering wheel in a left-hand drive vehicle.
- ③ No stereotype in Japan; not recommended in Japan.
- ④ Moderately strong stereotype on right side in Japan.
- ⑤ No stereotype on left in Japan.
- ⑥ Strong stereotype on right in Japan.
- ⑦ No stereotype on right in Japan.

FIGURE 1 - CONTROLS FOR ON OR INCREASE



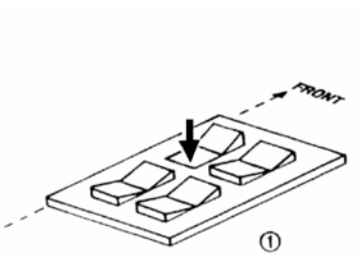
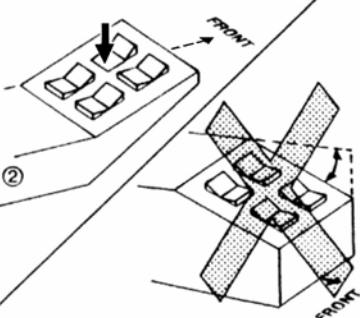
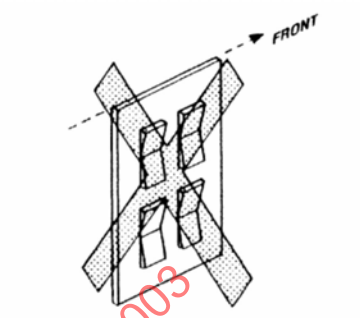
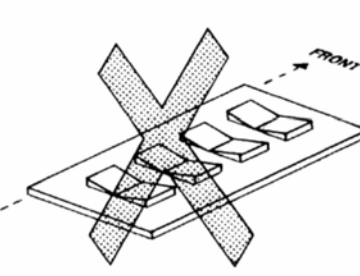
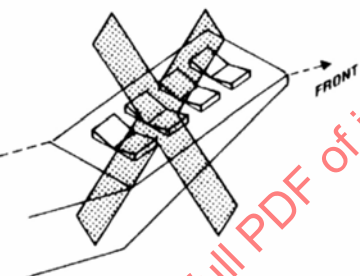
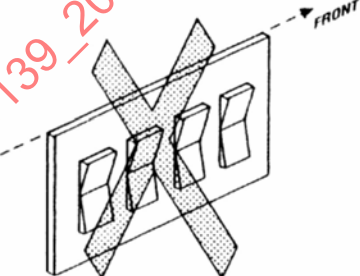
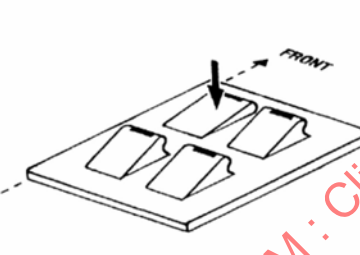
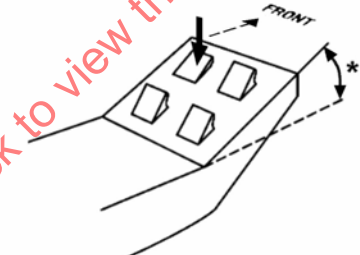
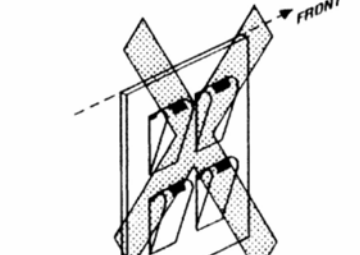
RAISE: In Japan, there is a very weak stereotype in favor of lowering, not raising.
PULL: In Japan, pull is a very weak stereotype.

FIGURE 2 - STALK CONTROLS: SOLID ARROWS INDICATE DIRECTION OF MOTION FOR ON OR INCREASE

CONTROL TYPE	MOUNTING PLANE		
	Horizontal (X-Y)	Vertical/Transverse (Y-Z)	Vertical/Longitudinal (X-Z)
4-WAY PAD			
Inclined Surface			
JOYSTICK			

- For 4-way pad controls, the letters (R, L, UP, or DOWN) indicate the area of the control to be activated to move the field of view to the right, left, up, or down.
- For joysticks, solid arrows indicate the direction-of-control motion for the corresponding field of view motion.
- The dashed reference line pointing to the front is parallel to the vehicle x-axis.
- Crossed-out configurations are not recommended.
- ① Indicates a very strong stereotype.
- The 4-way pad mounted in an X-Y plane is a very strong stereotype to the right of the driver in a right-hand drive vehicle.

FIGURE 3 - POWER MIRROR CONTROLS

CONTROL TYPE	MOUNTING PLANE		
	Horizontal (X - Y)	Angled Up/Down from Horizontal	Vertical/Longitudinal (X - Z)
TOGGLE OR ROCKER 2 x 2			
			
PUSH/PULL			
		* Any angle from 0° to 45°	

- Solid arrows indicate the direction of motion to LOWER the LEFT FRONT window.
- The dashed reference line pointing to the front is parallel to the vehicle x-axis.
- Crossed-out configurations are not recommended.
- ① Indicates a very strong stereotype in US; moderate stereotype in Japan.
- ② Indicates a very strong stereotype when angled up by as much as 60°.

FIGURE 4 - POWER WINDOW CONTROLS