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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1139

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Submitted for recognition as an American National Standard

Direction-of-Motion Stereotypes for Automotive Hand Controls

***Foreword*—**This Document has changed only to comply with the new SAE Technical Standards Board format. Definitions changed to Section 3. All other section numbers have changed accordingly.

***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. This document supersedes Figure 1 of SAE J1139 (9).

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).

Nearly all of the previous research on direction stereotypes in motor vehicles has been conducted in the United States. The extent to which these stereotypes apply to drivers of other nationalities or cultures, or to operators of right-hand drive vehicles, is unknown at this time. There is a need for other countries to study their direction-of-motion stereotypes.

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 Applicable Publications—The following publications form a part of this specification to the extent specified herein.

1. McGrath, J.J., "SAE Study of Vehicle Controls Location" (Report No. 182-11), Santa Barbara, CA, Anacapa Sciences, Inc., March, 1974
2. McGrath, J.J., "Driver Expectancy and Performance in Locating Automotive Controls" (SAE SP-407), Warrendale, PA, SAE, February, 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), Washington, DC, US 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), Ann Arbor, MI, The University of Michigan Transportation Research Institute, October, 1987
5. Jack, D.D., "Rocker Switch Tactile Coding and Direction-of-Motion Stereotypes," Proceedings of the 29th Annual Meeting, Santa Monica, CA, Human Factors Society, 1985, pp. 437-441
6. McFarlene, J. and Wierwille, W.W., "Overview of a Study on Direction-of-Motion Stereotype Strengths for Automobile Controls" (SAE Paper 910115), Warrendale, PA, SAE, February, 1991
7. McFarlene, J. and Wierwille, W.W., "Study of Direction-of-Motion Stereotypes for Automobile Controls" (ISE Report 90-02), Blacksburg, VA, Virginia Polytechnic Institute and State University, August, 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), Santa Barbara, CA, Anacapa Sciences, Inc., September, 1974
9. SAE J1139 (SEP1977), "Supplemental Information—Driver Hand Controls Location for Passenger Cars, Multi-Purpose Passenger Vehicles, and Trucks (10 000 GVW and Under)," Vol. 4, SAE Handbook, Warrendale, PA, SAE
10. Benedict, D. and Rupp, G.L., "Additional Documentation for the Direction-of-Motion Recommended Practice," Letter to SAE Control and Display Subcommittee, Troy, MI, SAE, April, 1994

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. The strength of a direction stereotype is measured by the percentage of people who activate the control in that direction.

3.3 Controls for ON or INCREASE—Controls whose function is to turn something on/off or to increase/decrease some unspecified effect.

3.4 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 5 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.

- Solid arrows indicate the direction of motion for ON or INCREASE.
- The dotted reference line is parallel to the x-axis (front-rear) of the vehicle and points to the front.
- (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.
- **Crossed-out configurations are not recommended.**

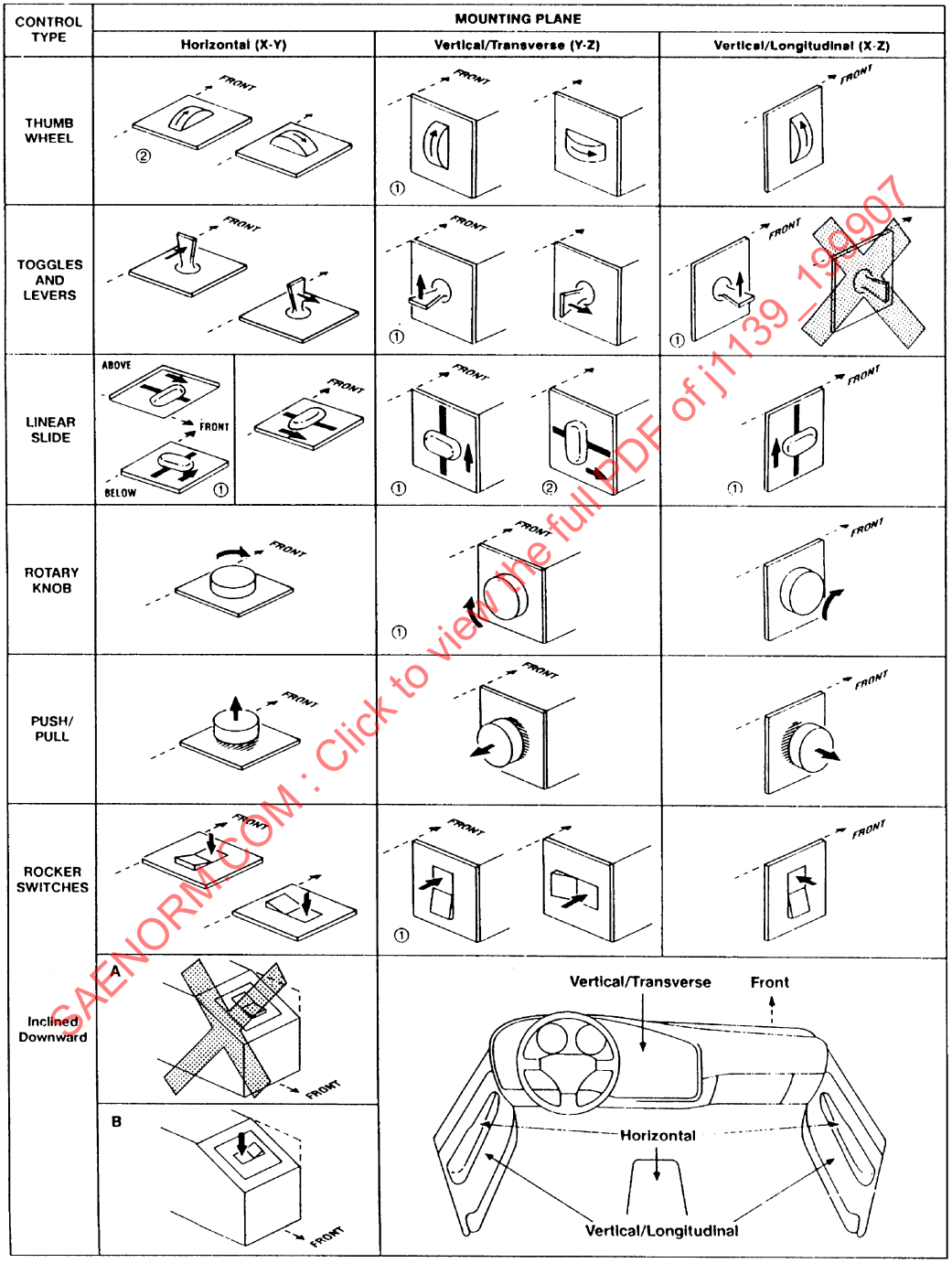


FIGURE 1—CONTROLS FOR ON OR INCREASE

• Solid arrows indicate the direction of motion for ON or INCREASE.

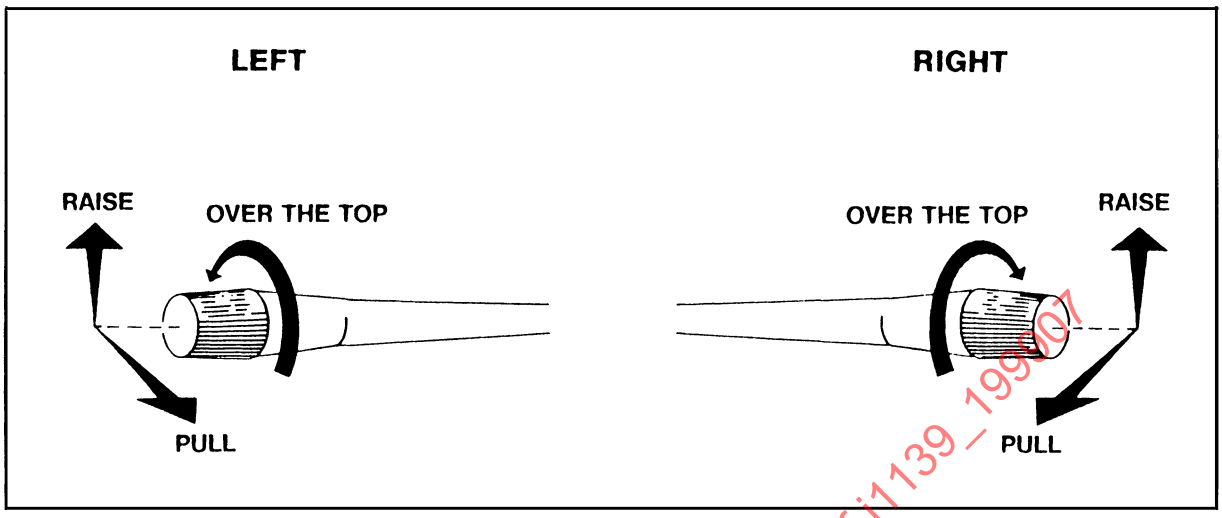


FIGURE 2—STALK CONTROLS FOR ON OR INCREASE

- For 4-way pad controls, the letters (R, L, UP, and DOWN) indicate the area of the control to be activated to move the field of view right, left, up, and down.
- For joysticks, solid arrows indicate the direction of control motion for the corresponding field of view motion.
- The dotted reference line is parallel to the x-axis (front-rear) of the vehicle and points to the front.
- ① indicates a very strong stereotype.
- **Crossed-out configurations are not recommended.**

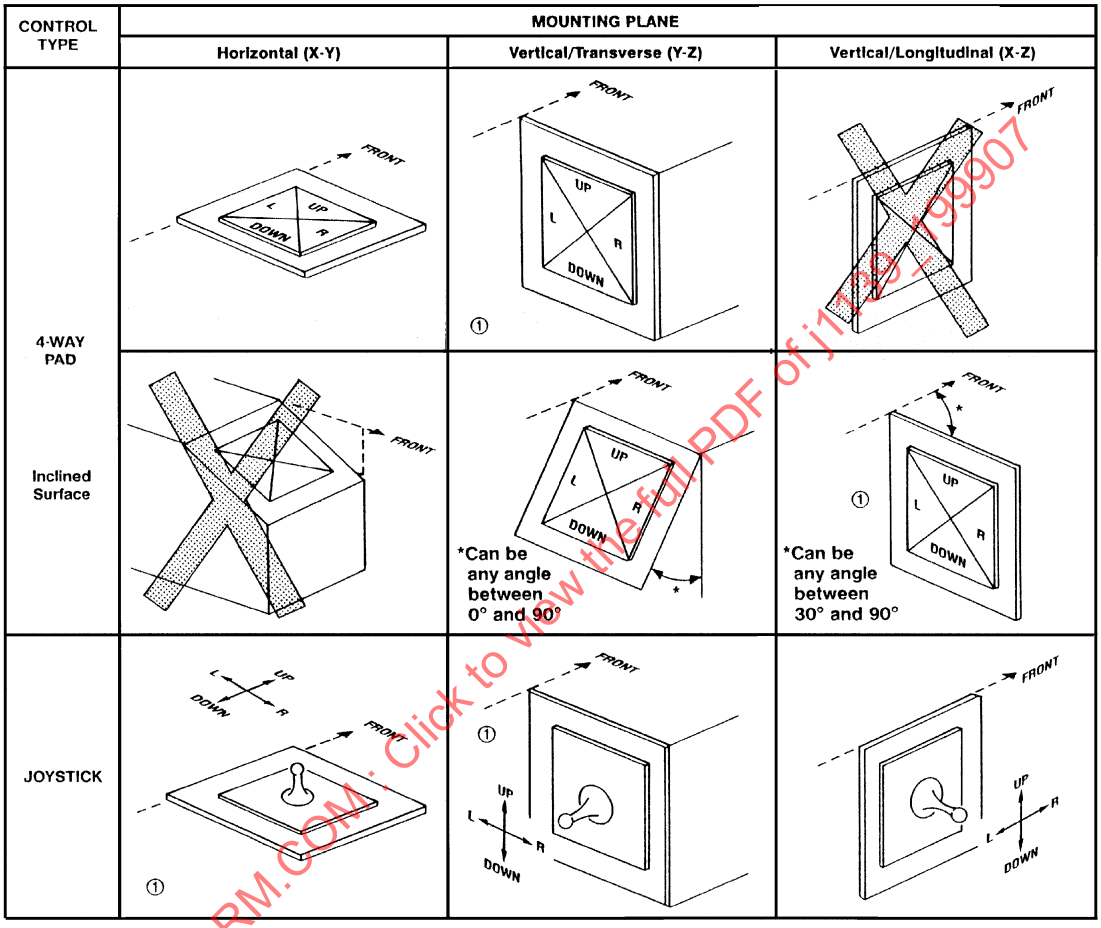


FIGURE 3—POWER MIRROR CONTROLS

- Solid arrows indicate the direction of motion to LOWER the LEFT-FRONT window.
- The dotted reference line is parallel to the x-axis (front-rear) of the vehicle and points to the front.
- ① indicates a very strong stereotype. ② indicates a very strong stereotype when angled up by as much as 60°.
- **Crossed-out configurations are not recommended.**

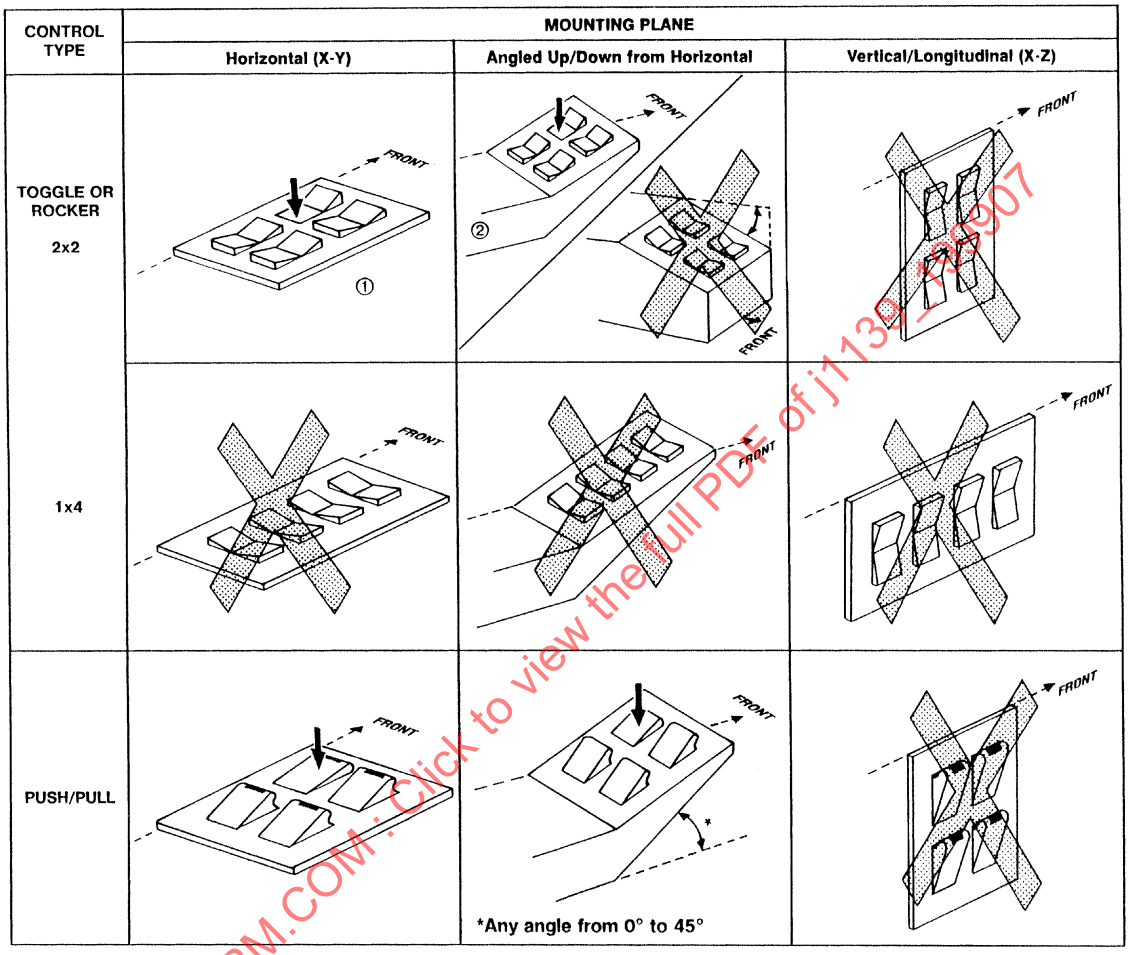
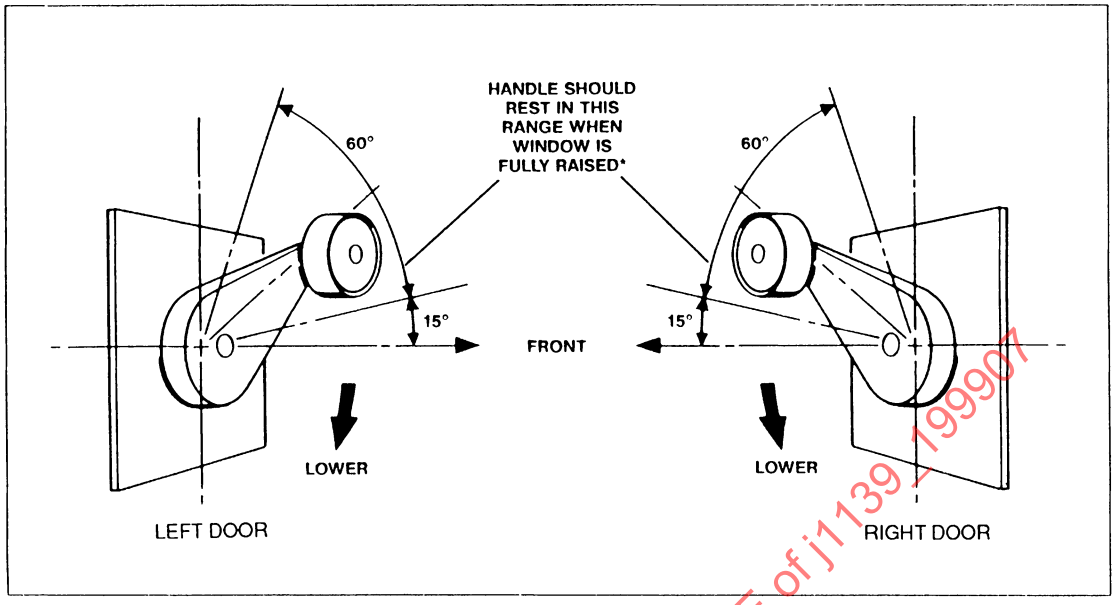


FIGURE 4—POWER WINDOW CONTROLS



*Desirable to be in this range when fully lowered also.

FIGURE 5—WINDOW REGULATORS (CRANK)

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.

4.3 Controls for Specific Functions—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 4.3.4.

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

4.3.1 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).