

## Chapter 3. General Guidelines for Controls

In this chapter are guidelines intended to be used for all the controls included in the handbook, including a section on the prevention of accidental actuation. Guidelines specific to each control are in chapter 4.

### 1. CONTROL SELECTION FACTORS:

Control selection should consider the following factors:

- a. The type of control selected and its location in the workspace should be compatible with applicable 5th-percentile-female through 95th-percentile-male body dimensions and with 5th-percentile-female strength.
- b. Controls should be selected and distributed in the workspace so that none of the user's limbs is overburdened.
- c. Hand manipulation is more precise than foot manipulation.
- d. Where right-handed manipulation of a control could create difficulties for a left-handed user, the control should be selected and located to minimize degradation for both right- and left-handed users.
- e. Allowances for special clothing (e.g., gloves) should be included.
- f. The control should act as if it were an extension of the user's limbs-it should be operable in terms of the natural motions of the arm, wrist, finger, leg, or foot. Control actions should not require awkward or unnatural positioning.
- g. The control interface should provide feedback so that the users know at all times what their control actions are accomplishing.<sup>(10,14)</sup>

### 2. CONTROL MOVEMENT RECOMMENDATIONS:

Control movements should conform to those shown in table 5 and figure 4.<sup>(10,22)</sup>

*Comment:* More complete discussions of control movement recommendations can be found in references 10 (pp. 432 to 433) and 23 (pp. 89 to 90).

**Table 5. Control movement recommendations.**

<b>To Do This</b>	<b>Move the Associated Control Like This</b>
Turn a function ON	Up, right, forward, clockwise, pull
Turn a function OFF	Down, left, rearward, counterclockwise, push
Move the pointer on an associated display to the right	Clockwise, right
Move the pointer on an associated display to the left	Counterclockwise, left
Move the pointer on an associated display upward	Up, back
Move the pointer on an associated display downward	Down, forward
Cause an increase in the controlled function	Forward, up, right, clockwise
Cause a decrease in the controlled function	Rearward, down, left, counterclockwise
Cause the controlled object to retract	Rearward, pull, counterclockwise, up
Cause the controlled object to extend	Forward, push, clockwise, down

VS = a very strong stereotype.

VSR = a very strong stereotype when the control is mounted to the right of the steering wheel in a left-hand-drive vehicle.

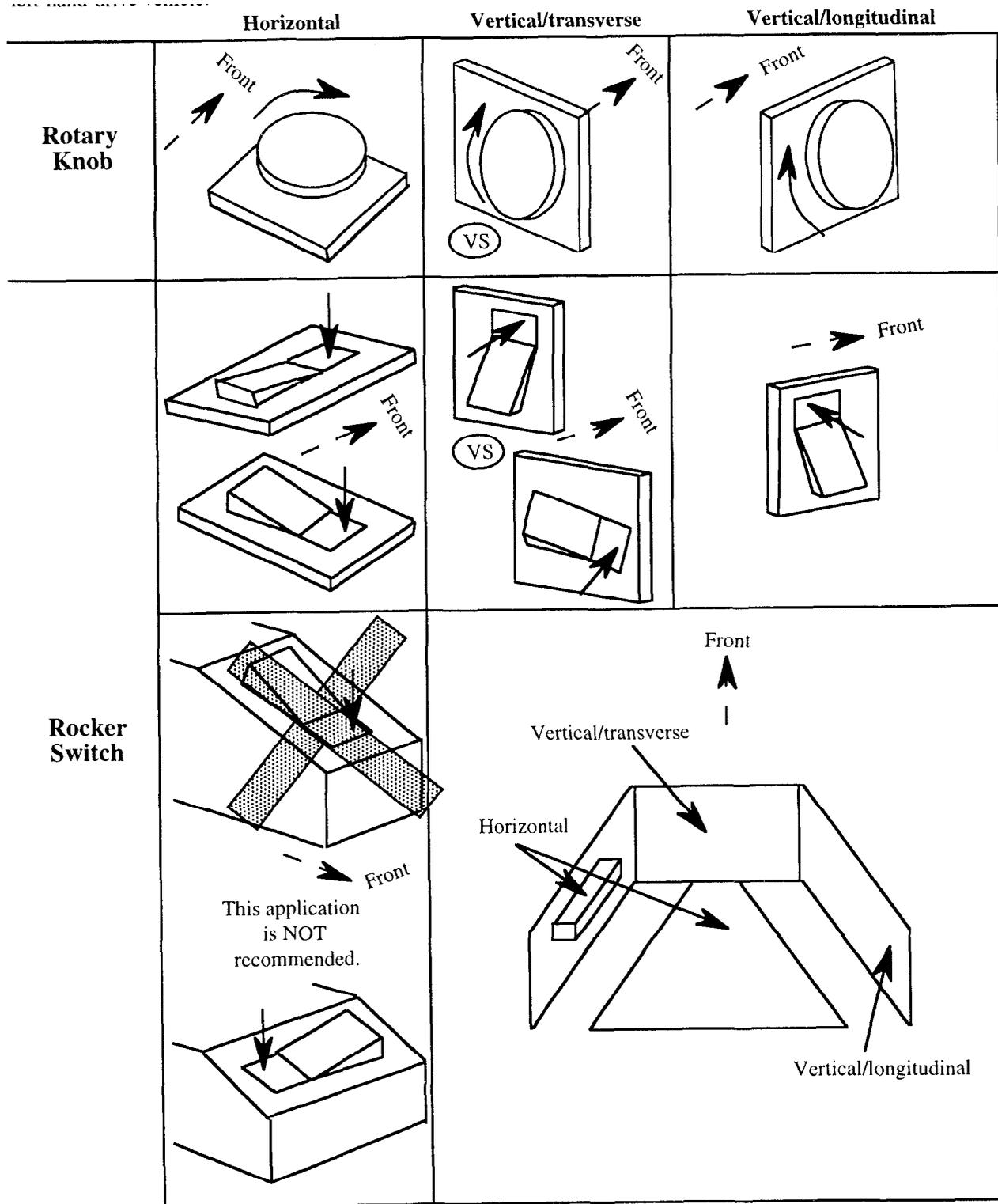
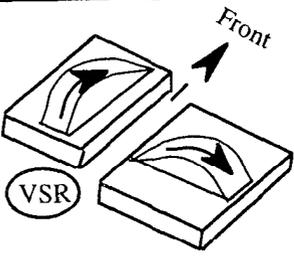
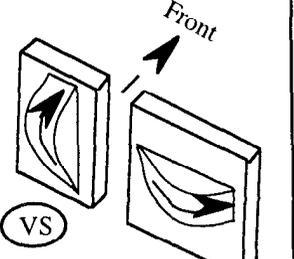
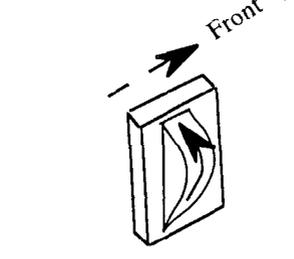
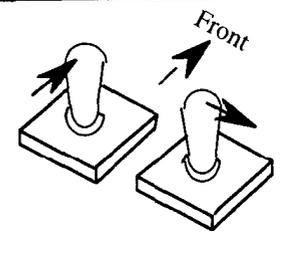
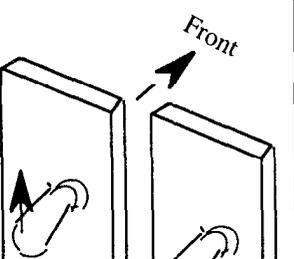
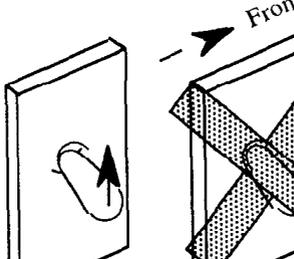
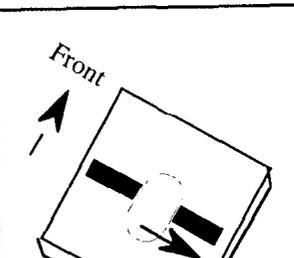
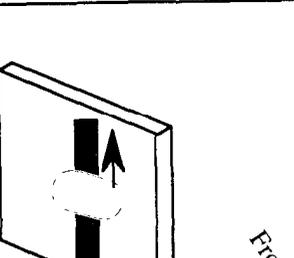
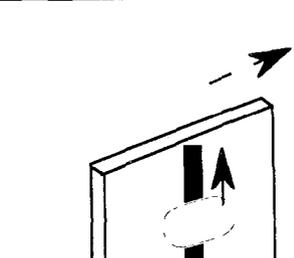


Figure 4. Some specific control movement recommendations for turning a device on or increasing a value.

VS = a very strong stereotype.

VSR = a very strong stereotype when the control is mounted to the right of the steering wheel in a left-hand-drive vehicle.

	Horizontal <sup>1</sup>	Vertical/transverse <sup>1</sup>	Vertical/longitudinal <sup>1</sup>
<b>Thumbwheel</b>	 <p>VSR</p>	 <p>VS</p>	
<b>Toggle Switch</b>		 <p>VS</p>	 <p>VS</p> <p>This application is NOT recommended</p>
<b>Slide Switch</b>		 <p>VS</p>	 <p>VS</p>

\* See key on first page of figure.

**Figure 4. Some specific control movement recommendations for tuning a device on or increasing a value (continued).**

### 3. MINIMUM CONTROLS SEPARATIONS:

Separations between adjacent controls should be as shown in table 6.<sup>(18,24)</sup>

**Table 6. Minimum separation distances between controls.<sup>1</sup>**

	Key Operated Switch	Knob	Legend Switch	Pushbutton	Rocker Switch	Rotary Selector	Slide Switch	Toggle Switch
Key Operated Switch	25 mm (1 in)	19 mm (.75 in)	25 mm (1 in)	13 mm (.5 in)	19 mm (.75 in)	19 mm (.75 in)	19 mm (.75 in)	19 mm (.75 in)
Knob	19 mm (.75 in)	25 mm (1 in)	50 mm (2 in)	13 mm (.5 in)	13 mm (.5 in)	25 mm (1 in)	13 mm (.5 in)	19 mm (.75 in)
Legend Switch	25 mm (1 in)	50 mm (2 in)	50 mm (2 in)	50 mm (2 in)	38 mm (1.5 in)	50 mm (2 in)	38 mm (1.5 in)	38 mm (1.5 in)
Pushbutton	13 mm (.5 in)	13 mm (.5 in)	50 mm (2 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)
Rocker Switch	19 mm (.75 in)	13 mm (.5 in)	38 mm (1.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	19 mm (.75 in)
Rotary Selector	19 mm (.75 in)	25 mm (1 in)	50 mm (2 in)	13 mm (.5 in)	13 mm (.5 in)	25 mm (1 in)	13 mm (.5 in)	19 mm (.75 in)
Slide Switch	19 mm (.75 in)	13 mm (.5 in)	38 mm (1.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	13 mm (.5 in)	19 mm (.75 in)
Toggle Switch	19 mm (.75 in)	19 mm (.75 in)	38 mm (1.5 in)	13 mm (.5 in)	19 mm (.75 in)	19 mm (.75 in)	19 mm (.75 in)	19 mm (.75 in)

\* All distances are edge to edge separations with single controls in their closest positions, and are for bare-handed operation. Separation distances for gloved-hand operation are not available for all controls in the handbook. Where they are available, they are given in the guidelines for those specific controls, and they should be used instead of the separation distances for bare-handed operation.

Where blind reaching is required, and controls are in the optimum space, provide at least 127-mm (5-in) separation between controls positioned vertically with respect to each other; provide at least 203.2-mm (8-in) separation between controls positioned horizontally with respect to each other. At the periphery of the manual work area, separation between adjacent controls should be 304.8 mm (12 in).

### Preventing Accidental Actuation of Controls

The guidelines in this section are generally applicable to the various control types covered in this handbook. Methods of preventing accidental actuation that are specific to particular control types are discussed in the sections on those controls.

### 4. CLEARANCES BETWEEN CONTROLS:

**Sufficient clearance should be provided between adjacent controls, between controls and the adjacent structure, and between the user's own body and the equipment so that critical controls can be easily grasped and manipulated in the normal manner. Special attention must be**

given to separating critical controls whose accidental operation could lead to loss of control or damage to a system.<sup>(10)</sup>

*Comment:* See table 6 for minimum separation distances between controls.

#### **5. NONINTERFERENCE WITH CONTROL OPERATION TIME:**

Any method of protecting a control from accidental actuation should not preclude operation within the time required.<sup>(13)</sup>

#### **6. METHODS OF PREVENTING ACCIDENTAL CONTROL ACTUATION:**

For situations in which controls must be protected from accidental actuation, one or more of the following methods, as applicable, should be used:

- a. Locate and orient the control so that the user is not likely to strike or move it accidentally in the normal sequence of control movements. When reorienting the control, care should be taken to ensure that recommended direction-of-movement relationships are not violated (see table 5).
- b. Recess, shield, or otherwise surround the control by physical barriers. The control should be entirely contained within the envelope described by the recess or barrier. A disadvantage of surrounding the control with barriers is the amount of panel space that must be used.
- c. Cover or guard the control. However, if a control is to be operated frequently, protective covers or guards cannot be used. Also, when a cover is in its open position, it should not interfere with operation of the protected control or adjacent controls.
- d. Provide the control with interlocks so that extra movement (e.g., a side movement out of a detent position, a pull-to-engage clutch) or the prior operation of a related or locking control is required.
- e. Provide the control with resistance (i.e., viscous or coulomb friction, spring-loading, or inertia) so that definite or sustained effort is required for actuation.
- f. Provide the control with a lock to prevent the control from passing through a position without delay when strict sequential activation is necessary (i.e., the control is moved to only the next position, then is delayed). However, locking is undesirable if the control is to be used frequently.
- g. Design the control for operation by rotary action.<sup>(13,25)</sup>

Table 7 shows recommended methods for preventing accidental actuation of the various control types in the handbook.

**Table 7. Recommended methods for preventing accidental actuation of controls.**

	Location	Orienta- tion	Recessing, Shielding, or Barriers	Covering	Interlock- ing	Increased Resistance	Locking	Operation by Rotary Action
Rotary Selector	✓		✓	✓	✓		✓	✓
Knob	✓		✓	✓	✓	✓	✓	✓
Toggle Switch	✓	✓	✓	✓	✓		✓ <sup>1</sup>	
Rocker Switch	✓	✓	✓	✓	✓	✓		
Joystick	✓		✓	✓	✓	✓		
Push-button	✓		✓	✓	✓	✓		
Foot Push-button	✓				✓	✓		
Legend Switch	✓		✓	✓	✓	✓		
Slide Switch	✓	✓	✓	✓	✓	✓	✓ <sup>2</sup>	
Key Operated Switch	✓		✓	✓	✓		✓ <sup>3</sup>	

<sup>1</sup> For three-position switches only.

<sup>2</sup> For switches with three or more positions only.

<sup>3</sup> Though they are recommended in the handbook for only two-position functions, reference 14 indicates they can be used for three-position functions also. Locking would be used only for three-position switches.

## **7. EMERGENCY CONTROL LOCATION:**

Emergency-function controls should be located where they can be identified and reached quickly. However, their location should not be such that accidental use or inadvertent contact could result in a serious system malfunction and/or ultimately injury to personnel. <sup>(14)</sup>

## **8. USE OF PROTECTIVE DEVICES FOR CONTROLS:**

Protective devices should not interfere with the normal operation of controls or the reading of associated displays. <sup>(26)</sup>

## **9. DESIGN OF CONTROLS COVERS AND GUARDS:**

Covers and guards should be designed to prevent accidental detachment. <sup>(26)</sup>

## **10. VISIBILITY OF COVERED CONTROLS:**

When a protective cover is used, control position should be evident without requiring cover removal. <sup>(26)</sup>

## 11. USE OF BARRIER GUARDS AS HANDHOLDS:

**Accidental actuation of controls can result when barrier guards are used as handholds. Barrier guards should be designed and located so as to minimize this problem.** <sup>(26)</sup>

*Comment:* This would seem most likely to occur upon entry to and exit from the vehicle, and this should be considered if barrier guards are used.