GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.2.1 DIRECTION OF MOVEMENT

To minimize operator error, control movements should conform to the following population stereotypes (for U.S. population only):

	Function	Control Action
a.	On, Start Run, Open	Up, right, forward, clockwise, pull
b.	Off, Stop, Close	Down, left, backward, counterclockwise, push
c.	Right	Clockwise, right
d.	Left	Counterclockwise, left
e.	Raise	Up
f.	Lower	Down
g.	Increase	Forward, up, right, clockwise
h.	Decrease	Backward, down, left, counterclockwise

5.4.1 GENERAL CHARACTERISTICS OF GRAPHIC RECORDERS (Cont'd)

COMPLIANCE CHECKLIST

	N/A	Yes	No	Reference/Comment
e.				
f.				
g.				
h.				
i.				

e. PLACEMENT OF RECORDERS—As devices which must be verified and attended by the operator, graphic recorders should in principle be located within the primary operating area rather than on back panels.

f. PAPER-SPEED ADJUSTABILITY—Not only should high paper speed option be provided to run out records for detachment, but a selection of lower speeds should be available to permit adjustment of the time scale so that rate-of-change information can be indicated.

g. ANNOTATION—It should be convenient to annotate recordings with date and time markings, with paper speed if varied from normal, with parameter identification, or with any other relevant information.

h. VISIBILITY—Recorder design should ensure that all data will be visible through the window of the recorder and not require open-door operation to expose it.

i. TYPE CHART PAPER—Is there a label inside the recorder advising the type chart paper to use?

ADVANTAGES	TYPE OF CODING					
	LOCATION	SHAPE	SIZE	MODE OF OPERATION	LABELING	COLOR
Improves visual identification.	X	X	X		X	X
Improves nonvisual identification (tactual and kinesthetic).	X	X	X	X		
Helps standardization.	X	X	X	X	X	X
Aid identification under low levels of illumination and colored lighting.	X	X	X	X	(When more illuminated)	(When more illuminated)
May aid in identifying control position (settings).		X		X	X	
Requires little (if any) training; is not subject to forgetting.					X	
DISADVANTAGES						
May require more room.	X	X	X	X	X	
Affects manipulation of the control (use of vast).	X	X	X	X		
Limited in number of available coding categories.	X	X	X	X		X
May be less effective if operator wears gloves.		X	X	X		
Controls must be viewed (i.e., must be within visual area and with adequate illumination present).					X	X

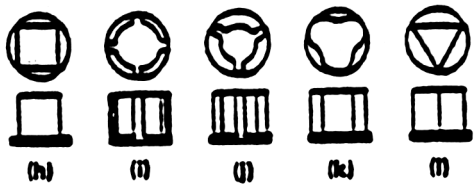
Exhibit 4-3. Advantages and disadvantages of various types of coding.

COMPLIANCE CHECKLIST

	N/A	Yes	No	Reference/Comment
5.3.3 DESIGN AND USE OF LEGEND LIGHT INDICATORS (Cont'd)				
b. LEGEND DESIGN				
(1) General legend design should be consistent throughout the control room.				
(2) Lettering should be simple, and should follow Guideline 5.1.3 for style and size.				
(3) Symbolic legends should be clear and unambiguous as to their meaning.				
(4) Text should be short, concise, and unambiguous.				
(5) Nomenclature and abbreviations should be standard, and consistent with usage throughout the control room and in the procedures.				
(6) Legends should be worded to tell the status indicated by glowing of the light.				
c. DISTINGUISHABILITY FROM LEGEND PUSHBUTTONS—Illuminated legend indicators should be readily distinguishable from legend pushbuttons by form, size, or other factors.				
d. COLOR CODING—Does the color coding for legend light indicators conform to specific plant standards?				

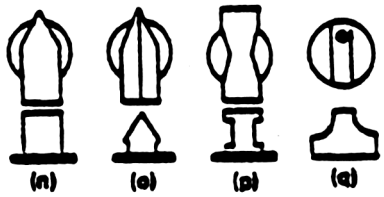
4.2.2 CODING OF CONTROLS (Cont'd)

e. ROTATING KNOB SHAPE OPTIONS (Cont'd)



Fractional Rotation Knobs: These knobs are for use on controls that do not require twirling or spinning, for which the adjustment range is less than one full turn; and for which the knob position is not a critical item of information.

Exhibit 4-6. Shape-coded knobs—fractional rotation.



Detent Positioning Knobs: These knobs are for use on discrete setting controls, for which position is critical.

Exhibit 4-6. Shape-coded knobs—detent positioning.

f. COLOR CODING

(1) Does the color code for controls conform to specific plant standards on color coding?

(2) When color coding is used to relate a control to its corresponding display, the same color should be used for both the control and the display.

(3) The color of the control should contrast with the panel background. (See Guideline 1.5.6.e.)

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.3.2 DESIGN AND USE OF NON-LEGEND LIGHT INDICATORS

Non-legend light indicators are represented by conventional pilot lights, bulls-eyes, and jewel lights. Color may be provided by a tinted cover glass or by a layer of colored material inside the cover.

a. IDENTIFICATION OF MEANING

(1) Where meaning is not apparent, labeling must be provided close to the light indicator showing the message intended by its glowing.

(2) Does the color code for pilot lights conform to specific plant standards?

(3) The color of the light should be clearly identifiable.

b. LIGHT INTENSITY—The illuminated indicator should be at least 10% greater in light intensity than the surrounding panel (as measured by a spot photometer).

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.3.2 ROUND PUSHBUTTONS

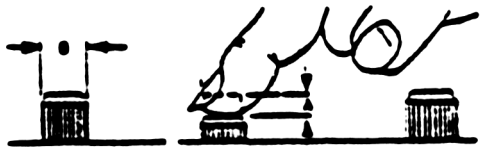
For best operation, pushbutton parameters should be as follows. (See Exhibit 4-7.)

a. Diameter (D), for fingertip operation (inches)
   (1) Unguarded and nonrecessed pushbuttons
   Minimum 0.375
   (2) Guarded or recessed pushbuttons
   Minimum 0.75

b. Diameter (D), for thumb or heel of hand operation (inches)
   Minimum 0.75

c. Displacement (A), for thumb or finger operation (inches)
   Minimum 0.125

d. Resistance (R), for fingertip operation (ounces)
   Minimum 10
   Maximum 40



	Dimensions (inches)		Resistance (ounces)	Displacement (A) (inches)
	Diameter (D)			
	Fingertip Operation	Thumb or Heel of Hand Operation	Fingertip Operation	Thumb or Finger Operation
Minimum	0.375*	0.75	10	0.125
Maximum	0.75		40	1.5

*Minimum diameter for guarded or recessed pushbuttons should be 0.75 inch.

Exhibit 4-7. Recommended dimensions for unguarded and non-recessed pushbuttons (finger or hand operated).

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.3.1 CHARACTERISTICS AND PROBLEMS OF LIGHT INDICATORS

By definition, light indicators show the existence of some state by the glowing of a light. They are transilluminated displays, although this term is too broad to identify them uniquely since it also covers certain back-lighted meters. These guidelines consider light indicators under their two subsets of non-legend light indicators (Guideline 5.3.2) and illuminated legend indicators (Guideline 5.3.3). Annunciators are a special class of light indicators, treated in the guidelines of Section 3.0

Since the presence of a light is the primary means by which light indicators communicate a message, it becomes essential that the light signal be physically reliable, that it be sensed unambiguously by the operator, and that it not be misinterpreted by him. These requirements hold for both classes of light indicators.

a. PRECAUTIONS TO ASSURE AVAILABILITY

The replacement of bulbs and determination of need for replacement should be provided.

b. PRECAUTIONS TO ASSURE UNAMBIGUOUS SENSING BY OPERATORS—Lights should not appear to be glowing when in fact they are off, or vice versa. To that end, ambient light sources should be selected, located, or controlled to avoid reflections or refractions. (See Guideline 1.5.3.)

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

4.3.3 LEGEND PUSHBUTTONS (Cont'd)

c. PROVISION FOR LAMP FAILURE (Cont'd)

(3) Legend pushbuttons should not short out during lamp replacement or be susceptible to inadvertent activation during the process of lamp removal or replacement.

(4) Legend covers should be keyed to prevent the possibility of interchanging the covers.

d. BARRIERS

(1) Barriers should be used when legend pushbuttons are contiguous.

(2) Barriers should have rounded edges.

e. LEGEND PUSHBUTTON DIMENSIONS—For maximum effectiveness of legend pushbutton controls, the following dimensions should be used (see Exhibit 4.8):

(1) Size (S) (inches)
Minimum 0.75
Maximum 1.5

(2) Displacement (A) (inches)
Minimum 0 (touch plate)
Minimum 0.125 (all others)
Maximum 0.250

(3) Barrier width (B_w) (inches)
Minimum 0.125

(4) Barrier depth (B_d) (inches)
Minimum 0.183
Maximum 0.250

(5) Resistance (ounces)
Minimum 10 (except touch plate)
Maximum 40

5.2.4 ORIENTATION OF MARKINGS ON FIXED-SCALE METERS (Cont'd)

b. END-POINT INDICATION ON PARTIAL-REVOLUTION SCALES

(1) Can the unit operator accurately read the end point indication on scales?

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.1 ROTARY CONTROL DESIGN PRINCIPLES

a. DIRECTION OF ACTIVATION – Rotary control settings should increase in value with a clockwise rotation.

b. ROTARY CONTROL SHAPE CODING – If rotary controls used for widely different functions are placed on the same panel, shape coding should be employed.

c. CODING SPECIFICATIONS – Shape-coded rotary controls should be:

(1) Visually identifiable.

(2) Tactually identifiable.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.2.3 ZONE MARKING

Zone markings should be used to show the operational implications of various readings such as "Operating Range," "Upper Limits," "Lower Limits," or "Danger Range." Exhibit 5-12 shows an example of good zone markings.

a. Zone markings should be conspicuous and distinctively different for different zones.

b. Zone marking should not interfere with reading of quantitative markings.

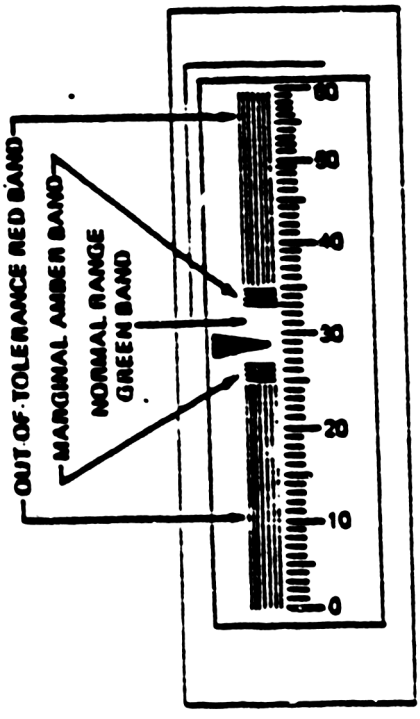


Exhibit 5-12. Example of good zone marking.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.3 KEY-OPERATED CONTROLS

a. USE—Key-operated controls should be used when system requirements dictate that the function being controlled should be secured against activation by unauthorized personnel. If key-operated controls cannot be justified in terms of security, they are probably not necessary and should not be used. Key-operated switches should not be used solely as a means of shape coding.

b. TEETH: SINGLE ROW—Keys with a single row of teeth should be inserted into the lock with the teeth pointing up or forward.

c. TEETH: DOUBLE ROW—If keys have teeth on both edges, they should fit the lock with either side up or forward.

d. ON-OFF ORIENTATION—Locks should be oriented so that the switch is OFF (or SAFE) when the key is in the vertical position.

e. KEY REMOVAL—Operators should not normally be able to remove the key from the lock unless the switch is turned to the OFF or SAFE position.

f. LABELING—Control positions should be labeled.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.2.1 DIRECTIONALITY OF MOVEMENT AND NUMBERING WITH FIXED-SCALE MOVING-POINTER METERS

a. CIRCULAR SCALES—Scale values should increase with clockwise movement of the pointer as in Exhibit 5-8.

b. VERTICAL STRAIGHT SCALES—Scale values should increase with upward movement of the pointer as in Exhibit 5-9.

c. HORIZONTAL STRAIGHT SCALES—Scale values should increase with pointer movement to the right as in Exhibit 5-10.

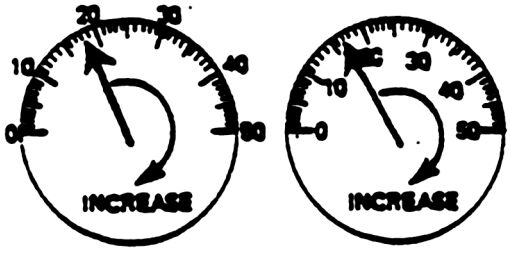


Exhibit 5-8. Direction of numbering and pointer movement with circular scales.

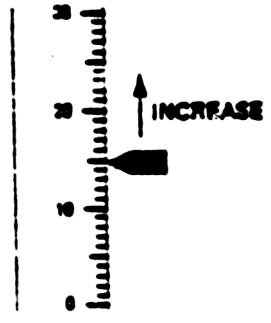


Exhibit 5-9. Direction of numbering and pointer movement for vertical fixed scales.

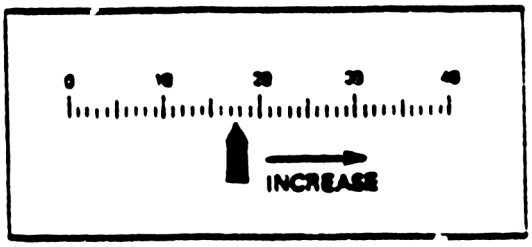


Exhibit 5-10. Direction of numbering and pointer movement for vertical fixed scales.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

4.4.4 CONTINUOUS ADJUSTMENT ROTARY CONTROLS

To ensure precise control along a continuous variable, continuous adjustment rotary controls are appropriate.

a. KNOBS – Knobs for continuous adjustment controls should be round in shape, with knurled or serrated edges.

b. POSITION INDICATION—When an indication of position is desirable, the pointer configurations shown in Exhibit 4-11 may be used. Where more accuracy is required, a line should be engraved (and filled with contrasting pigment) both on top and down the side of the pointer, as shown on the knob at the bottom of the exhibit.

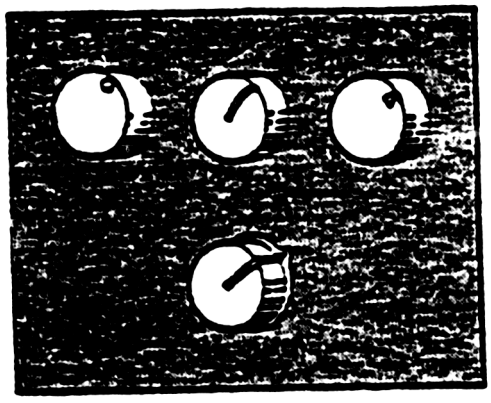
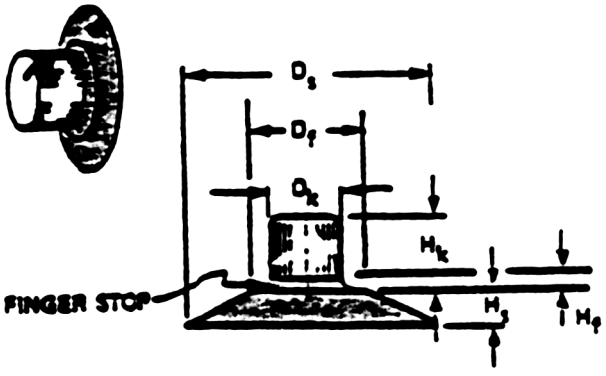


Exhibit 4-11. Continuous rotary control or position-selector knobs with markers.

APPENDIX A

VISUAL DISPLAYS 5.0
PRINCIPLES OF DISPLAY 5.1

"THIS PAGE INTENTIONALLY LEFT BLANK."



	Knob	F-Stop	Skirt
Diameter	0.75	1.25	2.0
Height	Combined 0.75		0.25

Exhibit 4-12. Minimum dimensions for rotary controls with knob skirts.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.6 COLOR CODING

The use of color as a coding medium in control rooms offers a valuable means of providing unambiguous, easily discriminable information to the operator. Among other applications, color coding can aid in the perception of warning signals, the identification of functional relationships, and the association of displays with related controls. When used in a coding system, color should always be redundant with some other cue. The information provided by a particular color should also be indicated in some other form, e.g., location, orientation, alpha-numerics, scale indications. Color can be effectively applied in both illuminated displays (e.g., mimics on panel surfaces and color pads) and in transilluminated displays (e.g., signal lights and CRTs). Color can be particularly useful as a means for organizing information and is especially effective as a means for coding low probability or very important events.

The benefits of color coding can be realized only if color is not used indiscriminately. Excessive use may, in fact, provide interference to effective control room operation. The same qualities which make color useful for coding can, if over used or inconsistently applied, result in unintended confusion and distraction. As colors are used more frequently and as the number of different colors used for coding increases, the attention-getting value of each color diminishes. Similarly, when a particular color has multiple meanings it both loses its attention-getting quality and may lead to confusion or operator error.

All coding schemes must be learned. Learning of a color code can be facilitated by keeping the code simple and by taking advantage of common usage in everyday life. Complex or poorly designed coding systems will detract from, rather than enhance, operator performance.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.5 ROTARY SELECTOR CONTROLS (Cont'd)

e. DIMENSIONS—Recommended dimensions for rotary selector switches are as follows (see Exhibit 4-13):

(1) Length (L) (inches)
Minimum 1.0

(2) Width (W) (inches)
Maximum 1.0

(3) Diameter (D) (inches)
Minimum 1.0

(4) Depth (H) (inches)
Minimum 0.625

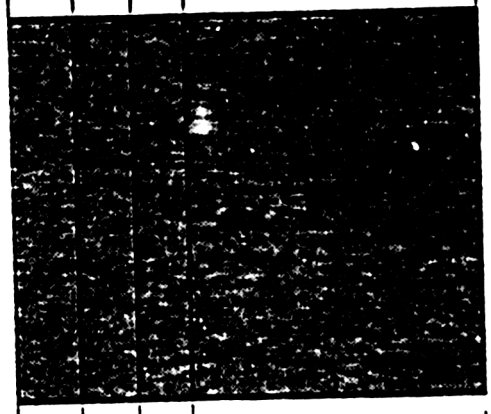
(5) Resistance (inch/pounds)
Minimum 1.0
Maximum 6.0

f. MOMENTARY-CONTACT ROTARY SELECTOR CONTROLS—Knobs for spring-loaded momentary contact rotary selector controls should be large enough to be easily held against the spring torque, without fatigue, for as long as necessary to accomplish the control action.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.5 SCALE MARKING (Cont'd)



b VALUES INDICATED BY UNIT GRADUATIONS—Successive values indicated by unit graduations should be one of those shown in Exhibit 5-5 or those values multiplied by some power of 10.

GOOD					FAIR				
1	2	3	4	5	2	4	6	8	10
5	10	15	20	25	20	40	60	80	100
10	20	30	40	50					

Exhibit 5-5. Recommend progression of values (from McCormick, 1976).

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.1 THUMBWHEELS

a. VISIBILITY—To minimize error, thumbwheel readouts should be visible from the thumbwheel operating position.

b. CODING—If the thumbwheel is used as an input device, the OFF, zero, or normal position should be coded to facilitate visual recognition of status.

c. CONTINUOUS ADJUSTMENT THUMBWHEELS—The dimensions of thumbwheel controls which permit continuous adjustment (not stepped or detented) should be as follows:

(1) At least 1 inch of the wheel should be exposed to permit easy manipulation.

(2) Resistance should be between 3 and 6 ounces.

(3) If the thumbwheel has an OFF position, a detent should be provided for feedback at that point.

d. DISCRETE SETTING (STEPPED) THUMBWHEELS

(1) Thumbwheel controls which have discrete settings should be detented between positions. The control should snap into each position, and resist intermediate or uncertain settings.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.4 PRINTING ON THE DISPLAY FACE

Besides scale markings and scale numbering, brief printed material is often included on the display face. The valid purposes justifying such printing are: identification of the parameter displayed, indication of the units shown, and indication of transformations required in reading (such as multiply x 100).

a. PROVISION OF NEEDED MESSAGE—If any of the above information categories are required to use the display, the required message must be provided close enough to the scale so that the scale and the message are clearly associated in the viewer's mind. The message may be communicated:

(1) By printing on the display face.

(2) By an appropriate label adjacent to the display.

b. BREVITY—To avoid distraction and interference with the needed essential markings, messages should be written as briefly as clarity permits.

c. ABBREVIATIONS- Are the abbreviations used in accordance to "List of abbreviations & symbols." TVA Document, 1980?

d. CONSISTENCY WITH PROCEDURES—The printed message should use the same terms as the procedures in display identification, parameter identification, and units displayed.

e. INDICATION OF TRANSFORMATIONS NEEDED—Where necessary to multiply or divide the displayed readings by powers of 10 to determine quantitative value, the operation required and result derived must be clearly indicated.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.2 SLIDE SWITCHES

a. **SURFACE** – The surface of slide switches should be serrated or knurled.

b. **DIMENSIONS** – Slide switches should conform to approximately the following dimensions. See Exhibit 4-15.

(1) Thickness (T): 0.25 inch.

(2) Length (L): 1.0 inch.

Thickness (T)	0.25
Length (L)	1.0

Exhibit 4-15. Slide switches.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.3 READABILITY

a. CHARACTER HEIGHT – Character height should conform to the minimum dimensions given in Table 5.1.

b. TYPE STYLE – Exhibits 5-1 and 5-2 present two recommended sets of characters. In general, character size and style should meet the following:

(1) Type styles should be simple.

(2) Type styles should be consistent.

(3) Only upper-case letters should be used.

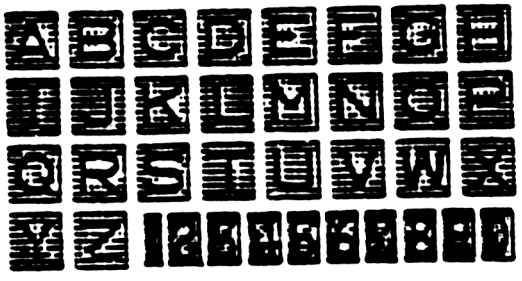


Exhibit 5-1. A recommended set of characters (from U.S. Military Specification MIL-M-18012B).

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9

Exhibit 5-2. A recommended set of characters (from U.S. Military Standard MS-33558 (ASG)).

CHARACTER HEIGHT DIMENSIONS

VIEWING DISTANCE INCHES	MIN. CHAR. HEIGHT, INCHES
<19.7	0.1
19.7-39.4	0.2
39.4-78.7	0.4
78.7-157.5	0.8
157.4-315.5	1.5

TABLE 5.1

	Dimensions (inches)			Resistance (ounces)	
	Arm Length (L) *	Arm Length (L) **	Tip Diameter (D)	Small Switch	Large Switch
Minimum	0.5	1.5	0.125	10	10
Maximum	2.0	2.0	1.0	16	40

	Displacement (A) (degrees)	
	Two Position	Three Position
Minimum	30	18
Maximum	120	60
Desired		25

* Use by Bare Finger
** Use by Gloved Finger

Exhibit 4-16. Recommended dimensions for toggle switches.

VISUAL DISPLAYS 5.0
PRINCIPLES OF DISPLAY 5.1

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

5.1.1 INFORMATION TO BE DISPLAYED (Cont'd)

f. DISPLAY FAILURE—When panel instruments, such as meters, fail or become inoperative, the failure should be apparent to the operator (e.g., through off-scale indication).

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.4 ROCKER SWITCHES (Cont'd)

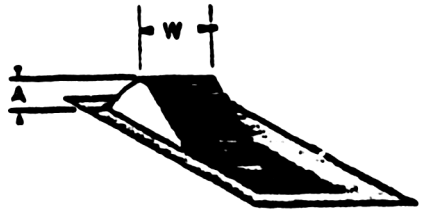
a. ROCKER SWITCH DIMENSIONS—For maximum effectiveness, rocker switches should conform to the following dimensions (see Exhibit ' 4-17):

(1) Width (W) (inches)
Minimum 0.75
Maximum 1.5

(2) Resistance (ounces)
Minimum 10
Maximum 40

(3) Displacement, two-position switches (A) (degrees)
Minimum 30
Maximum 120

(4) Displacement, three-position switches (A) (degrees)
Minimum 18
Maximum 60
Optimum 25



	Width (W) (inches)	Resistance (ounces)
Minimum	0.75	10
Maximum	1.5	40

	Displacement (A) (degrees)	
	2-position	3-position
Minimum	30	18
Maximum	120	60
Optimum	–	25

Exhibit 4-17. Recommended dimensions for rocker switches.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.4 ROCKER SWITCHES (Cont'd)

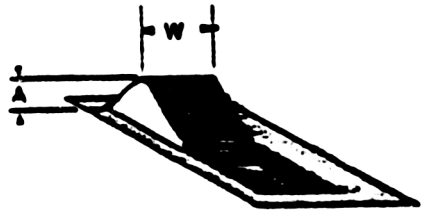
e. ROCKER SWITCH DIMENSIONS—For maximum effectiveness, rocker switches should conform to the following dimensions (see Exhibit ' 4-17):

(1) Width (W) (inches)
Minimum 0.75
Maximum 1.5

(2) Resistance (ounces)
Minimum 10
Maximum 40

(3) Displacement, two-position switches (A) (degrees)
Minimum 30
Maximum 120

(4) Displacement, three-position switches (A) (degrees)
Minimum 18
Maximum 60
Optimum 25



	Width (W) (inches)	Resistance (ounces)
Minimum	0.75	10
Maximum	1.5	40

	Displacement (A) (degrees)	
	2-Position	3-Position
Minimum	30	18
Maximum	120	60
Optimum	–	25

Exhibit 4-17. Recommended dimensions for rocker switches.

VISUAL DISPLAYS 5.0
PRINCIPLES OF DISPLAY 5.1

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

5.1.1 INFORMATION TO BE DISPLAYED (Cont'd)

f. DISPLAY FAILURE—When panel instruments, such as meters, fail or become inoperative, the failure should be apparent to the operator (e.g., through off-scale indication).

	Dimensions (inches)			Resistance (ounces)	
	Arm Length (L) *	Arm Length (L) **	Tip Diameter (D)	Small Switch	Large Switch
Minimum	0.5	1.5	0.125	10	10
Maximum	2.0	2.0	1.0	16	40

	Displacement (A) (degrees)	
	Two Position	Three Position
Minimum	30	15
Maximum	120	60
Desired		25

* Use by Bare Finger
** Use by Gloved Finger

Exhibit 4-16. Recommended dimensions for toggle switches.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.3 READABILITY

a. CHARACTER HEIGHT – Character height should conform to the minimum dimensions given in Table 5.1.

b. TYPE STYLE – Exhibits 5-1 and 5-2 present two recommended sets of characters. In general, character size and style should meet the following:

(1) Type styles should be simple.

(2) Type styles should be consistent.

(3) Only upper-case letters should be used.

Exhibit 5-1. A recommended set of characters (from U.S. Military Specification MIL-M-18012B).

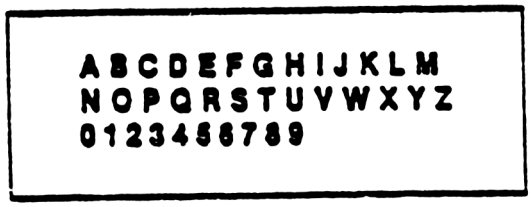


Exhibit 5-2. A recommended set of characters (from U.S. Military Standard MS-33558 (ASG)).

CHARACTER HEIGHT DIMENSIONS

VIEWING DISTANCE INCHES	MIN. CHAR. HEIGHT, INCHES
<19.7	0.1
19.7-39.4	0.2
39.4-78.7	0.4
78.7-157.5	0.8
157.4-315.5	1.5

TABLE 5.1

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.2 SLIDE SWITCHES

a. SURFACE – The surface of slide switches should be serrated or knurled.

b. DIMENSIONS – Slide switches should conform to approximately the following dimensions. See Exhibit 4-15.

(1) Thickness (T): 0.25 inch.

(2) Length (L): 1.0 inch.

Thickness (T)	0.25
Length (L)	1.0

Exhibit 4-15. Slide switches.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.1.4 PRINTING ON THE DISPLAY FACE

Besides scale markings and scale numbering, brief printed material is often included on the display face. The valid purposes justifying such printing are: identification of the parameter displayed, indication of the units shown, and indication of transformations required in reading (such as multiply x 100).

a. PROVISION OF NEEDED MESSAGE—If any of the above information categories are required to use the display, the required message must be provided close enough to the scale so that the scale and the message are clearly associated in the viewer's mind. The message may be communicated:

(1) By printing on the display face.

(2) By an appropriate label adjacent to the display.

b. BREVITY—To avoid distraction and interference with the needed essential markings, messages should be written as briefly as clarity permits.

c. ABBREVIATIONS- Are the abbreviations used in accordance to "List of abbreviations & symbols." TVA Document, 1980?

d. CONSISTENCY WITH PROCEDURES—The printed message should use the same terms as the procedures in display identification, parameter identification, and units displayed.

e. INDICATION OF TRANSFORMATIONS NEEDED—Where necessary to multiply or divide the displayed readings by powers of 10 to determine quantitative value, the operation required and result derived must be clearly indicated.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

4.5.2 SLIDE SWITCHES

a. SURFACE—The surface of slide switches should be serrated or knurled.

b. DIMENSIONS—Slide switches should conform to approximately the following dimensions. See Exhibit 4-15.

(1) Thickness (T): 0.25 inch.

(2) Length (L): 1.0 inch.

Thickness (T)	0.25
Length (L)	1.0

Exhibit 4-15. Slide switches.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.5.1 THUMBWHEELS

a. VISIBILITY—To minimize error, thumbwheel readouts should be visible from the thumbwheel operating position.

b. CODING—If the thumbwheel is used as an input device, the OFF, zero, or normal position should be coded to facilitate visual recognition of status.

c. CONTINUOUS ADJUSTMENT THUMBWHEELS—The dimensions of thumbwheel controls which permit continuous adjustment (not stepped or detented) should be as follows:

(1) At least 1 inch of the wheel should be exposed to permit easy manipulation.

(2) Resistance should be between 3 and 6 ounces.

(3) If the thumbwheel has an OFF position, a detent should be provided for feedback at that point.

d. DISCRETE SETTING (STEPPED) THUMBWHEELS

(1) Thumbwheel controls which have discrete settings should be detented between positions. The control should snap into each position, and resist intermediate or uncertain settings.

5.1.5 SCALE MARKING (Cont'd)

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

b VALUES INDICATED BY UNIT GRADUATIONS—Successive values indicated by unit graduations should be one of those shown in Exhibit 5-5 or those values multiplied by some power of 10.

GOOD					FAIR				
1	2	3	4	5	2	4	6	8	10
5	10	15	20	25	20	40	60	80	100
10	20	30	40	50					

Exhibit 5-5. Recommend progression of values (from McCormick, 1976).

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.5 ROTARY SELECTOR CONTROLS (Cont'd)

e. DIMENSIONS—Recommended dimensions for rotary selector switches are as follows (see Exhibit 4-13):

(1) Length (L) (inches)
Minimum 1.0

(2) Width (W) (inches)
Maximum 1.0

(3) Diameter (D) (inches)
Minimum 1.0

(4) Depth (H) (inches)
Minimum 0.625

(5) Resistance (inch/pounds)
Minimum 1.0
Maximum 6.0

f. MOMENTARY-CONTACT ROTARY SELECTOR CONTROLS—Knobs for spring-loaded momentary contact rotary selector controls should be large enough to be easily held against the spring torque, without fatigue, for as long as necessary to accomplish the control action.

GUIDELINE

COMPLIANCE CHECKLIST

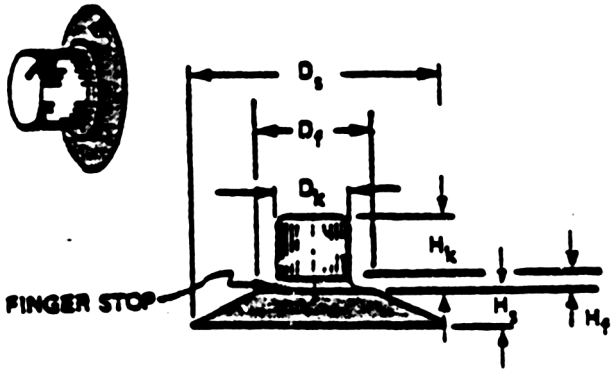
N/A	Yes	No	Reference/Comment

5.1.6 COLOR CODING

The use of color as a coding medium in control rooms offers a valuable means of providing unambiguous, easily discriminable information to the operator. Among other applications, color coding can aid in the perception of warning signals, the identification of functional relationships, and the association of displays with related controls. When used in a coding system, color should always be redundant with some other cue. The information provided by a particular color should also be indicated in some other form, e.g., location, orientation, alpha-numerics, scale indications. Color can be effectively applied in both illuminated displays (e.g., mimics on panel surfaces and color pads) and in transilluminated displays (e.g., signal lights and CRTs). Color can be particularly useful as a means for organizing information and is especially effective as a means for coding low probability or very important events.

The benefits of color coding can be realized only if color is not used indiscriminately. Excessive use may, in fact, provide interference to effective control room operation. The same qualities which make color useful for coding can, if over used or inconsistently applied, result in unintended confusion and distraction. As colors are used more frequently and as the number of different colors used for coding increases, the attention-getting value of each color diminishes. Similarly, when a particular color has multiple meanings it both loses its attention-getting quality and may lead to confusion or operator error.

All coding schemes must be learned. Learning of a color code can be facilitated by keeping the code simple and by taking advantage of common usage in everyday life. Complex or poorly designed coding systems will detract from, rather than enhance, operator performance.



	Knob	F-Sese	Skirt
Diameter	0.75	1.25	2.0
Height	Combined 0.75		0.25

Exhibit 4-12. Minimum dimensions for rotary controls with knob skirts.

APPENDIX A

VISUAL DISPLAYS 5.0
PRINCIPLES OF DISPLAY 5.1

"THIS PAGE INTENTIONALLY LEFT BLANK."

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.4 CONTINUOUS ADJUSTMENT ROTARY CONTROLS

To ensure precise control along a continuous variable, continuous adjustment rotary controls are appropriate.

a. KNOBS – Knobs for continuous adjustment controls should be round in shape, with knurled or serrated edges.

b. POSITION INDICATION—When an indication of position is desirable, the pointer configurations shown in Exhibit 4-11 may be used. Where more accuracy is required, a line should be engraved (and filled with contrasting pigment) both on top and down the side of the pointer, as shown on the knob at the bottom of the exhibit.

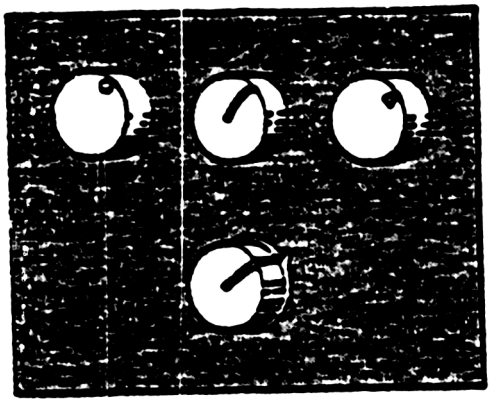


Exhibit 4-11. Continuous rotary control or position-selector knobs with markers.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.2.1 DIRECTIONALITY OF MOVEMENT AND NUMBERING WITH FIXED-SCALE MOVING-POINTER METERS

a. CIRCULAR SCALES—Scale values should increase with clockwise movement of the pointer as in Exhibit 5-8.

b. VERTICAL STRAIGHT SCALES—Scale values should increase with upward movement of the pointer as in Exhibit 5-9.

c. HORIZONTAL STRAIGHT SCALES—Scale values should increase with pointer movement to the right as in Exhibit 5-10.

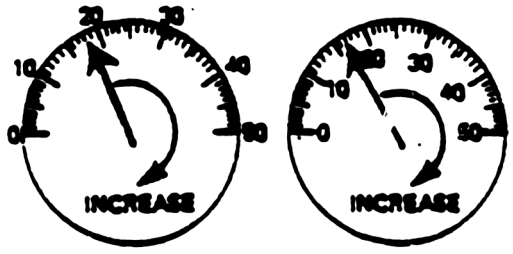


Exhibit 5-8. Direction of numbering and pointer movement with circular scales.

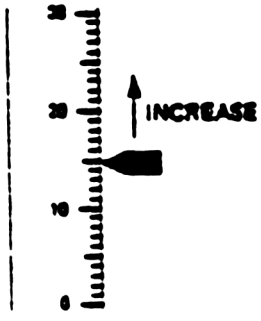


Exhibit 5-9. Direction of numbering and pointer movement for vertical fixed scales.

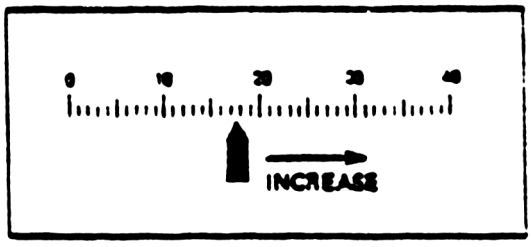


Exhibit 5-10. Direction of numbering and pointer movement for vertical fixed scales.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comment

4.4.3 KEY-OPERATED CONTROLS

a. USE—Key-operated controls should be used when system requirements dictate that the function being controlled should be secured against activation by unauthorized personnel. If key-operated controls cannot be justified in terms of security, they are probably not necessary and should not be used. Key-operated switches should not be used solely as a means of shape coding.

b. TEETH: SINGLE ROW—Keys with a single row of teeth should be inserted into the lock with the teeth pointing up or forward.

c. TEETH: DOUBLE ROW—If keys have teeth on both edges, they should fit the lock with either side up or forward.

d. ON-OFF ORIENTATION—Locks should be oriented so that the switch is OFF (or SAFE) when the key is in the vertical position.

e. KEY REMOVAL—Operators should not normally be able to remove the key from the lock unless the switch is turned to the OFF or SAFE position.

f. LABELING—Control positions should be labeled.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.2.3 ZONE MARKING

Zone markings should be used to show the operational implications of various readings such as "Operating Range," "Upper Limits," "Lower Limits," or "Danger Range." Exhibit 5-12 shows an example of good zone markings.

a. Zone markings should be conspicuous and distinctively different for different zones.

b. Zone marking should not interfere with reading of quantitative markings.

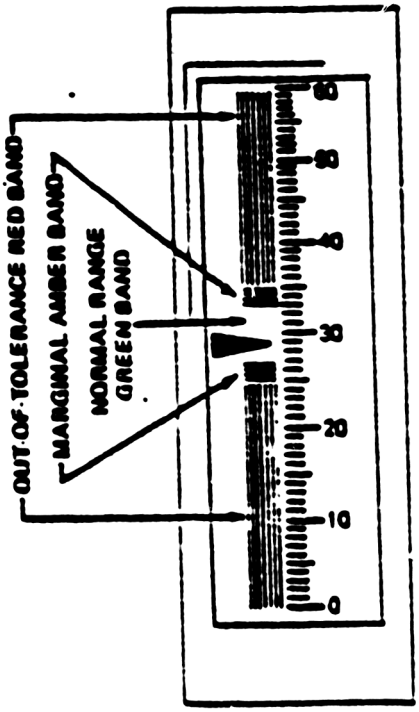


Exhibit 5-12. Example of good zone marking.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.4.1 ROTARY CONTROL DESIGN PRINCIPLES

a. DIRECTION OF ACTIVATION – Rotary control settings should increase in value with a clockwise rotation.

b. ROTARY CONTROL SHAPE CODING – If rotary controls used for widely different functions are placed on the same panel, shape coding should be employed.

c. CODING SPECIFICATIONS – Shape-coded rotary controls should be:

(1) Visually identifiable.

(2) Tactually identifiable.

5.2.4 ORIENTATION OF MARKINGS ON FIXED-SCALE METERS (Cont'd)

b. END-POINT INDICATION ON PARTIAL-REVOLUTION SCALES

(1) Can the unit operator accurately read the end point indication on scales?

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

COMPLIANCE CHECKLIST

	N/A	Yes	No	Reference/Comment
4.3.3 LEGEND PUSHBUTTONS (Cont'd)				
c. PROVISION FOR LAMP FAILURE (Cont'd)				
(3) Legend pushbuttons should not short out during lamp replacement or be susceptible to inadvertant activation during the process of lamp removal or replacement.				
(4) Legend covers should be keyed to prevent the possibility of interchanging the covers.				
d. BARRIERS				
(1) Barriers should be used when legend pushbuttons are contiguous.				
(2) Barriers should have rounded edges.				
e. LEGEND PUSHBUTTON DIMENSIONS—For maximum effectiveness of legend pushbutton controls, the following dimensions should be used (see Exhibit 4.8):				
(1) Size (S) (inches) Minimum 0.75 Maximum 1.5				
(2) Displacement (A) (inches) Minimum 0 (touch plate) Minimum 0.125 (all others) Maximum 0.250				
(3) Barrier width (B_w) (inches) Minimum 0.125				
(4) Barrier depth (B_d) (inches) Minimum 0.183 Maximum 0.250				
(5) Resistance (ounces) Minimum 10 (except touch plate) Maximum 40				

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.3.1 CHARACTERISTICS AND PROBLEMS OF LIGHT INDICATORS

By definition, light indicators show the existence of some state by the glowing of a light. They are transilluminated displays, although this term is too broad to identify them uniquely since it also covers certain back-lighted meters. These guidelines consider light indicators under their two subsets of non-legend light indicators (Guideline 5.3.2) and illuminated legend indicators (Guideline 5.3.3). Annunciators are a special class of light indicators, treated in the guidelines of Section 3.0

Since the presence of a light is the primary means by which light indicators communicate a message, it becomes essential that the light signal be physically reliable, that it be sensed unambiguously by the operator, and that it not be misinterpreted by him. These requirements hold for both classes of light indicators.

a. PRECAUTIONS TO ASSURE AVAILABILITY

The replacement of bulbs and determination of need for replacement should be provided.

b. PRECAUTIONS TO ASSURE UNAMBIGUOUS SENSING BY OPERATORS—Lights should not appear to be glowing when in fact they are off, or vice versa. To that end, ambient light sources should be selected, located, or controlled to avoid reflections or refractions. (See Guideline 1.5.3.)

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.3.2 ROUND PUSHBUTTONS

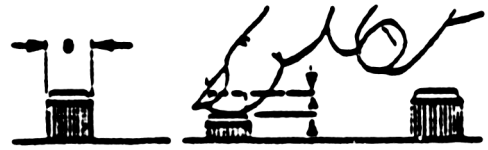
For best operation, pushbutton parameters should be as follows. (See Exhibit 4-7.)

a. Diameter (D), for fingertip operation (inches)
   (1) Unguarded and nonrecessed pushbuttons
   Minimum 0.375
   (2) Guarded or recessed pushbuttons
   Minimum 0.75

b. Diameter (D), for thumb or heel of hand operation (inches)
   Minimum 0.75

c. Displacement (A), for thumb or finger operation (inches)
   Minimum 0.125

d. Resistance (R), for fingertip operation (ounces)
   Minimum 10
   Maximum 40



	Dimensions (inches)		Resistance (ounces)	Displacement (A) (inches)
	Diameter (D)			
	Fingertip Operation	Thumb or Heel of Hand Operation	Fingertip Operation	Thumb or Finger Operation
Minimum	0.375*	0.75	10	0.125
Maximum	0.75		40	1.5

*Minimum diameter for guarded or recessed pushbuttons should be 0.75 inch.

Exhibit 4-7. Recommended dimensions for unguarded and non-recessed pushbuttons (finger or hand operated).

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.3.2 DESIGN AND USE OF NON-LEGEND LIGHT INDICATORS

Non-legend light indicators are represented by conventional pilot lights, bulls-eyes, and jewel lights. Color may be provided by a tinted cover glass or by a layer of colored material inside the cover.

a. IDENTIFICATION OF MEANING

(1) Where meaning is not apparent, labeling must be provided close to the light indicator showing the message intended by its glowing.

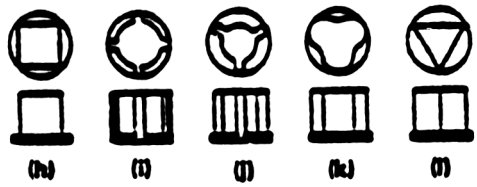
(2) Does the color code for pilot lights conform to specific plant standards?

(3) The color of the light should be clearly identifiable.

b. LIGHT INTENSITY—The illuminated indicator should be at least 10% greater in light intensity than the surrounding panel (as measured by a spot photometer).

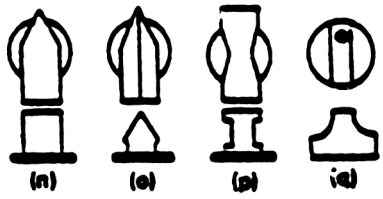
4.2.2 CODING OF CONTROLS (Cont'd)

e. ROTATING KNOB SHAPE OPTIONS (Cont'd)



Fractional Rotation Knobs: These knobs are for use on controls that do not require twirling or spinning, for which the adjustment range is less than one full turn; and for which the knob position is not a critical item of information.

Exhibit 4-8. Shape-coded knobs—fractional rotation.



Detent Positioning Knobs: These knobs are for use on discrete setting controls, for which position is critical.

Exhibit 4-8. Shape-coded knobs—detent positioning.

f. COLOR CODING

(1) Does the color code for controls conform to specific plant standards on color coding?

(2) When color coding is used to relate a control to its corresponding display, the same color should be used for both the control and the display.

(3) The color of the control should contrast with the panel background. (See Guideline 1.5.6.e.)

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

COMPLIANCE CHECKLIST

5.3.3 DESIGN AND USE OF LEGEND LIGHT INDICATORS (Cont'd)	N/A	Yes	No	Reference/Comment
b. LEGEND DESIGN				
(1) General legend design should be consistent throughout the control room.				
(2) Lettering should be simple, and should follow Guideline 5.1.3 for style and size.				
(3) Symbolic legends should be clear and unambiguous as to their meaning.				
(4) Text should be short, concise, and unambiguous.				
(5) Nomenclature and abbreviations should be standard, and consistent with usage throughout the control room and in the procedures.				
(6) Legends should be worded to tell the status indicated by glowing of the light.				
c. DISTINGUISHABILITY FROM LEGEND PUSHBUTTONS—Illuminated legend indicators should be readily distinguishable from legend pushbuttons by form, size, or other factors.				
d. COLOR CODING—Does the color coding for legend light indicators conform to specific plant standards?				

ADVANTAGES	TYPE OF CODING					
	LOCATION	SHAPE	SIZE	MODE OF OPERATION	LABELING	COLOR
Improves visual identification.	X	X	X		X	X
Improves nonvisual identification (tactual and kinesthetic).	X	X	X	X		
Helps standardization.	X	X	X	X	X	X
Aid identification under low levels of illumination and colored lighting	X	X	X	X	(When white illuminated)	(When white illuminated)
May aid in identifying control position (settings).		X		X	X	
Requires little (if any) training; is not subject to forgetting.					X	
DISADVANTAGES						
May require more space.	X	X	X	X	X	
Affects manipulation of the control (Loss of use).	X	X	X	X		
Limited in number of available coding categories.	X	X	X	X		X
May be less effective if operator wears gloves.		X	X	X		
Controls must be viewed (i.e., must be within visual area and with adequate illumination present).					X	X

Exhibit 4-3. Advantages and disadvantages of various types of coding.

COMPLIANCE CHECKLIST

5.4.1 GENERAL CHARACTERISTICS OF GRAPHIC RECORDERS (Cont'd)	N/A	Yes	No	Reference/Comment
e. PLACEMENT OF RECORDERS—As devices which must be verified and attended by the operator, graphic recorders should in principle be located within the primary operating area rather than on back panels.				
f. PAPER-SPEED ADJUSTABILITY—Not only should high paper speed option be provided to run out records for detachment, but a selection of lower speeds should be available to permit adjustment of the time scale so that rate-of-change information can be indicated.				
g. ANNOTATION—It should be convenient to annotate recordings with date and time markings, with paper speed if varied from normal, with parameter identification, or with any other relevant information.				
h. VISIBILITY—Recorder design should ensure that all data will be visible through the window of the recorder and not require open-door operation to expose it.				
i. TYPE CHART PAPER—Is there a label inside the recorder advising the type chart paper to use?				

GUIDELINE

4.2.1 DIRECTION OF MOVEMENT

To minimize operator error, control movements should conform to the following population stereotypes (for U.S. population only):

	Function	Control Action
a.	On, Start Run, Open	Up, right, forward, clockwise, pull
b.	Off, Stop, Close	Down, left, backward, counterclockwise, push
c.	Right	Clockwise, right
d.	Left	Counterclockwise, left
e.	Raise	Up
f.	Lower	Down
g.	Increase	Forward, up, right, clockwise
h.	Decrease	Backward, down, left, counterclockwise

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.5.1 DRUM-TYPE COUNTERS

Counter-type presentation of information is useful when there is a need for quick, precise reading of quantitative value and trend information is not needed.

a. NUMERICAL PRESENTATION FACTORS

(1) ORIENTATION – Multi-digit numbers formed by several counter drums should be read horizontally from left to right (see Exhibit 5-14).

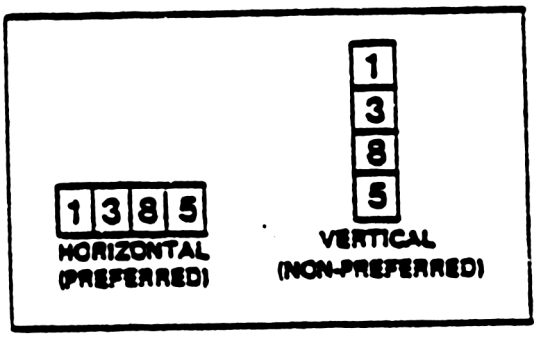


Exhibit 5-14. Preferences for counter orientation.

(2) WIDTH-HEIGHT RATIO—To compensate for the distortion imposed by the curved surface of the drum, counter numerals should reflect a width-height ratio of 1:1, not 3:5 as recommended for numerals of other displays.

CONTROLS 4.0

SELECTION OF CONTROLS 4.1

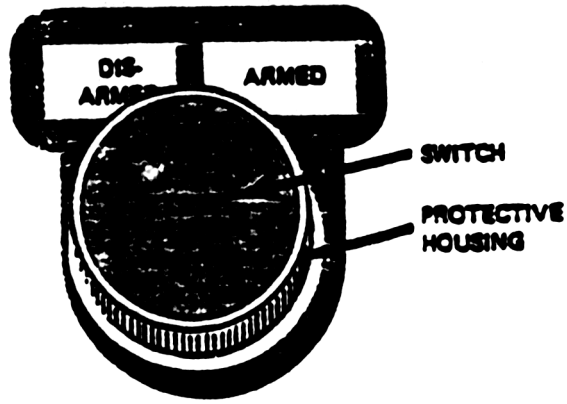


Exhibit 4-1. Recessed pushbutton switch.

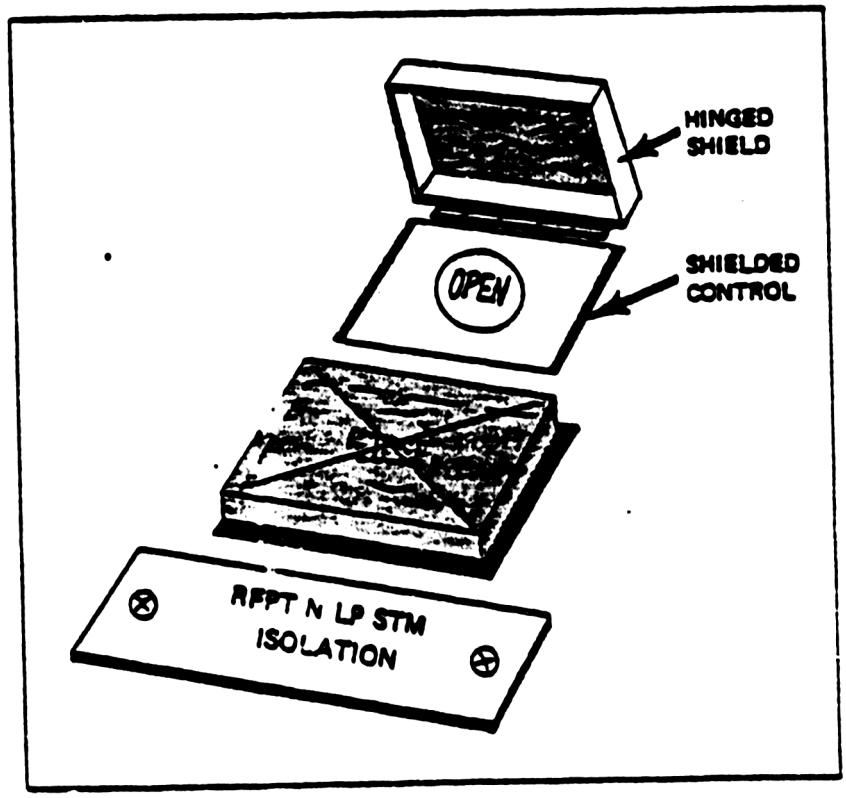


Exhibit 4-2. Control with hinged plastic shield.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

5.5.2 ELECTRONIC COUNTERS

Electronic counters using "Nixie" tubes, light emitting diodes (LEDs), or other electroluminescent devices may be preferred over mechanical counters in many control room applications.

a. NUMERICAL PRESENTATION FACTORS

(1) ORIENTATION – Multi-digit counters should be oriented to read horizontally from left to right.

(2) CHARACTER STYLE–Simple character fonts should be used. Styles using variable stroke widths, slanted characters, etc. should be avoided.

(3) NUMERAL HEIGHT–Numerals should be of such a height as to subtend a visual angle of 15 minutes from the farthest anticipated viewing distance.

(4) WIDTH-TO-HEIGHT RATIO – Width-to-height ratio of numerals should be approximately 3:5.

(5) SPACING–Horizontal spacing between numerals should be between one-quarter and one-half the numeral width.

b. RATE OF CHANGE – Numerals should not follow each other faster than two per second when the operator is expected to read the numerals consecutively.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

4.1.1 GENERAL PRINCIPLES (Cont'd)

d. COMPATIBILITY WITH EMERGENCY GEAR —If used while wearing protective equipment (e.g., oxygen masks, protective gloves), controls should be:

(1) Easy to identify.

(2) Easy to activate.

e. DURABILITY—Controls should be sufficiently rugged to withstand normal and emergency use. Each control should retain its appearance, "feel," and functional characteristics during its service life.

(1) Broken, chipped, or crumbled control surfaces should not ordinarily occur.

(2) Control knobs or handles should not rotate, slip, or move loosely on their shafts.

(3) No internal wear or breakage should occur which alters the "feel" or other sensory feedback of a control. Controls should not develop internal looseness, binding, or backlash.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.1.2 HIERARCHICAL SCHEME

To reduce confusion, operator search time, and redundancy, a hierarchical labeling scheme should be used. (See Exhibit 6-1.)

a. RANKING

(1) Major labels should be used to identify major systems or operator work stations.

(2) Subordinate labels should be used to identify subsystems or functional groups.

(3) Component labels should be used to identify each discrete panel or console element.

(4) Labels should not repeat information contained in higher-level labels.

b. LETTER GRADATIONS—If possible labels should be graduated in letter size such that:

(1) System/work station labels are about 25% larger than

(2) Subsystem/functional group labels which are about 25% larger than

(3) Component labels which are about 25% larger than

(4) Control position identifiers.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.2.1 PLACEMENT

a. NORMAL PLACEMENT – Labels should be placed above the panel element(s) they describe.

b. PANEL LABELING—The placement of labels on control panels should conform to the guidance shown in Exhibit 6-1.

c. VISIBILITY ENHANCEMENT—Labels for elements located above eye level should be positioned to ensure label visibility.

d. PROXIMITY—Labels should be placed close to the panel element. See Exhibit 6-2.

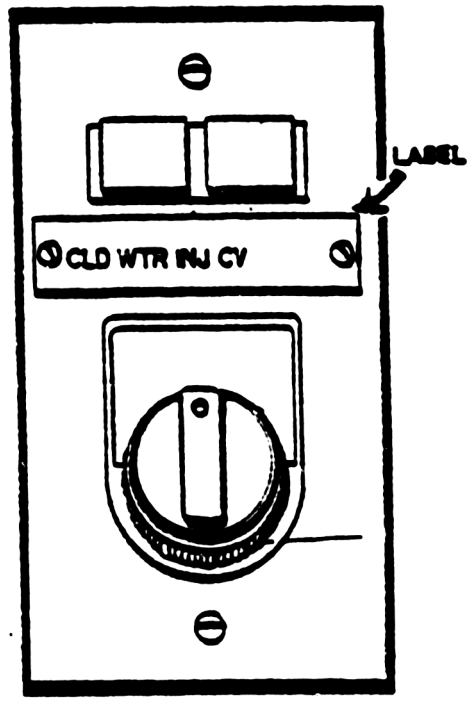


Exhibit 6-2. Label in close proximity to panel element.

ALARM SYSTEM 3.0
OPERATOR RESPONSE SUBSYSTEM 3.4

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.4.2 CONTROL SET DESIGN

a. POSITIONING OF REPETITIVE GROUPS—Repetitive groups of annunciator controls should have the same arrangement and relative location at different work stations. This is to facilitate "blind" reaching.

b. CONTROL CODING—Annunciator response controls should be coded for easy recognition using techniques such as:

Color coding:

color shading the group of annunciator controls;

demarcating the group of annunciator controls.

c. NONDEFEATABLE CONTROLS—Annunciator control designs should not allow the operator to defeat the control. For example, some pushbuttons used for annunciator silencing and acknowledgement can be held down by inserting a coin in the ring around the pushbutton. This undesirable design feature should be eliminated.

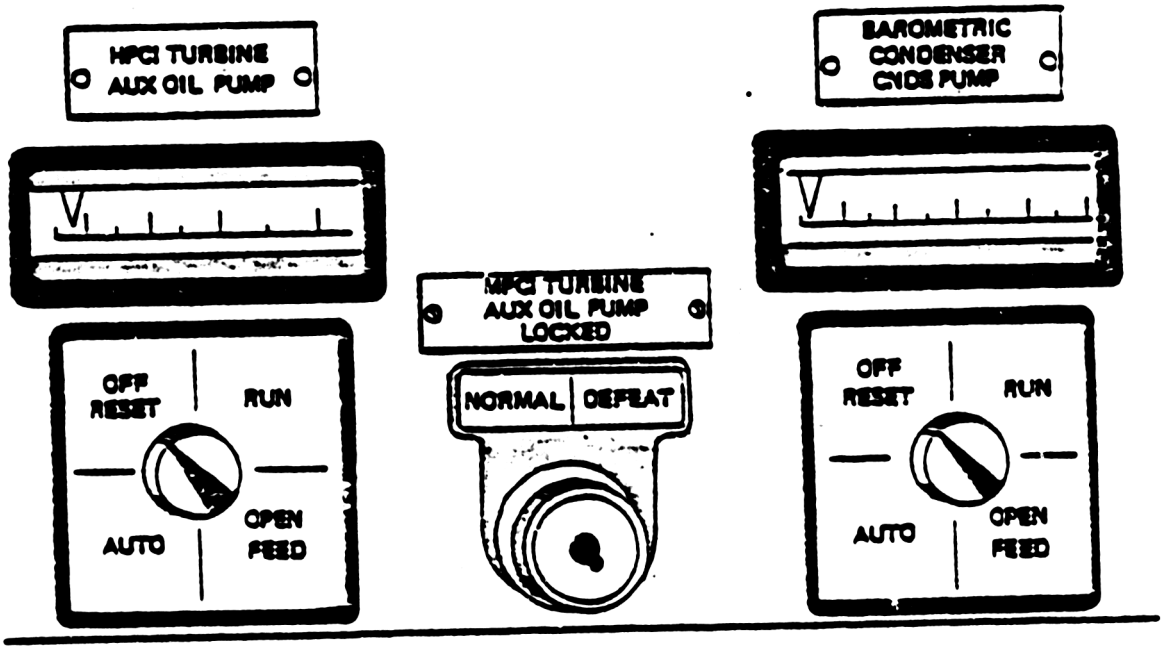


Exhibit 6-4. Adjacent labels with good separation.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.4.1 CONTROLS

Controls for operator response to the annunciator system include silence, acknowledge, reset, and test controls. (See Exhibit 3-5.)

a. SILENCE

(1). A method of silencing the audible alert should be provided.

(2) It should be possible to silence an auditory alert signal from any set of annunciator response controls in the primary operating area.

b. ACKNOWLEDGE

(1) A control should be provided to terminate the flashing of a visual tile and have it continue at steady illumination until the alarm is cleared.

(2) Acknowledgement should be possible only at the work station where the alarm originated.

c. RESET

(1) If an automatic cleared alarm feature is not provided, a control should be provided to reset the system after an alarm has cleared.

(2) The reset control should silence any audible signal indicating clearance and should extinguish tile illumination.

(3) The reset control should be effective only at the work station for the annunciator panel where the alarm initiated.

d. TEST

(1) A control to test the auditory signal and flashing illumination of all tiles in a panel should be provided.

(2) Periodic testing of annunciators should be required and controlled by administrative procedure.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.2.3 SPATIAL ORIENTATION

Improperly oriented labels can lead to confusion and cause delays in location and identification of important controls and/or displays.

a. HORIZONTAL ORIENTATION

(1) Where possible labels should be oriented horizontally so that they may be read quickly and easily from left to right.

b. CURVED PATTERNS—Curved patterns of labeling should be avoided. See Exhibit . 6-5.

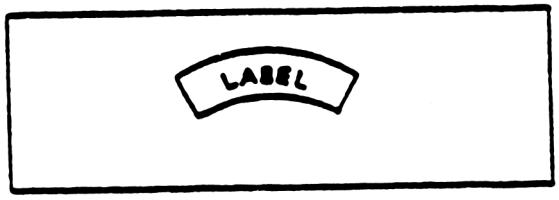


Exhibit 6-5. Poor practice: Curved pattern.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.3.5 VISUAL TILE READABILITY

a. DISTANCE—The operator should be able to read all the annunciator tiles from the position at the work station where the annunciator acknowledge control is located.

Letter height should conform to the values given in Table 3.3 on Page 3-19.

(1) Letter height should be identical for all tiles, based on the maximum viewing distance. Separate calculations should be made for stand-up and sit-down work stations.

b. TYPE STYLE—The size and style of lettering should meet the following:

(1) Type styles should be simple.

(2) Type styles should be consistent on all visual tiles.

(3) Only upper-case type should be used on visual tiles.

c. LEGEND CONTRAST—Legends should provide high contrast with the tile background.

(1) Legends should be engraved.

(2) Legends should be dark lettering on a light background.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.3.1 KINDS OF INFORMATION

Labels should describe the function of equipment items. If needed for clarity, engineering characteristics or nomenclature may also be described.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.3.3 ARRANGEMENT OF VISUAL ALARM TILES (Cont'd)

e. OUT-OF-SERVICE ALARMS—Cues for prompt recognition of an out-of-service annunciator should be designed into the system.

f. BLANK TILES—Blank or unused annunciator tiles should not be illuminated (except during annunciator testing).

GUIDELINE

6.3.3 CONSISTENCY

a. ADMINISTRATIVE CONTROL—A list of standard names, acronyms, abbreviations, and part/system numbers used should be per appropriate TVA procedures and standards.

b. INTERNAL CONSISTENCY—Labels should be consistent within and across pieces of equipment in their use of words, acronyms, abbreviations, and part/system numbers. See Exhibit 6-6.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

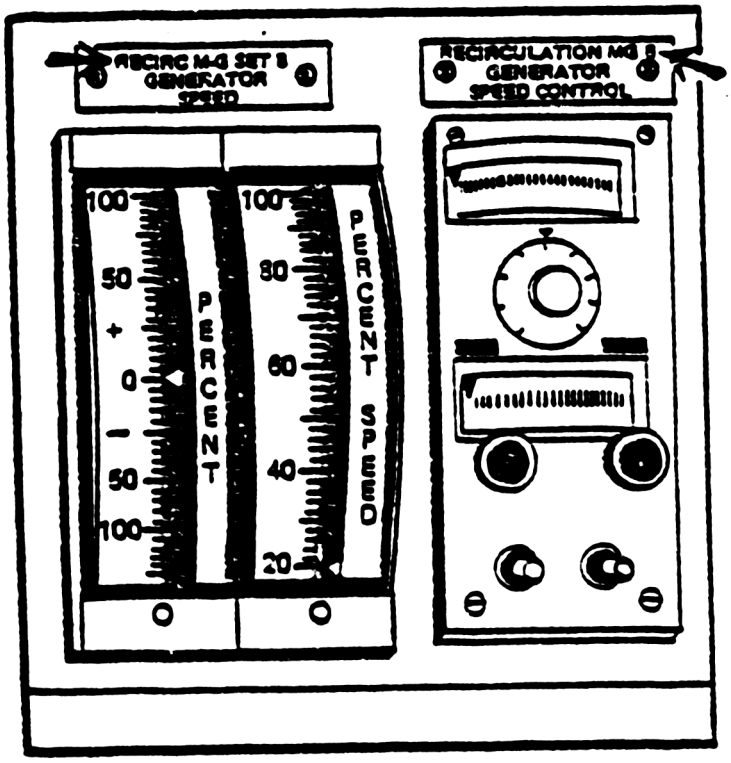


Exhibit 6-6. Inconsistent labeling.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.3.2 VISUAL ALARM RECOGNITION AND IDENTIFICATION

Specific guidelines for visual recognition and identification of alarmed tiles follow:

a. FLASHING – The specific tile(s) on an annunciator panel should use flashing illumination to indicate an alarm condition.

b. FLASH RATE – Flash rates should be from three to five flashes per second with approximately equal on and off times.

c. FLASHER FAILURE – In case of flasher failure of an alarmed tile, the tile light should illuminate and burn steadily.

d. CONTRAST DETECTABILITY – There should be high enough contrast between alarming and steady-on tiles, and between illuminated and non-illuminated tiles, so that operators in a normally illuminated control room have no problem discriminating alarming, steady-on, and steady-off visual tiles.

e. "DARK" ANNUNCIATOR PANELS – A "dark" annunciator panel concept should be used. This means that under normal operating conditions no annunciators would be illuminated; all of the visual tiles of the annunciator panels would be "dark."

f. EXTENDED DURATION ILLUMINATION – If an annunciator tile must be "ON" for an extended period during normal operations (e.g., during equipment repair or replacement), it should be:

(1) Distinctively coded for positive recognition during this period, and

(2) Controlled by administrative procedures.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.3.5 BREVITY

Brevity should not be stressed if the results will be unfamiliar to operating personnel. Words on labels should be concise and still convey the intended meaning. See Exhibit 6-7.

24 VDC SWITCHBOARD	24 VOLT DIRECT CURRENT SWITCHBOARD
PREFERRED	NON-PREFERRED

Exhibit 6-7. Labeling brevity.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.3.1 VISUAL ANNUNCIATOR PANELS

Annunciator panels are generally organized as matrices of visual alarm tiles. These matrices, separated into groups by function, are usually positioned along the top of the control boards or consoles (see Guidelines 1.2.2 and 1.2.3).

a. LOCATION—Visual alarm panels should be located above the related controls and displays which are required for corrective or diagnostic action in response to the alarm. (See Exhibit 3-4.)

b. LABELING

(1) Each panel should be identified by a label above the panel.

(2) Panel identification label height should be visible when viewed from a control position within the primary operating area.

c. LAMP REPLACEMENT

(1) If a lamp replacement requires legend tile removal, there should be a way to ensure that the tile is replaced in the correct location.

(2) Lamp replacement should not subject the operator to a shock hazard.

(3) Operator aids should be provided if needed for lamp replacement.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.3.7 FUNCTIONAL GROUPS

a. FUNCTIONAL RELATIONSHIP—Labels should be used to identify functionally grouped controls or displays.

b. LOCATION—Labels should be located above the functional groups they identify.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.2.1 SIGNAL DETECTION

The first requirement for an effective annunciator warning system is rapid penetration of the operator's awareness under any and all conditions. Some "worst case" conditions might be: (a) during the first graveyard shift after four days off-duty, (b) the sixteenth hour of work occasioned by the sudden illness of the relief operator, (c) a warning signal appearing while the operator is very busy attending to the three or more immediately preceding problems, or (d) a warning signal appearing after a series of false or nuisance alarms. Specific principles for the auditory alert subsystem follow.

a. INTENSITY—The signal should be such that operators can reliably discern the signal above the ambient control room noise. A nominal value of 10 dB(A) above average ambient noise is generally adequate.

b. CONTROL—Signal intensity, if adjustable, should be controlled by administrative procedure.

c. LIMITS—The signal should capture the operator's attention but should not cause irritation or a startled reaction.

d. DETECTION—Each auditory signal should be adjusted to result in approximately equal detection levels at normal operator work stations in the primary operating area.

e. RESET—The annunciator auditory alert mechanism should automatically reset when it has been silenced.

f. IDENTIFICATION—The operator should be able to identify the work station or the system where the auditory alert signal originated.

GUIDELINE

6.3.9 ACCESS OPENING, DANGER, WARNING, AND SAFETY INSTRUCTION LABELING

a. **ACCESS OPENING LABELS**—Each access opening used by control room operators should be labeled to identify the function of items accessible through it.

b. **DANGER, WARNING, AND SAFETY INSTRUCTION LABELS**—All danger, warning, and safety instruction labels should be in accordance with appropriate safety standards.

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comments

3.1.4 PRIORITIZATION (Cont'd)

b. PRIORITY CODING

(1) Some method for coding the visual signals for the various priority levels should be employed. Acceptable methods for priority coding include color, position, shape, or symbolic coding.

(2) Auditory signal coding for priority level is also appropriate. See Guideline 2.2.3 for recommended coding techniques.

COMPLIANCE CHECKLIST

N/A	Yes	No	References/Comments

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GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.1.3 FIRST OUT ANNUNCIATORS

As an aid to diagnostic procedures, provision should be made for identifying the initiating event (first out) associated with automatic plant shutdowns.

a. REACTOR SYSTEM

(1) A separate first out panel should be provided for the reactor system.

(2) The first out panel should consist of separate annunciator tiles for each of the automatic reactor trip functions.

(3) In the event of a reactor trip, the tile associated with the event should illuminate, and no other.

b. TURBINE-GENERATOR SYSTEM—A separate first out panel, similar in function to the reactor system panel, is recommended.

c. POSITION—First out panels should be located directly above the main control work station for the system.

d. APPLICATION—First out annunciators should conform to the general auditory, visual, and operator response guidelines of this section.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

6.5.1 USE

When necessary to identify out-of-service equipment; accommodate unique, one-time plant activities; or to improve operator understanding and efficiency, temporary labels may be used until permanent labels are available or until the temporary label is no longer necessary.

a. NECESSITY—Temporary labels should be used only when necessary.

b. HUMAN FACTORS PRACTICES—Temporary labels should conform to good human engineering principles.

c. VISIBILITY—Temporary labels should not obscure prior permanent labels unless the old label is to be replaced.

d. IDENTIFICATION—Tag-out labels should clearly identify out-of-service components and equipment.

e. MOUNTING—Tag-outs should be securely affixed.

f. OBSCURATION—Tag-outs should not obscure the label associated with the non-operable device.

g. ACTIVATION—Tag-outs should be designed to physically prevent actuation of a control.

h. ADJACENT DEVICES—Tag-outs should not obscure any adjacent devices or their associated labels.

GUIDELINE

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

3.1.2 ALARM PARAMETER SELECTION

Plant parameters selected for inclusion in the annunciator warning system and the limits or alarm set points for those parameters should be established to ensure compliance with technical specifications and to allow the operator to monitor the status of the plant and respond to out-of-tolerance conditions effectively. The following general guidelines are suggested to increase the operational effectiveness of the annunciator warning system.

a. SET POINTS—The limits or set points for initiating the annunciator warning system should be established to meet the following goals:

(1) Alarms should not occur so frequently as to be considered a nuisance by the operators.

(2) However, set points should be established to give operators adequate time to respond to the warning condition before a serious problem develops.

b. GENERAL ALARMS

(1) Alarms that require the control room operator to direct an auxiliary operator to a given plant location for specific information should be avoided.

(2) If general alarms must be used, they should only be used for conditions that allow adequate time for auxiliary operator action and subsequent control room operator action.

c. MULTICHANNEL OR SHARED ALARMS

(1) Annunciators with inputs from more than one plant parameter set point should be avoided. Multi-input alarms that summarize single-input annunciators elsewhere in the control room are an exception.