METRIC

NOTICE OF CHANGE

MIL-HDBK-759B
NOTICE 1
1 NOVEMBER 1992

MILITARY HANDBOOK

HUMAN FACTORS ENGINEERING
DESIGN FOR ARMY MATERIEL

TO ALL HOLDERS OF MIL-HDBK-759B:

1. THE FOLLOWING PAGES OF THE MIL-HDBK-759B HAVE BEEN REVISED OR CREATED AND SUPERCEDE THE PAGES LISTED:

NEW PAGES	DATE	SUPERCEDED PAGE	DATE
123	30 June 1992	123	REPRINTED WITHOUT CHANGE
124	1 Nov 1992	124	30 JUNE 1992
127	30 June 1992	127	REPRINTED WITHOUT CHANGE
128	1 Nov 1992	128	30 JUNE 1992

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-HDBK-759B will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

Custodian:
Army - MI

Preparing Activity
Army - MI

Review Activities:
ARMY - AR, AT, AV, CR, EA, GL, MD, ME, MR, TE, TM

Project HFAC-A020

AMSC-N/A

AREA HFAC

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

d. To create a “pictorialized” representation of a system process, communication network, or other information or component organization.

5.2.2.2.4.1 Integrally-lighted subpanels. Integrally-lighted subpanels should be designed so that all panel markings are equally visible throughout the range of panel light level adjustment; and brightness variation among separate subpanels on the same lighting circuit should not exceed 1:7.

5.2.2.2.4.2 Large, single-pictorial, graphic panels. Large, single-pictorial graphic panels used to display items such as system processing o-r communications networks should comply with criteria for visibility, legibility, color, and illumination as specified herein.

5.2.2.2.4.3 Re-lamping. When incandescent lamps are used as the source for integral lighting of panel assemblies, lamps should be readily accessible without removing the panel(s). There should be a sufficient number of lamps provided so that failure of one lamp will not cause the display to be unreadable.

5.2.2.2.4.4 Brightness. Brightness of illuminated panel markings and/or transilluminated controls should be compatible with the ambient environment and/or the operating conditions (dark adaptation criteria). Brightness control (dimming) by the operator should be provided where applicable to maintain appropriate visibility and/or operator dark adaptation level.

5.2.2.3 Scalar Indicators.

5.2.2.3.1 General.

5.2.2.3.1.1 Applications. Scalar indicators should be used in preference to digital readouts when the data displayed are of qualitative as well as quantitative value (when trends, direction of movement, more-than/less-than relationships are of value as well as the specific numeral value), or of qualitative value only. Scalar indicators should not be used when the primary purpose is readout of precise quantitative information. (see Table 20.)

5.2.2.3.1.2 Preferred. The preferred type of scalar indicator for most applications has a moving pointer and a fixed scale. (The scale may be circular, curved (arc), horizontal straight, or vertical straight.) With a moving-pointer, fixed-scale indicator, both the scale progression and control movement are compatible with operator expectancies. Therefore, this type of scale can be used effectively wherever a scalar indicator is required. The other major type of scalar indicator has a fixed pointer and a moving pointer. Because there is always compromise to one or another human engineering principle in use of this design, its use should be limited to the following applications: (a) where multiple scales can be lined up and read in a row or column (with the readout values always appearing in the same position--preferably in the center of window openings) and/or (b) where speed and accuracy of setting is not critical.

5.2.2.3.1.3 Scale linearity. Scales should be graduated linearly even if the function being controlled is non-linear. If the non-linearity of the function causes too much scale compression making readout or adjustment difficult, another type of device such as a moving-tape indicator would be preferred over use of a non-linear scale.

5.2.2.3.1.4 Scale marking and numbering.

5.2.2.3.1.4.1 Graduation markings. Scale graduations should be in increments of 1, 2, or 5 units or decimal multiples thereof (except as noted in 5.2.2.3.1.4.2). No more than three sizes of marks should be used on any scale. The scales which require three sizes of marks include those which have numbered values in multiples of 10 but are graduated in 5° and 10° intervals. The number of graduation marks between numbered marks (not to exceed nine) are presented in Table 21, and illustrations of scales graduated in various ways are provided in Figure 27.

5.2.2.3.1.4.2 Scale numerals. Except for measurements that are normally expressed in decimal fractions, whole numbers should be used for major graduation marks. Intermediate marks should ordinarily not be numbered. On fixed scales, numerals should be vertically oriented, and on rotating scales numerals should be radially oriented and positioned so as to be upright when read against the pointer. Bearing dials should have numerals (and major graduation marks) at either 10° or 30° as shown in Figure 28.

5.2.2.3.1.4.3 Scale length. Scales should start and end on a major graduation mark even if this puts either or both ends beyond the usable range of the scale. For example, if the maximum voltage which can be read on an instrument is 23 volts, the scale should go at least to 25 volts where there could be a major graduation mark.

5.2.2.3.1.4.4 Starting point. Display scales should start at zero, except where this would be inappropriate for the function involved.

5.2.2.3.1.5 Pointers.

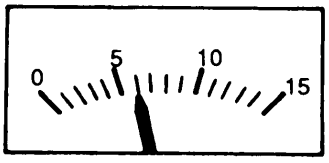
5.2.2.3.1.5.1 General. For best legibility, indicators with scales should have pointers that are relatively wide at the pivot, tapering gradually to a fine tip, arrowhead, or teardrop that is the same width as the smallest graduation mark.

5.2.2.3.1.5.2 Relationships of Tip to Graduation Marks. Pointers should meet, but not overlap, the shortest scale-graduation mark. The tips should never be more than 1.5 mm from the scale graduations. The tip should be equal in width to the minor scale graduations.

5.2.2.3.1.5.3 Normal Pointer Position. The normal (or zero) pointer position of a scalar indicator should be at 12 o'clock for right-left directional information, and 9 o'clock for up-down information. For purely quantitative information, either position may be used.



A - FIXED-SCALE, MOVING-POINTER PREFERRED; THREE-LEVEL MARKING, NUMBERED AT EACH MAJOR MARK. POINTER AWACENT TO GRADUATION MARKS TO PRECLUDE OBSCURATION OF EITHER MARKS OR NUMBERS.



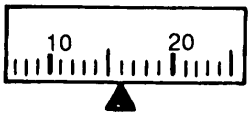
B - FOR SHORT, FINITE SCALE, EVERY 5TH GRADUATION IS MARKED; USING ONLY TWO-LEVEL MARKING.



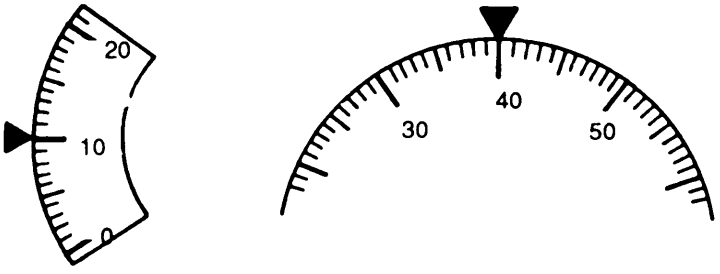
C - WHEN SCALE CROWDING MAKES POINTER-MARK ASSOCIATION DIFFICULT, SCALE MAY BE GRADUATED IN UNITS OF TWO, WITH TWO-LEVEL SCALE MARKING AND NUMBERING AT EACH MAJOR MARKING.



D - WHEN DIAL FACE IS DEEPLY INSET WITHIN INSTRUMENT CASE AND VISIBILIW OF NUMBERS IS MORE IMPORTANT THAN SCALE MARK-POINTER ASSOCIATION, POINTER MAY BE LOCATED INSIDE THE GRADUATIONS ALONG WITH NUMBERS AT MAJOR MARKINGS. POINTER WIDTH SHOULD BE NARROWED AT POINT IN WHICH IT PASSES NUMBERS.



E - MOVING SCALE AGAINST AN INDEX MARK OR POINTER MAY BE USED WHEN SCALE LENGTH PRECLUDES THE FIXED-SCALE FORMAT (GRADUATION MARKS WOULD BE TOO CLOSE TOGETHER). OPEN WINDOW CONFIGURATION HELPS OPERATOR FOCUS ON SIG-NIFICANT SCALE AREA.



F - WHEN OPEN WINDOW CONFIG-URATION IS ORIENTED IN VERTICAL POSITION, NUMBERS SHOULD APPEAR UPRIGHT AS EACH NUMBER PASSES THE INDEX MARK OR POINTER. TOTAL SCALE EXPOSURE IS DESIRABLE WHEN OPERATOR NEEDS TO REFER TO OTHER PORTIONS OF THE SCALE.

FIGURE 27. Scale graduation, pointer position and scale numbering alternatives

5.2.2.3.1.5.4 Pivot Point. Pointers should be pivoted at the right for vertical scales, and at the bottom for horizontal scales.

5.2.2.3.1.5.5 Mounting. The pointer should be mounted as close as possible to the face of the dial to minimize parallax.

5.2.2.3.1.5.6 Luminance contrast. Luminance contrast of at least 75% should be provided between the scale face and the markings and pointer.

5.2.2.3.1.5.7 Color. Pointer color from the tip to the center of the dial should be the same as the color of the marks. The tail of the pointer should be the same color as the dial face unless the tail is used as an indicator itself or unless the pointer is used for horizontal alignment.

5.2.2.3.1.5.8 Pointers per shaft. There should not be more than two pointers on a single shaft.

5.2.2.3.1.5.9 Reciprocal pointers. With reciprocal (double-ended) pointers, it should be easy to distinguish the end that indicates the reading.

5.2.2.3.1.5.10 Edgewise indicators. In edgewise indicators, such as rectangular meters with straight scales, only the tip of the pointer may be visible. If so, it should be distinctive and obvious: a flag, spade, or target pointer.

5.2.2.3.1.5.11 Dial faces. If the display is used for making a setting, such as tuning in a desired wavelength, it is usually advisable to cover the unused portion of the dial face. The open window should be large enough to show at least one numbered graduation on each side of any setting. If the display is one used in tracking, such as a heading indicator, the whole dial face should be exposed.

5.2.2.3.1.5.12 Coding. When certain operating conditions (such as normal operating temperature or dangerous pressure level) always fall within a limited range of the total scale, these ranges should be made readily identifiable by means of pattern, color, or shape coding applied to the face of the instrument. Use of red color coding should be limited to critical situations. Operating zones may be shape coded when the indicator should be viewed in very low-light-level work environments (0.07-0.7 cd/m^2) or where the illuminant color will cause difficulty in discrimination of colors (see Figure 29).

5.2.2.3.2 Moving-pointer, fixed scale indicators.

5.2.2.3.2.1 Numerical progression. Numbered scales show increase clockwise, from left to right, or from bottom to top, depending on the scale layout (circumferential, or linear in horizontal or vertical axis).

5.2.2.3.2.2 Orientation of numerals. Numbers on fixed scales should appear vertical (upright) to the observer.