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TRANSPORTATION MARKINGS: A STUDY IN  
COMMUNICATION MONOGRAPH SERIES

VOLUME I FIRST STUDIES IN  
TRANSPORTATION MARKINGS

PART B A FIRST STUDY IN  
TRANSPORTATION MARKINGS: THE U.S.

Second Edition, Revised & Enlarged

Brian Clearman

Mount Angel Abbey

1992

The Dedication is that of Volume I,  
First Edition:

To My Parents:

Dad (1909-1980) Mom (1910-1973)

My step-Mother Jennie (1911-1977)

My step-Mother Mary

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PREFACE

This monograph is the second edition of **A First Study in Transportation Markings: The U.S.**, Part B of Volume I. Part B was originally one unit of a unified Volume I published by University Press of America in 1981. A second edition of Part A and of Parts C & D have already been published. The diverse materials of the original study have now all achieved separate existences.

This edition is more than a reprinting of the original study. It is a revision characterized by limited deletions, not inconsiderable additions and substantial revision of retained materials. The old Chapter 7 contained a multifaceted introduction, nomenclature, notes and a pictorial classification. The new chapter bears little resemblance to it. Chapter 7 now contains a brief introduction, followed by extensive review of the monograph's many classifications; messages and nomenclature are also in that chapter. Chapter 8 originally contained three classifications and no explanatory notes. It now contains the main classification with notes augmented by two variant classifications with notes.

Descriptive material originally was in one chapter, Chapter 9. That material is now divided into two chapters: sea and air markings in Chapter 9 and surface markings in Chapter 10. Marine aids in 9A are divided into floating and fixed segments. Materials on terminology, role of federal and non-federal agencies have been added. Fog signals messages have been increased

while electronic aids have undergone some downsizing. Lightships receive little attention as they are now of the past. The passing of the transition era in buoyage systems has also been noted.

Aero navigation aids in 9B includes more terminology, comments on more stability in aids, substantially new coverage on approach aids, beacons, obstructions and some electronic devices. Reductions from the first edition are notable for signs and markings of all forms; this is true of some forms of electronics as well. Some reduction of coverage for elevated lights has also occurred. Signs and markings are not less important than in the first edition but the treatment was overly long in the earlier edition.

Railway signals in 10A has undergone the greatest change: the detailed rule-by-rule discussion of messages has been dropped. Instead a home-crafted chart joined by brief notes serves for the message treatment. Discussion of signal types has been added.

Traffic control devices in 10B is now marked by more stability in contrast to the more accelerated changes of an earlier time. There is more treatment of special forms of signals. Sign treatment is similar but reformulated and treatment of markings is somewhat reduced.

Illustrations have been revised for the study and in some instances expanded. The Glossary has been dropped since the salient terms are adequately explained in the text. The former Chapter 10, Message Producing Equipment, has been dropped as it was too cursory to

adequately cover the topic and a substantial expansion of the material would have been inappropriate for this study.

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CHAPTER SEVEN

U.S. TRANSPORTATION MARKINGS:

PRELIMINARY CONSIDERATIONS

7A Transportation Markings:

Taxonomy & Semiotics

7A1 Introduction: U.S. Markings as Model for  
Further Studies: The Role of Classification

This study of U.S. Transportation Markings has two principal dimensions: classification of markings and a descriptive treatment of markings. The classification is found in several parts of the study: Chapter 7b, all of Chapter 8, and the Appendix. The descriptive treatment is considered in Chapters 9 and 10. The descriptive treatment includes both types of markings and their messages with an emphasis on messages. Other topics of significance, though more briefly examined, are the concern of Chapter 7A.

A preface supposedly exists to explain the why, the scope and the purpose of a study. What follows may seem to overlap or overshadow the preface; however, neither is intended. What is intended is the formulation of a foundation for this study, a foundation which is an integral part of the entire monograph and that takes the form of a largely historical vignette. The material has a resonance with the Prolegomena of Part A, 2nd ed. However, those earlier comments constituted a basic core for the Series and were less immediately directed to one monograph.

The initial transportation marking study began many years ago as a classification of U.S. transportation markings. Yes: taxonomy was the initial element of the Series. In time it was joined by a "anthological survey of beaconology" and in time the material moved beyond an anthology state. And in time a semiotics dimension was added, and the postanthological title of Transportation Markings: A Study in Communications was prefaced with the word American. In yet more time the manuscript became Part B, a single element, in a much larger study.

For quite some time Part B seemed of limited interest as globally-orientated monographs were planned and written. Yet of late this study seems to have importance both in itself and as a model for the other studies (and further revisions and studies not connected to this monograph series). That importance has more to do with taxonomy than with anything else.

The first edition of the study had several classifications; this edition has ten classifications. Chapter 7B and other parts of the study will take up those topics; there is no need to present ever more redundant information here. However, the role of model, which resides primarily in taxonomy, belongs here. The many classifications offer a variegated pattern for viewing markings in themselves and in many different perspectives. The smaller scale of transportation markings in one nation makes the classifications more feasible to compile and to apply. But the taxonomical perspectives on this smaller scale offer a multi-linear matrix for taking up transportation markings in other

nations, or in trans-national models of multiple-modal marking constructs.

These brief remarks indicate the original cast of the study, the explosion of classifications in this study and their value for examining markings from many perspectives. The classifications uncover the points of commonality: the elements binding transportation markings together, and thereby illuminating a pre-existing commonality. All of this can be transferred to different milieux whether broad and general studies or narrow, in-depth studies in a restricted field.

#### 7A2 Communication, Semiotics & the Physical Object

Classification is an important tool for transportation markings but it is not the only tool. Three other areas offering important perspectives are communications, semiotics (in two forms) and the physical object in itself. Part A, (2nd ed), from which the following remarks are extracted, offers further information on these topics and provides bibliographical aids for further reading.

Semiotics is the study or science of signs; it also can be defined as the study of sign systems. Sign systems, including various types of codes and codes, are central to transportation markings. Semiosis or sign process is an essential concept for semiotics; it includes the sign, the object it refers to, the interpretant, and signification.

The sign (with the meaning of mental process, not a physical object) stands for

something else, the interpretant creates a disposition to act in a given way and signification is the meaning of the actualized process. For example, a red nun buoy (color and shape more than the physical buoy) is the sign, it stands for the side of the channel; the interpretant is that disposition to keep the edge of the channel to the right of your vessel. The signification is: keep the buoy to your right.

The aspect of codes is also important for semiotics. They constitute a major sign system and are of many forms. According to the typology of Pierre Guiraud, the category of codes that is important for transportation markings is that of logical codes and, within that category, practical codes. Ship whistles, fire alarms and military signals are other forms of practical codes (Guiraud 1975, 51-53).

Semiotics, though important, does not give much attention to the physical dimension that creates semiotic signs. That dimension may be supplied by communication theory. This is seen in the communication chain concept of Shannon & Weaver. The chain contains an information source, transmitter, channel, receiver and destination. Messages are defined as "a sequence of elementary symbols" and signals "are only the energetic or material vehicles of signs, their physical form." Shannon and Weaver's concept includes the signal (the physical aspect) though not the signs. However, at least one scholar expresses the view that the sign part is present implicitly (Shannon & Weaver in Noth 1990, 174-175).

In summary, communication theory is important because that model is concerned with physical forms while semiotics centers on the mental process of the sign; while that is a simplification it is essentially valid.

One final perspective that can be offered is that of Roland Barthes' semiotics of the object, even though transportation markings was not included within it. Barthes defined the object "as what is fabricated or produced; it is of finite substance, standardized, formed and normalized." His semiotics of the object includes a set of connotations and a set of coordinates; the coordinates are of especial interest for this study (Barthes 1988, 180-184 TISR).

The first coordinate, that of the symbolic, denotes the fact that every object serves as a signifier of something signified. While the second coordinate, that of classification, refers to the classification of objects that "is imposed upon us or suggested by our society." The focus on objects and the meaning directly emanating from the object and the social construction of classifications of objects within society can reasonably be applied to transportation markings. Neither "regular" semiotics nor even communication theory places a specific focus on objects, while the semiotics of the objects offers that dimension. The classification of transportation marking phenomena in themselves, and outside of any qualifying context, is found in the Index of Transportation Marking Phenomena.

Note on References



The first edition of Part B, and all of Volume I for that matter, contained voluminous traditional end-notes. This writer has abandoned that form of references for Volume II as well as for the second edition of Part A (2nd ed. for Parts C & D retained the traditional notes; that constitutes their final use in the Series). The author-date system of the **Chicago Manual** is employed in this edition of Part B. The acronym "TISRP" is sometimes employed in the study: This Is the Source for the Remainder of the Paragraph.

References in this study may be overly terse. Since, for example, traffic control device material stems largely from one source, references have been to the main parts of that source rather than to individual pages. To do otherwise would have resulted in a vast system of references flanking tiny snippets of text (a nineteenth century British historian once wrote of a work that was a "thin stream of text flowing between rich meadows of footnotes"). In the first edition the writer erred on the side of references and possibly the opposite error has been committed here. An exception to terse references will be the aero navigation aids area. Since aero sources are fragmented among many advisory circulars and other publications it is necessary to provide more references.

The existence of the several other monographs and their sources constitutes a primary reference for this study and includes frequent and detailed references that would soon become redundant in this study. The references are sufficient for identifying sources and locating additional source materials and that, hopefully, will suffice.

The Appendix lacks references since the sources are those of complementary portions of Chapter 8.

## 7B A Celebration of Classifications

### 7B1 Forms of Classification in this Study

Classifications are a basic tool in science and much else; a tool both utilitarian and theoretical. To speak of a "celebration of classifications" may be unusual, even odd. Yet taxonomies are found at the heart of transportation markings and constituted the core of early transportation marking studies.

The initial review of Part B soon went beyond the existing classifications and uncovered a need for new classification forms and for explaining hitherto unseen nuances in existing classifications.

The end result can be termed an explosion of classifications or, more prosaically, a plethora of classifications. The classifications, have developed, in a sense, a life of their own. They constitute a positive force and play a pivotal role in transportation markings. Perhaps a "celebration of classifications" is an apt turn of phrase rather than a markedly odd one.

The best introduction to this topic may be through a classification of the classifications:

#### A Quarternary of Classifications

##### I. **Quadripartite Main Classification**

- A. Main Form: Outline of markings within a context of transportation modes (8A1)
- B. Schematic Classification: Grid pattern with numerical format (8A2)

- C. Pictorial Classification: Schematic form with grid and numerical format (8A3)
- D. An Extrapolation and Expansion of the Main Classification: Multiple & Variant Classification with an alternate numbering system (Appendix i)

### II. Double Transition Classification:

- A. Markings within forms of energy (Appendix ii a)
- B. Markings within forms of markings (Appendix ii b)

### III. Tripartite Message Classification:

- A. Nature of Message Classification constitutes one form of classification though it may also be seen as a key through which essential characteristics of marking messages can be determined (7B2)
- B. Macro-Messages Classification  
An informal review/classification of principal message forms within transportation modes. (7B2)
- C. Selective Message Classification of Signs & Markings:
  1. These markings require an additional classification because the physical form and messages are so closely united.
  2. The plethora of Traffic Control Devices requires an exclusive TCD segment. (Appendix iii a)
  3. Aero/Railway/Marine share a second segment. (Appendix iii b)

### IV. Marking Phenomena in Themselves:

Arranged through the medium of an index (7B2 & Index)

The Quadripartite Main Classification focusses on transportation markings within a context of the transportation modes: marine, aeronautical, road and rail. The schematic and outline formats may appear substantially different yet the transportation marking context is present in both forms. The pictorial form follows the grid pattern of the schematic though with fewer entries; sufficient entries are retained to illustrate the salient features of the first classification. The outline form provides a complete listing of the entries with word descriptions added to the numerical designations.

The idea of the Multiple and Variant Classification, a new feature for Part B, originated in the railway study (Volume II, Part F). That study includes an extensive variant classification for the many rail markings that produce the same or similar messages even though the design of the signals varies considerably. For example, color-light signal designs take many forms even though the messages are often very similar. This classification is selective since not all markings have variant forms.

The Double Transition Classification centers on a double outline classification that a) places markings within a framework of the energy forms (visual, acoustic, and electronic) employed to create and project messages, and b) places markings also within a construct of the forms of markings. It is transitional in that markings are seen through the forms of energy of

which the messages are composed; this thereby moves the markings from the transportation mode to the message dimension. And it is also transitional in that the forms of markings refer not only to forms but also to messages.

The Tripartite Message Classification is the concern of the third category. The first sub-category is discussed in 7B2, while the second and third segments are reviewed here with amplification in 78B and the final phase of the Appendix respectively. The nature of messages classification outlines the characteristics for transportation markings and is more in the guise of a key for classifying marking than a complete line-by-line classification.

The second subcategory includes a macro-message classification which is exactly that: a brief attempt at outlining general purposes or core message forms that markings exhibit. It is also included in this chapter.

The third subcategory, Selective Message Classifications, encompasses markings with numerous unitary messages. Most of the members are from the unitary subcategory of the Unchanging Message and Single Message category with the Nature of Message classification being the focus of this classification. For example, traffic signs require this classification since they exhibit many messages even though distinct shapes and color patterns are limited. The main classification includes the physical sign marking but not the plethora of message forms. The titles of these markings indicate the function of the marking though they do not denote the actual message.

Originally there appeared to be a second subcategory of messages. That subcategory was a chimera of the compiler who misunderstood the FAA classification of obstruction lighting. It first seemed that the actual message characteristic was contained in the title of the various types of lights. However, the message was instead attached to the nature of a message description accompanying the titles. The subcategory is retained as a hypothetical construct suggesting a message classification consisting of transportation markings whose descriptive title and message characteristics are unified.

The final category, Marking Phenomena in Themselves, is explained in 7B2, and presented in the second index.

#### 7B2 Classifications: Messages & Marking Phenomena

The topic of messages is multi-faceted. It includes semiotic and communication concepts (touched on briefly in Chapter 7A2), and includes classifications of specific messages (Appendix iii), the nature of messages classification, and what may be termed macro messages (or the goals or purposes of messages) which are both in this section. The last-named topic provides an introduction for the monograph and especially the message coverage.

The definition of Transportation Markings of the Monograph Series is: "any device which aids a mode of transportation by giving guidance, by expressing regulations, or by giving warnings." The core words of guidance, regulation and warning come from traffic control devices

terminology. The definition, concise and possibly simplistic, sums up the purposes of markings; it also serves as a list of the general core messages of markings. General messages can be made more specific by turning to the individual transportation modes of marine, aero, road and rail.

The Coast Guard description of the purposes of aids to navigation (and this also serves as a description of core messages) is simple: aids to navigation assist mariners in determining their position, or course, and warn of dangers (USCG 1977, 1). All aids, lighted and unlighted, fixed and floating, acoustical and electronic, carry out one or more of those three purposes or general messages.

The general goal of traffic control devices given by MUTCD centers on the expediting of traffic movements; a drawing out of that goal would include the words guidance, warning and information (MUTCD 1988, 1A-1).

Neither aero nor rail sources appear to have a succinct over-arching description of goals/ general message patterns. However, it is relatively easy to determine messages patterns for aero and rail markings.

Aeronautical navigation aids have five purposes or general messages (which can be conflated into three purposes): identify airports; determine position (these first two named can be conflated into one purpose of determination of position or airport -- this resembles marine practice); provide guidance; delineate runways and taxiways (and, in turn, the last two named can be merged into a single

message of providing guidance); and give warnings of obstructions (a variety of FAA Advisory Circulars constitute the reference; see Chapter 8A1). Signs and pavement markings augment these messages and supplement them with messages of information.

The Association of American Railroads (AAR) notes that safety was the original goal for rail signals, with a major goal of expediting train movement later becoming significant. However, safety and efficient movement of trains are so intertwined as to be one goal (AAR, ARSPAP, III, 1953, 3). Armstrong, a major writer in rail matters, speaks of the rail signal system as having three accomplishments: safe movement of closely following trains, safe passage at junctions and crossings, and safe movement of opposing trains on single tracks (Armstrong 1957, 3). Regulation, guidance and warnings are closely united, even fused within the double-goal and triple "accomplishments". Rail signs add an additional message of information.

The following material on the nature (or forms or primary characteristics) of messages is reprinted from the second edition of Part A, Volume I.

Transportation marking message can be reduced to four major forms:

1. Multiple capability that permits **Changing message/Multiple Message (C3M)**
2. Message capability that permits only **Changing Message/Single Message (CMSM)**
3. Message capability that includes an **Unchanging Message but with Multiple Messages (U3M)**

4. Message capability that is restricted to  
**Unchanging Message and Single Message (UMSM)**

Marking messages have a dialectical character about them: they are either unchanging or changing; either they are multiple messages or they are a single message. All of the possibilities are combinations of one member of each of the two sets of that dialectical matrix.

The most frequent type of changing message/multiple message (C3M) are those of road and rail lighted signals. In these instances the message has several phases or sub-messages which change according to pre-programming, transportation mode-initiated change, or central control. The basic signal for rail and road contains three lenses displaying red, green and yellow hues. The meaning of multiple-message refers to distinctly different messages at various times from a single marking. Changing refers to the situation in which the messages alternate or change according to some established pattern. A marine light may have a complex message but nonetheless it is a single sequence or period and that means one message. There are few examples of C3M outside road and rail signals. Other varieties of railway signals (searchlight, position, color-position) follow the C3M pattern though the manner of executing the message varies from one signal type to the next.

The changing message/single message (CMSM) type suggests a contradiction since change and a single message sequence are in one message formulation. A reasonable explanation is possible: some markings contain one message but that message is not continuous. For example, a

road signal at a school may only operate during school hours, or a drawbridge signal may function only when the lift span is raised. The signal, when inoperative, creates a different pattern of traffic than when on.

A contradictory nature may also seem present in the unchanging message/multiple message form (U3M). This category refers to the situation where at least two distinct messages are found within a single marking. For example, the device known as a "traffic beacon" has an unchanging message yet two messages are displayed: one a flashing yellow indication denoting caution, the other, a flashing red indication denoting stop and then proceed only when the intersection is clear. A second example is the marine light known as a directional signal. It emits two or three messages for different zones of a channel simultaneously.

Unchanging message/single message (UMSM) at first appears to be self-explanatory. It includes the greater part of marine and aeronautical markings as well as many unlighted and partially-lighted road and rail markings. The UMSM type has one sequence which is unvarying in all cases. But in the 1984 monograph on traffic control devices - in this Series - it became apparent that some very different forms of markings were merged together in the UMSM category, that UMSM could contain significant differences. The changes made in that study carried forward to the railway study, then to the revised version of Part A and now Part B.

The members of UMSM exhibit one of two message characteristics: they either produce one message at a time (though other messages could be programmed for the mechanism) or they produce a single message and are incapable of any other message. The former sub-category can be termed "Programmable Transportation Markings" and the remainder can be named "Unitary Transportation Markings".

The unitary group needs to be further subdivided: a) some markings have a single form and admit no variation; these are termed "Variant A"; b) an intermediate group allows for one of several predictable variations and these are subsumed under "Variant B"; c) finally, there are markings about which few, if any, predictions can be made and they are labelled "Variant C". A stop sign clearly suggests the "A" variant, a turn sign (displaying one of several types of turns) represents "B" while a sign denoting the name of a town denotes the "C" form.

A programmable marking, such as a marine light, cannot easily be further subdivided. The relevant marine agency may publish a listing of light phase characteristics (and a range of characteristics for specific functions) but the actual light/dark sequence is an individualized process and one would have to examine many individual lights to gain an appreciation of the categories of messages.

This final segment of 7B2 does not refer to messages. Instead it refers to transportation marking phenomena in themselves. Transportation markings are often not perceived in their own uniqueness free of ties to modes of

transportation or to energy forms or semiotics or specific messages. Seemingly any classification places the markings within a context of something else. How can the markings stand alone? Probably only by a simple alphabetical listing. A Victorian economist, W. Stanley Jevons, offers a form for such a listing.

In his tome, **The Principles of Science: a Treatise on Logical and Scientific Method**, Jevons notes that even a simple alphabetical index is a true classification. An index follows a classifying principle - the letters of the alphabet - and the objects so arranged can thereby be regarded as truly classified. The index of marking phenomena, which would have been included in any case, serves a double purpose by also providing a classification of the individual markings (Jevons 1958, 714).

7B3 Nomenclature  
[Reprinted from Part A, 2nd ed]

The nomenclature or rules for naming and classifying transportation markings were established in 1969 and 1970. The classification system has been substantially influenced by the Dana System of Mineralogy (1944 edition edited by Charles Palache). The Dana system uses numbers (newer editions of that system have dropped the distinctive feature of numbers for mineral) as well as names for mineral specimens (in contrast to many natural classifications that have names only; to be sure, other classifications, including those of libraries, use numbers).

What is the rationale behind this nomenclature and classification schema? The

schema adopted is not a "natural" pattern since there is no natural transportation markings arrangement. But hopefully, the adopted arrangement is not altogether arbitrary. The system has four levels (each represented by a digit): mode of transportation; nature of marking; classes of markings (when applicable); and the individual marking. Because of the special nature of buoys and other floating aids to navigation the marine mode of transportation has been divided into two parts.

Buoys are therefore represented by the number "1" and fixed aids by "2". Aeronautical navigation aids adjoin marine and are allotted "3" (there are some resemblances between marine and aero; for example, **Readers' Guide to Periodical Literature** in some older volumes referred to "Aerial Lighthouses"; Volumes VI-X, 1922-1937). Traffic control devices are represented by "4" and rail signals, signs and markings by "5".

Other arrangements by mode of transportation are possible. Historically, road markings are probably the oldest followed by marine, rail and aero. Yet there are other factors supporting the present arrangement: marine aids are the most diverse area of modern markings. Many aeronautical aids are unlighted or partially-lighted which is also the case with marine, and many aids are electronic in nature for both aero and marine. One could further say that "beacons" are a major form of marine and aero aid while many rail and road signals are of the "signal" form. Therefore marine, followed in turn by aero, then by road and rail, is a reasonable and even sensible arrangement.

The nature of the message number is denoted by the second digit following this arrangement: fully-lighted visual messages are represented by "1" (for example, rail and road signals). Partially-lighted markings are listed under "2". The original classification attempted to distinguish between over 50% lighted and those merely half-lighted. But that is a difficult, if not impossible, distinction. Perhaps some computer might be able to ascertain that a lighthouse, for example, is more than 50% lighted (since the need for that may be greater at night than in daytime) and that a railway target with switch lamp is exactly half-lighted and half-unlighted. But in this preliminary study such distinctions are not possible.

Number "3" denotes unlighted markings (signs, pavement markings, buoys without sound or lighted mechanisms). Acoustical signals are "4" in the classification and electronic devices are "5". Because of changes in the system and in different monographs it will be necessary to examine and alter the numbers of some transportation markings in older classifications.

The third digit number is not required for all markings. It is needed where two or more groups of markings are found within a message type. For example, there are several forms, or classes, of unlighted buoys: nuns, cans, spars, etc. The third or class number designates the various groups. In this classification the third digit "1" marks a nun buoy. A "0" will be found in the third digit position when classes do not exist.

The last digit denotes the specific marking number and this allows for up to ten members for

a specific classification sequence. For a nun buoy in the international classification the total number is 1412: indicating it is a buoy that is unlighted (14), that it is the first member of a group of more than one type of unlighted buoys (141, unlighted-conical) and the "2" designates that it is a U.S. nun buoy.

A classification problem developed with traffic control devices. Traffic signs merge the type of sign (in a physical other-than-semiotic sense) with the message so that instead of a single marking which can be programmed for many different specific message characteristics (such as a marine light) the traffic sign has a fixed and very narrow message. There are many types of signs each with one message (this classification is of types not messages, but with traffic signs the type and message become closely united and can not be readily "broken" apart). This has meant that the last digit does not represent individual signs since, in part, they are more semiotic signs - in some sense and to some degree - than physical signs and therefore the fourth digit refers to groups of signs. For example under 442, Regulatory signs, there are several categories for prohibitory purposes and these in turn are divided into subcategories, so those dealing with turns are 4423. A message for a sign affects the physical appearance of the sign as a physical unit and is therefore within the nomenclature of the classification.

In summary, the transportation markings classification follows this pattern:

First Digit: mode of transportation-marine (in two parts), aeronautical, road and rail

Second Digit: nature of the message (visual divided in all-lighted, partially-lighted, and unlighted; acoustical, electronic, combination)

Third Digit: classes of a given form of marking when applicable

Fourth Digit: individual marking number (altered to group of closely united markings when numerous)

Numbers employed:

First Digit: numbers 1 to 5

Second Digit: numbers 1 to 6

Third Digit: numbers 0 to 9

Fourth Digit: numbers 0 to 9



CHAPTER EIGHT

CLASSIFICATION

8A Main Classification

8A1 Outline Form: Markings Within a Context of  
Transportation Modes

- 1 Floating Aids to Navigation: Marine Use
  - 12 Lighted & Lighted Sound Buoys
    - 120 Most Exposed
      - 1200 Lighted
      - 1201 Lighted Whistle
      - 1202 Lighted Horn
      - 1203 Lighted Bell
      - 1204 Lighted Gong
    - 121 Exposed
      - 1210 Lighted
      - 1211 Lighted Whistle
      - 1212 Lighted Horn
      - 1213 Lighted Bell
      - 1214 Lighted Gong
    - 122 Semi-Exposed
      - 1220 Lighted
      - 1221 Lighted Horn
      - 1222 Lighted Bell
    - 123 Protected
      - 1230 Lighted
    - 124 Most Protected
      - 1240 Lighted
    - 125 Discrepancy Buoy
      - 1250 Lighted
    - 126 Major Aids
      - 1260 Large Navigation Buoy (LNB)
  - 13 Unlighted Buoys
    - 130 Most Exposed
      - 1300 Can

- 1301 Nun
- 131 Exposed
  - 1310 Can
  - 1311 Nun
- 132 Semi-Exposed
  - 1320 Can
  - 1321 Nun
- 133 Ice
  - 1330 Can
  - 1331 Nun
- 134 Western Rivers
  - 1340 Can
  - 1341 Nun
- 135 Swiftest Western Rivers
  - 1350 Can
  - 1351 Nun
- 136 Foam-Filled Buoys
  - 1360 Can, Protected
  - 1361 Nun, Protected
  - 1362 Can, Most Protected
  - 1363 Nun, Most Protected
- 137 Plastic Buoys
  - 1370 Can, Protected-Temporary
  - 1371 Nun, Protected-Temporary
  - 1372 Can, Most Protected-Temporary
  - 1373 Nun, Most Protected-Temporary
- 138 Discrepancy Buoy
  - Most Protected-Temporary (Foam-filled Plastic)
  - 1380 Unlighted, Can daymark
  - 1381 Unlighted, Nun daymark
- 139 Other Unlighted Buoys
  - 1390 Spar
  - 1391 Sphere
  - 1392 Drum
  - 1393 Barrel

- 15 Sound Buoys
  - 150 Single Types
    - 1500 Bell
    - 1501 Gong
    - 1502 Whistle
- 2 Fixed Aids to Navigation: Marine Use
  - 22 Lighted Aids
    - 220 Major Light Structures
      - 2200 Enclosed Towers
      - 2201 Skeleton Towers
      - 2202 Houses/Towers on Special Foundations
    - 221 Minor Light Structures: Marine Sites
      - 2210 Single Pile
      - 2211 Multiple Pile
      - 2212 Standard Structures on Special Foundations
    - 222 Minor Light Structures: Land Sites
      - 2220 Post
      - 2221 Spindle
      - 2222 Skeleton Tower
      - 2223 Cylindrical
      - 2224 Small House
      - 2225 Pyramidal
  - 23 Unlighted Aids
    - 230 Marine Sites
      - 2300 Single Pile
      - 2301 Multiple Pile
    - 231 Land Sites
      - 2310 Post
      - 2311 Spindle
      - 2312 Stake
      - 2313 Tripod
  - 24 Electronic Aids to Navigation
    - 240 Short Range

- 2400 Radiobeacon
- 2401 Racon
- 2402 Radar Reflector
- 241 Long Range
- 2410 Loran
- 2411 Omega
- 2412 GPS
- 25 Fixed Sound Signals
  - 250 Single Types
    - 2500 Diaphragm [Pure tone, Bell tone, Gong tone]
    - 2501 Diaphone
    - 2502 Siren
    - 2503 Air Horn
- 3 Aeronautical Navigation Aids
  - 31 All-Lighted
    - 310 Approach Lighting
      - 3210 Lampholder Unit
      - 3211 Discharge Flashing Light
      - 3212 Generic Visual Glideslope Indicator
      - 3213 Precision Approach Path Indicator
  - 32 Partially-Lighted
    - 321 Beacons
      - 3210 Rotating
      - 3211 Flashing
    - 322 Runway & Taxiway Inpavement Lighting
      - 3220 Runway Centerline & Touchdown Zone Lights
      - 3221 Edge, Threshold/End Lights
      - 3222 Taxiway Centerline Light
      - 3223 Taxiway Intersection Lights
    - 323 Runway & Taxiway Elevated Lighting

- 3230 High Intensity Runway Edge & Threshold/End Lights
- 3231 Medium Intensity Runway Edge, Threshold/End & Taxiway Lights
- 3232 Medium Intensity Threshold Light-Special
- 3233 Low Intensity Edge, Threshold/End Light
- 3234 Holding Position Edge Light
- 324 Obstruction Lighting
  - 3240 Steady-burning Light
  - 3241 Flashing Light
  - 3242 High Intensity Light
  - 3243 Medium Intensity Light
- 325 Lighted Signs: Taxiway Guidance & Runway
  - 3250 Mandatory Instruction
  - 3251 Location
  - 3252 Direction
  - 3253 Taxiway Ending Marker
  - 3254 Destination
  - 3255 Roadway
  - 3256 Information
  - 3257 Runway Distance Remaining
- 326 Wind Indicators
  - 3260 Wind Cone
  - 3261 Wind Tee
- 33 Unlighted Aero Navigation Aids
  - 330 Runway Markings
    - 3300 Centerline
    - 3301 Designation
    - 3302 Threshold
    - 3303 Fixed Distance
    - 3304 Holding Position
    - 3305 TDZ
    - 3306 Side Stripes

- 331 Taxiway Markings
  - 3310 Centerline
  - 3311 Edge
  - 3312 Holding Position
- 332 Runway & Taxiway Retroreflective Markers
  - 3320 Inpavement-Centerline
  - 3321 Elevated-Edge
- 333 Obstruction Markings
  - 3330 Patterns
  - 3331 Markers
- 334 Single Types
  - 3340 Segmented Circle
    - Airport Marker System
  - 3341 Compass Calibration Pad
- 34 Electronic Aids
  - 340 Course and Distance Signals
    - 3400 Glide Slope
    - 3401 Localizer
    - 3402 VOR
    - 3403 VORTAC
    - 3404 TACAN
    - 3405 DME
  - 341 Location Identification Signals
    - 3410 Non-directional Beacon
    - 3411 Marker Beacon
    - 3412 Compass Locator (COMLO)
- 4 Traffic Control Devices
  - 41 Traffic Signals
    - 410 Single
      - 4100 Traffic Control Signals
    - 411 Specialized Use
      - 4110 Traffic Beacons

- 4111 Lane-Control Signals
- 4112 Moveable Bridge Signals
- 4113 Railroad Crossing Signals
- 4114 Ramp Control Signals
- 4115 Pedestrian Signals
- 4116 Emergency Traffic Signals
- 4117 One-Lane/Two-Way Signals
- 43 Signs and Markings
  - 430 Regulatory Signs
    - 4300 Dominant Model, Rectangles (vertical emphasis)
    - 4301 Secondary Model, Squares
  - 431 Warning Signs
    - 4310 Dominant Model, Diamonds
    - 4311 Supplemental Model, Rectangles (vertical emphasis)
    - 4312 Supplemental Model, Squares
    - 4313 Supplemental Model, Triangle (isosceles)
  - 432 Guide Signs
    - 4320 Dominant Model, Rectangles (horizontal emphasis)
    - 4321 Special Shape, Shields
    - 4322 Special Shape, Rectangles, (elongated-vertical emphasis)
    - 4323 Supplemental Model, Rectangle (vertical emphasis)
  - 433 Markings
    - 4330 Pavement
    - 4331 Curb
    - 4332 Objects-within roadway
    - 4333 Objects-adjacent to roadway
    - 4334 Objects-end of roadways
    - 4335 Delineators-curb
    - 4336 Delineators-upright

- 4337 Barricades
- 4338 Channelizing Devices
- 45 Sound Signals
  - 450 Railway Crossing Signal Bells
- 5 Railroad Signals, Signs and Markers
  - 51 Lighted Signals
    - 510 Trackside Signals
      - 5100 Searchlight-Color Light
      - 5101 Color-Light
      - 5102 Position-Light
      - 5103 Color-Position Light
    - 511 Dwarf Signals
      - 5110 Searchlight-Color Light
      - 5111 Color-Light
      - 5112 Position-Light
      - 5113 Color-Position Light
    - 512 Cab Signals
      - 5120 Color-Light
      - 5121 Position-Light
  - 52 Partially-Lighted Signals
    - 520 Semaphore Signals
      - 5200 Trackside
      - 5201 Dwarf
    - 521 Switch Signals
  - 53 Unlighted Signals, Signs, Indicators, Markers
    - 530 Targets
      - 5300 Color
      - 5301 Shape
      - 5302 Position
      - 5303 Color-shape
    - 531 Miniature Graphic Symbols
    - 532 Signs
      - 5320 Location

- 5321 Advanced Location
- 5322 Speed Control
- 5323 Safety
- 5324 Maintenance of Way
- 533 Markers
- 55 Sound Signals
  - 550 Cab Signal Bells

## 8A2 Explanatory Notes for Main Classification

Separate explanatory notes have been prepared for the various classifications or groups of classifications. The following notes pertain to the main classification only. Schematic and Pictorial Classifications (Chapter 8B), though clearly and closely related to this classification, require separate notes even if brief. The classifications of the Appendix are also accompanied by explanatory notes.

12. Lighted and Lighted-Sound Buoys. The first edition of Part B separated Lighted-Sound from Lighted buoys; a category entitled combination markings was created for markings encompassing two or more message forms. However, the U.S. Coast Guard includes lighted and lighted-sound forms together since buoys for a given class are of the same shape and size, and that approach has been adopted in this edition. While this integrated approach is valid, the older method of placing multi-message markings in a special category has merit. There are seven classes within 12. Most Exposed and Exposed have a full complement of buoys; semi-exposed has a partial complement of forms. The remaining classes have lighted forms only. The Large Navigational Buoy makes up the final class and it has both light and sound capabilities (Reference for all buoys: USCG 1990, 2-2 and 2-3; see also individual descriptions, 2-31 to 2-99).

13. Unlighted Buoys. The apparent complexity of this category of can and nun buoys has been greatly conflated for this coverage. can and nun buoys are designated both by location (Most Exposed, etc) and by class (of

which there are six). The main classification includes the primary differentiation only. Unlighted buoys include additional categories based on special conditions, location and buoy construction materials. These include ice, western rivers and buoy materials (foam and plastic).

Spar, Drum and Barrel were formerly standard buoys and perhaps they should be placed in the multiple and variant classification and not in the main classification. However, the **Aids to Navigation Manual-Technical** mentions these forms, if only in passing, and they are therefore included in 13.

22. Fixed lighted forms, unlike floating forms of marine aids, include many long-established forms. This is especially true with major fixed lights (lighthouses). A classification of fixed lights may become cursory and even simplistic since it can only suggest the physical appearance of these markings. This situation is exemplified in the 220 category which contains just four broad entries. The USCG **Civil Engineering Manual** as well as the **Aids to Navigation Manual- Technical** greatly influenced this segment of the classification. The Multiple and Variant classification includes greater details on fixed lights though the individuality of many aids precludes an exhaustive listing of all nuances (minor fixed aids: USCG 1990, 4-27; major: USCG 1964).

The 221 and 222, Minor Structures, segments of 22 contain only the standard forms of the **Aids to Navigation Manual**. There are many other forms extant and more detailed standard forms

are found in the multiple and variant classification (References for minor fixed aids: USCG 1990, 4-27ff).

24. There are only a few members in the Electronic aids to navigation segment; however the brevity of these aids does not indicate a peripheral role. Older types and subforms are found in Appendix i.

25. The diversity of past fog signals has been reduced to one form (though electronic processes allow for emulation of bell and gong sounds). However, USCG Light Lists include mention of fog signals which are not standard types (from the perspective of the Manual, which includes current federal aids; for example, Fauntleroy Cove Fog Signal in Seattle and Benicia-Martinez Railroad Bridge Fog Signals, Suisan Bay; both locations have sirens) and these are included. The Multiple and Variant classification contains additional forms and subforms (USCG 1990, 7-29ff).

31. Aero Approach Lighting constitutes a fully-lighted segment.

32. Aeronautical lights are precisely regulated so that substantial detail is available even in a classification given over to main forms. A further elucidation in Appendix i allows for a classification that approaches a technical level of content and terminology.

321. Beacons are encompassed within just two classes for this classification. 322. Approach lighting, is largely covered in this classification though some extrapolations are found in the Appendix .

323. Runway and Taxiway Inpavement lights exhibit a high degree of conflation in the main classification. This is permissible in large part because of multiple uses of several basic light fixtures. While there are few entries here there are many more in the Appendix. This situation is true of 324, Runway and Taxiway Elevated lights as well, though to a reduced degree.

325. Obstruction lighting includes basic forms in this classification with extensions in the multiple and variant classification.

326. Since signs are frequently lighted they are listed among the partially-lighted markings (though they need to be included with unlighted markings as well). The older classification nomenclature practice of including a more than 50% lighted aids category and a 50% lighted category had merit especially in the matter of lighted signs. But it is nearly impossible to say a marking is more than 50% lighted or exactly 50%. A carefully thoughtout and executed methodology may be able to resolve the issue but such a resolution has not yet been achieved; the present imperfect merger of largely lighted markings with sometimes unlighted markings (which can be equipped with light apparatus) remains in use. The classification attempt was made to include the major forms of signs without unduly invading the actual message dimension. 327, Wind Indicators, represents a partially-lighted marking category that is more clear: the wind indicator has both day and night dimensions. The multiple and variant classification provides elaboration on taxiway guidance signs but not for runway signs, as it is unneeded.

33. Markings. These are clearly unlighted markings. The confusion over dual use of the term "markings" (also found with road and rail) also appears here. Most of these markings are of the pavement form though raised markings and elevated markers are in use. The problem of distinguishing the type of marking from its message is present here as well as with signs. The main classification focusses on forms and purposes and avoids specific message configurations. The multiple and variant classification elaborates on obstruction markings but the main classification is sufficient for other markings; message classifications provide much information on markings and their messages.

34. Electronic aids provide a special challenge in that there are many aids and almost too many for a single category. In addition, many are part of either Instrument Landing System (ILS) or Microwave Landing System (MLS). Electronic aids, in the main classification, are bifurcated into two categories based on their primary purpose; the multiple and variant classification follows a differentiation principle based on the system (ILS or MLS) that most such aids belong to.

41. Traffic Signals is a very numerous object that can be largely classified under the heading of traffic control signals. Specialized uses include signals at variance, to some degree, with the typical configurations of traffic control signals. Traffic Beacons are substantially expanded in the variant classification (MUTCD 1988, Part IV).

43. Traffic Signs (430-432). Earlier comments about signs and the problem of classification also apply to traffic signs. These matters have been sufficiently discussed in these Notes. Markings, 433, exhibit clearly delineated forms which have been easier to deal with. (MUTCD 1988, Part II).

45. Sound signals have a limited role for TCD since many railway crossings include bells. In the older classification they were included with the combination category since they were usually combined with signs and movable barriers (MUTCD 1988, Part VIII).

51. Railway signals are largely confined to the main classification since the forms are standardized into a few designs. Dwarf signals require separate classification since not infrequently they are physically at variance with full-sized versions. Cab signals can be subdivided into color-light and position-light forms (ARSPP 1949, Ch. 13).

52. Partially-lighted signals require brief mention in the main classification and nothing further in the multiple and variant classification. Switch signals present a problem that is shared with the targets (530) part of 53. Switch signals can be a stand-alone entity or they can be joined with a target. Targets can therefore be either an unlighted marking or part of a partially-lighted assemblage. Only principal shapes of targets are classified in 8A1 since further elucidation would invade either the variant or the message spheres; further shapes are given in the variant classification though that approaches the boundaries of messages (ARSPP 1949; Camp 1903).



531. Miniature graphic symbols (known as track indicators or one of several other designations) are a single entity here since the actual symbols are very much a matter of messages (AAR 1987, 8, 57, 59-60).

532. Signs are classified according to form and function and attempts to skirt actual message configurations. The message classification of Appendix II takes up that vital concern (AREA 1990, Part 7).

55. Most railway sound signals are part of cab signal assemblages; railway crossing bells are part of road signals though closely related to railway operations.

8B1 Schematic Classification of U.S Transportation Markings

Types of Messages	Marine Aids:		Aero- nautical Aids	Traffic Control Devices		Rail- way Signals
	Floating	Fixed				
	I	II	III	IV	V	
			31	41	51	
			310	410	510	
			3100	4100	5100	
			3101	411	5101	
			3102	4110	5102	
			3103	4111	5103	
1				4112	511	
All-				4113	5110	
Lighted				4114	5111	
				4115	5112	
					5113	
					512	
					5120	

40

2  
Par-  
tially  
Lighted

12	22	32
120	220	320
1200	2200	3200
1201	2201	3201
1202	2202	321
1203	221	3210
1204	2210	3211
121	2211	3212
1210	2212	3213
1211		322
1212		3220
1213		3221
1214		3222
122		3223
1220		3224
1221		323
1222		3230
123		3231
1230		3232
124		3233
1240		
125		
1250		
126		
1260		

41

3  
Un-  
lighted

			325		
			3250		
			3251		
			3252		
			3253		
			3254		
			3255		
			3256		
			3257		
			326		
			3260		
			3261		
13	23	33	43	53	
130	230	330	430	530	
1300	2300	3300	4300	5300	
1301	2301	3301	4301	5301	
131		3302	431	5302	
1310		3303	4310	5303	
1311		3304	4311	531	
132		3305	4312	5310	
1320		3306	4313	532	
1321		331	432	5320	

42

3  
Un-  
lighted  
(cont'd)

133	3310	4320	5321
1330	3311	4321	5322
1331	3312	4322	5323
134	332	4323	5324
1340	3320	433	
1341	3321	4330	
135	333	4331	
1350	3330	4332	
1351	3331	4333	
136	334	4334	
1360	3340	4335	
1361	3341	4336	
137		4337	
1370		4338	
1371			
1372			
1373			
138			
1380			
1381			
139			
1390			
1391			
1392			
1393			

4  
Elec-  
tronics

24	34
240	340
2400	3400
2401	3401
2402	3402
241	3403
2410	3404
2411	3405
2412	341
	3410
	3411
	3412

5  
Sound

15	25	45
150	250	450
1500	2500	4500
1501	2501	
1502	2502	
	2503	

43

	I	II	III	IV	V
All-lighted			Pg 45	Pg 45	Pg 45
Partially-Lighted	Pg 46	Pg 46 & 47	Pg 46 & 47		Pg 47
Unlighted	Pg 48	Pg 48	Pg 48 & 49	Pg 49	Pg 49
Sound	Pg 50	Pg 50			
Elec-tronic		Pg 50	Pg 50		

References for 8B2

Page 45:

Column III Top, Bottom: Godfrey  
Center Left: Based on Devore PLAS1  
Center Right: Crouse-Hinds, BT 2.2

Column IV Top, Center Left: MUTCD  
Bottom Left: Eagle  
Bottom Center: Canadian MUTCD  
Bottom Right: WRRS

Column V Template reconstructions of AAR source material

Page 46:

Column I Top, Center: USCG 1990  
Bottom: Parts C & D, Vol I (USCG)

Column II USCG 1964

Column III Top Left  
Top Right: Godfrey  
Center, Bottom: FAA 1991

Page 47:

Column I USCG 1990

Column II Top Right: Godfrey  
Top Left: Template influenced by ADB-ALNACO, L-802

Center Left-Upper: Godfrey  
Center Left-Lower: Crouse-Hinds CT 1.3  
Center Right/Bottom Right: uppermost: SEPCO; remainder are altered existing drawing

Column III Top: Western-Cullen  
Bottom: From Part F

Page 48:

Column I USCG 1990

Column II USCG 1990

Column III Upper Left & Right: FAA 1991  
Center Middle: FAA 1980  
Lower Left & Right: FAA 1991

Page 49:

Column III Top & Center Right/Bottom Right: FAA 1987.  
Bottom Left: FAA 1984.

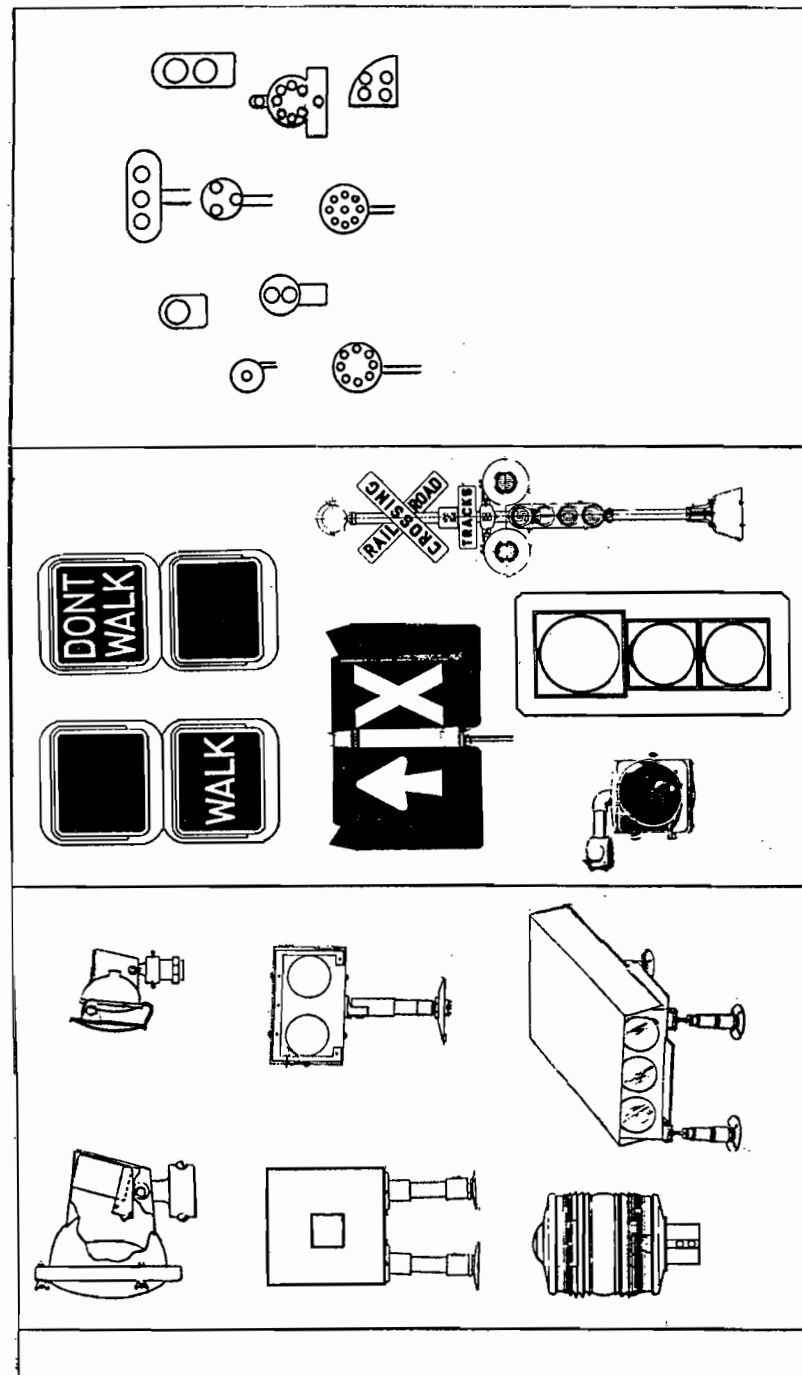
Column IV MUTCD 1988 & HTCD 1983.

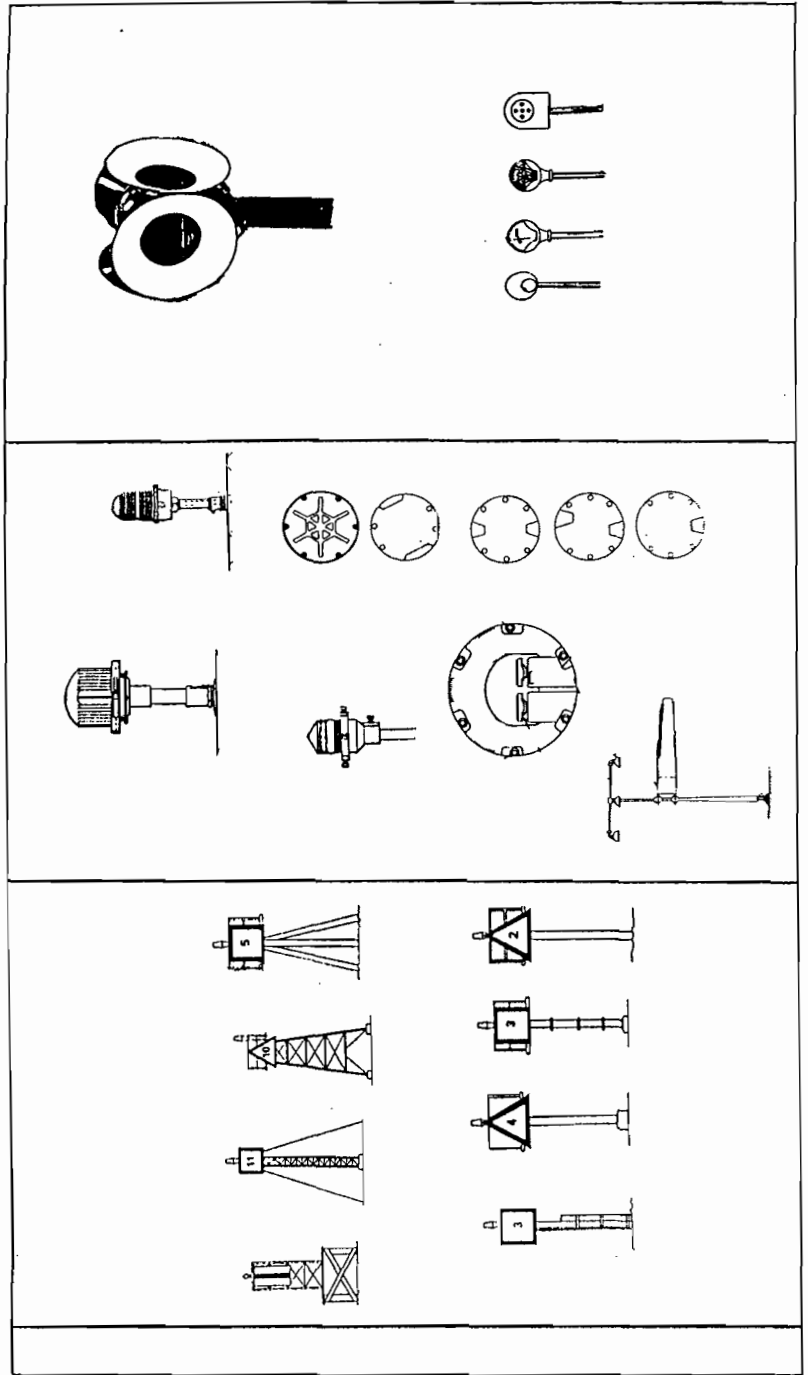
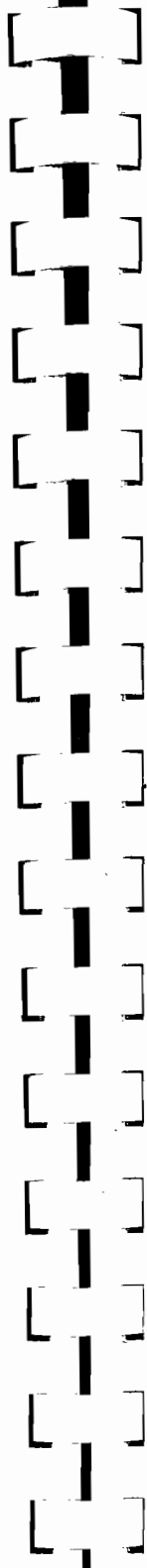
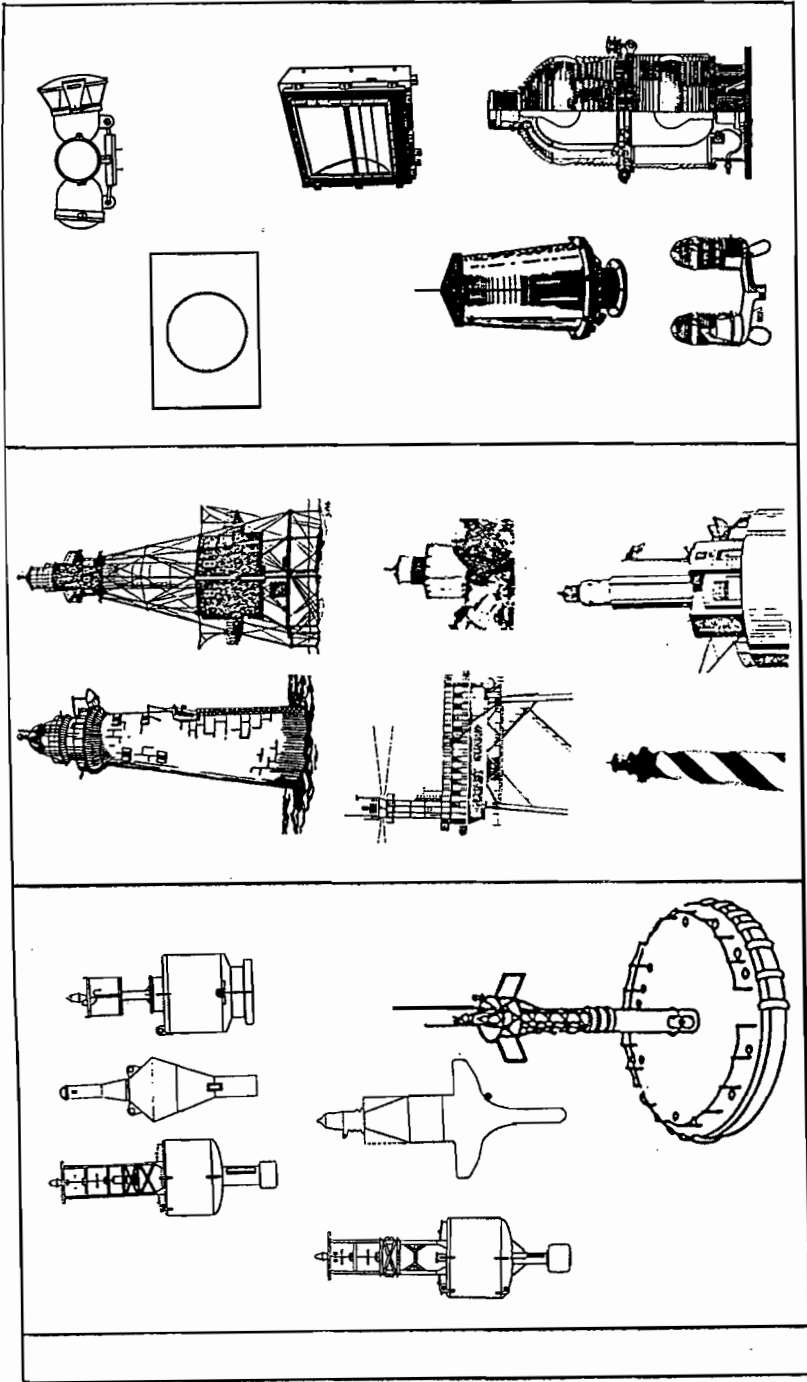
Column V Top & Center: Bethlehem 1981.  
Bottom AAR 1985.

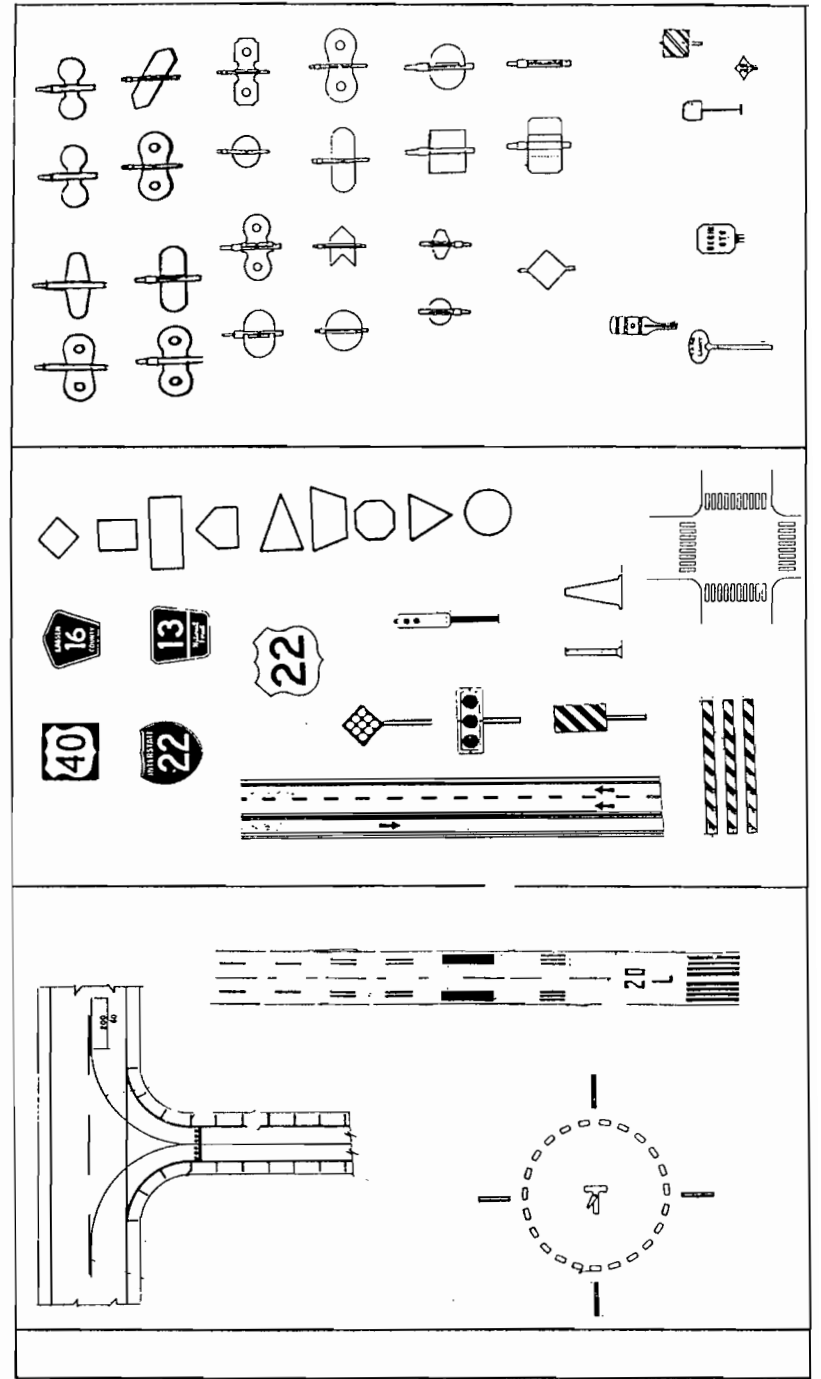
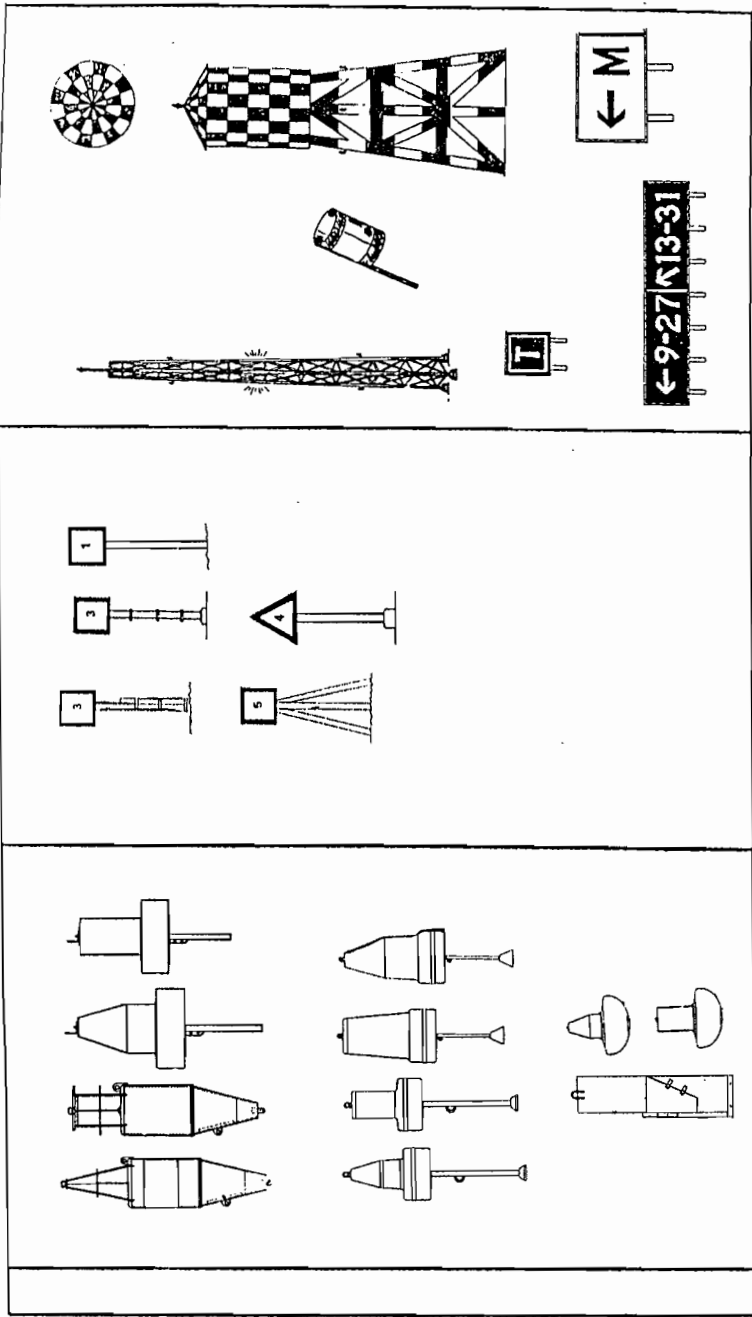
Page 50:

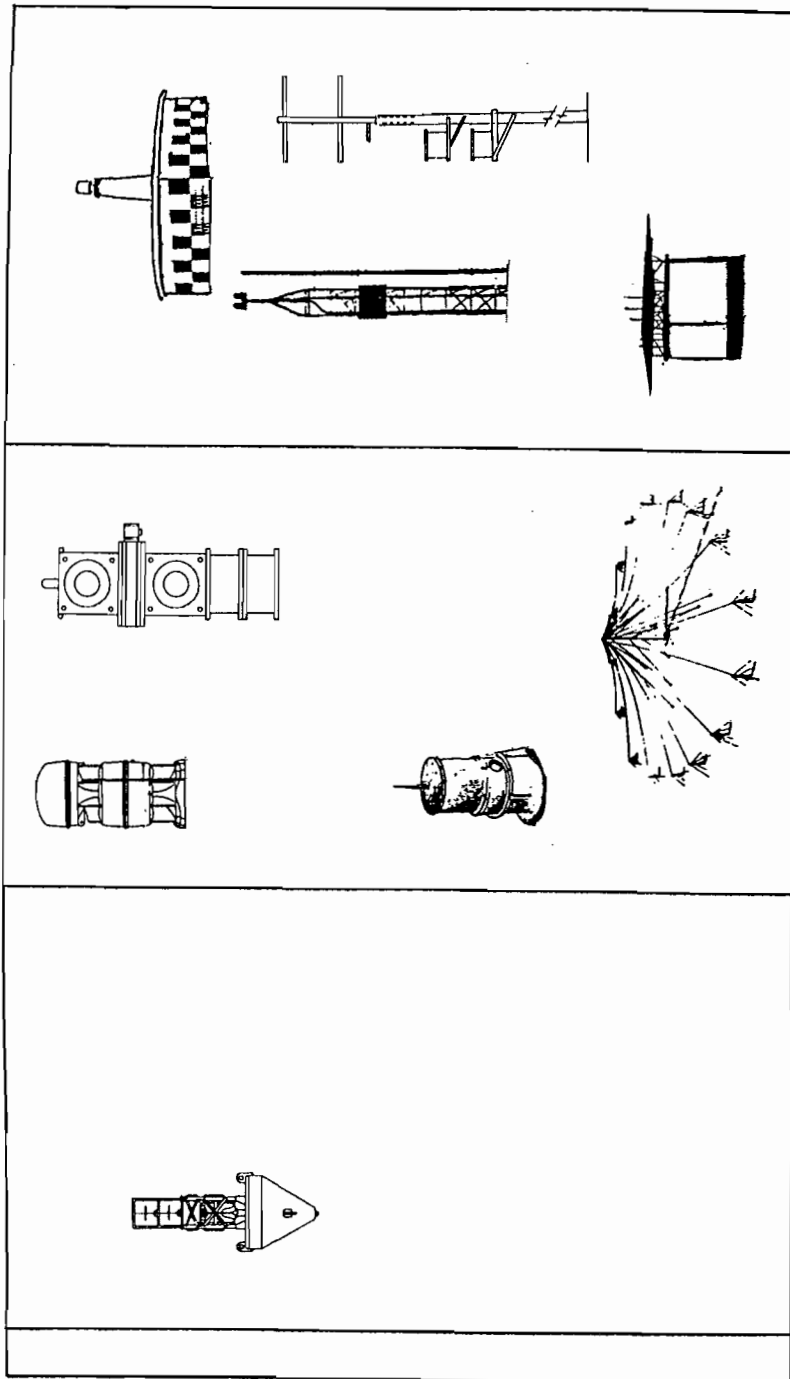
Column I USCG 1990

Column II Top: USCG 1990  
Center Left: Part B, 1st ed. (USCG)  
Bottom: US Navy Omega









### 8B3 Explanatory Notes for Schematic & Pictorial Classifications

The schematic classification requires few explanatory notes. The contents and numerical designations of this classification are those of the main classification. The difference is exclusively one of format. The schematic classification is arranged by transportation mode (horizontal dimension) and by nature of energy wave form (vertical dimension). It thereby integrates two vital aspects of transportation markings and simultaneously illustrates relationships and interconnection between and among the individual markings.

The pictorial classification refers only to principal forms of transportation markings and does not include variant forms. The classification centers on physical appearance of markings. Markings of similar form will be represented by one marking which exemplifies the core design of that grouping. Acoustic and electronic markings illustrations are included though the appearance is less important; nonetheless even in those cases the physical form gives some information about the marking and its messages.

All-lighted: While traffic control signals can have variant configurations the signal pictured is an adequate representative. Traffic beacons are of several physical forms yet a shared core element is present and the illustrated intersection traffic beacon suggests the basic form. Pedestrian signals can be of several shapes and have more than one message configuration; nonetheless standard pedestrian signals bear a strong resemblance to one another

and the signal pictured is an adequate representation.

Railway signals include both full-size and dwarf models. There are notable differences between full-size and dwarf railway signals (for example, height, design, and the number of lamps) that warrant pictures of both forms.

Aeronautical approach lighting is a recent addition to all-lighted transportation markings. This compiler formerly grouped them with partially-lighted markings (marine and aero) yet unlike nearly all other aeronautical lights they are in operation day and night. The illustrations are representative of approach lighting types.

Partially-lighted: Lighted/sound buoys were formerly placed in a special combination category. But in this revised classification they are found with lighted forms. This change better conforms with the USCG practice. Pictures of lighted-sound buoys are therefore included with representations of light-only buoys. These comments also apply to the Large Navigational Buoy and it too is included here. There are many forms of the lighted buoy each with specific physical characteristics. Nonetheless, many of the larger lighted buoys are somewhat similar in design and hence one form can represent all of them. The Protected and Most Protected types exhibit quite different forms and therefore buoys from those groups represent those classes.

Major lights are very singular in design and the accompanying illustrations only suggest the range of designs. Minor lights increasingly

follow standard forms which are included but many minor lights have individual forms that are too numerous to be included; this is also true of daybeacons.

More forms of aeronautical aids have been included than may seem necessary. But the precise nature of aeronautical messages and their configurations are such that even limited differences in the lights can be significant. Hence "minor" differences between lamp units are major and that leads to more illustrations.

Many aero signs are lighted and therefore included here. Sign types have a wide range of messages but few physical types and the latter are the focus of the illustrations; the accompanying messages are only incidental. Wind-cones and other partially-lighted aids more clearly differentiate between type and message.

Semaphores, though very much in decline, continue to be an important signal form. Both full-size and dwarf forms are included. Dwarfs, though somewhat similar to full-sized versions, represent a distinct physical appearance. Track Indicators, though now rarely used, are included since they exhibit a singular form not represented by other railway devices.

Unlighted can and nun buoys classes differ in size yet the overall appearance is similar; therefore one sample of each is an adequate representative. Foam and plastic buoys, within the can and nun matrix, however, are notably different in appearance and representative samples are included.



Targets, a form of unlighted signal, exhibits messages, in large part, through shape. At the same time the physical forms represent types of markings; therefore a representative sampling is included.

Railway sign and marking shapes also constitute physical entities as well as message forms and therefore representative forms are included.

Sound: Sound-only buoy pictures are included but in a different category. Standard fog signals are exclusively diaphone in character. Acoustic messages cannot be pictured; nonetheless, the physical form has some bearing on the sound signal and is therefore represented. Two fog signals are included: a fully self-contained unit, and a second that requires emitters separate from the energy supply unit.

Electronics aids messages are not visible (though they may be translated at the reception point into visual and/or aural forms) but the physical structure affects the energy waves and is therefore included with representative forms.

## CHAPTER 9

### DESCRIPTIVE TREATMENT OF U.S.

#### TRANSPORTATION MARKINGS: MARINE & AERO MODES

##### 9A Marine Aids to Navigation

##### 9A1 Introduction & Fixed Aids

Marine transportation markings has an overarching and encompassing term: aids to navigation. These include major lights (or lighthouses), minor lights (river, harbor, channel lights), daybeacons (unlighted fixed aids), buoys and other floating aids (the latter now confined to large navigational buoys), fog signals, and electronic devices (radiobeacons, Loran, Omega, racons, radar reflectors).

Marine markings, found along the coasts and in navigable inland waters, are heavily involved with guidance: providing landfalls for mariners coming in from the open sea, marking channels, and providing for coastwise navigators so they can proceed safely and accurately. Other significant functions include warning of isolated dangers, a regulatory role. More contemporary aids, allowing for long-range and even global navigation, are also with guidance aids.

Marine aids to navigation date back to ancient times in the form of simple beacons and primitive lighthouses (including one which ranked as a wonder of the ancient world). The modern era began in the earlier part of the nineteenth century; that time, marked by more modern means of transportation, was accompanied

by more sophisticated message equipment and construction technology. The high point of visual/acoustical aids to navigation was probably reached in the late nineteenth and early twentieth centuries; the early post-World War I era saw the beginning of electronic aids.

The contemporary field of marine markings is a composite of visual, acoustical and electronic aids. Great advances in electronics have been made though advances in optics and sound research have also been made. Nonetheless electronics is increasingly important and many great landfall lights have been reduced in power, and some shrinkage of the aids to navigation system is underway (not entirely due to electronics). Even some electronic aids (for example, radiobeacons and loran) have been reduced in number while longer-range electronic aids have increased their role (USCG LNM #10, 5; Keeler 1987, 290-295).

In the view of this compiler (admittedly based on limited information) the reduction of aids (including long-established river and harbor lights in the Pacific Northwest) by the federal Coast Guard may result in some increase in non-federal aids (see for example, LNM #10 & Keeler 1987, 290, 291, 293). The Uniform State Waterway Marking System (founded in 1966) whose aids are operated by states, local governments and private groups and persons, may need to increase to cover the federal withdrawal. (Reference for USWMS: USCG 1977, 18-19 & USCG 1991, vii). Plastic and foam buoys produced by companies such as the Rolyan (Menomonee Falls, Wisconsin) and pier, dock and buoy lights produced by companies such as Perko (Miami, Florida) and Julian McDermott (Ridgewood, Long

Island, New York) may provide the tools for a growth in non-federal aids.

The direct human involvement in aids has steadily declined, especially in recent decades, and automatic equipment increasingly dominates aids to navigation. A human presence may be a feature of some national aids to navigation systems but not that of the U.S. Aids can operate for lengthy periods of time through the use of sophisticated equipment including solar panels.

Fixed marine aids encompasses lights on fixed structures (major and minor), fog signals (except those on buoys), unlighted beacons, and electronic aids. Fixed lights includes lights on marine sites as well as on land sites. They offer aid for determining position, warning of dangers and marking channels. They include everything from a lofty Victorian tower to a small harbor light composed of a single pile, lamp and daymark. All of these markings are identified by the color of light and its light phase characteristics (fixed, flashing, occulting, etc.). During the day the great seaward light stations are identified by the distinctive design and possibly by special color schemes. Smaller lights are often a part of the lateral system of beacons and buoys and thereby conform to the requirements of that system. Small fixed aids may exhibit dayboards with easily recognized messages of color, design and occasionally alphanumeric symbols.

Daybeacon is a term seemingly unique to the U.S. and to Canada though other nations have similar aids. Daybeacons are fixed aids and are found on both land and marine sites. Day

messages are similar to those of the day part of smaller lights. The reflectorized material applied to dayboards enhances the aid's value at night when illuminated by a ship's lights. Daybeacons are also part of the lateral systems of aids to navigation. The term daymark (the Coast Guard appears to use dayboard and daymark interchangeably) in a more precise sense is a special board added to a structure displaying standardized messages. Daymark, in a wide sense, is the physical structure whether or not a specially designed daymark is present (USCG 1990, xii, xviii).

The fog signal is the sound aspect of fixed aids; fog signals are also found with floating aids though many floating signals are at variance with land forms. Fog signal message characteristics have two elements: the tone and the signal characteristic. The tone of a signal is set by the type of sound-producing facility (diaphragm horn, diaphone, bell, siren, etc.). The signal part of the message is determined by the number of tonal emissions in a given period of time.

Most fixed fog signals have had a set characteristic for a long time. Only more recently have buoy signals emitted a set characteristic. Formerly all buoy signals were sea-activated which precluded a regular message pattern. But sea-activated signals are a problem since they are less active in calm and foggy weather and more active in stormy weather when visibility is better. Various international agreements on buoys and beacons have not given much attention to fog signals, which means that a regular pattern of messages has not been established. However, the U.S.

Coast Guard has established message possibilities for signals that range from a one-second blast and nine seconds of silence (1s bl/9s si) to two three-second blasts separated by three seconds of silence followed by a three-second blast and ending with 51 seconds of silence (3s/3s/3s bl/41s si). Sea-activated signals are termed "random" (USCG 1979, 7-1).

Fog signal operations are of several forms. Some signals run continuously either for the full year or a specific season. Some signals are manually activated while others are activated by some form of automated sensing device. Increasingly the Coast Guard lists fog signals as horns without further details. These horns are diaphones in most instances; the variety of fog signal types is increasingly narrowed as the diaphone more and more dominates. Other forms may be in use notably at non-Coast Guard locations (for examples, sirens are commonplace at bridges) (USCG 1979, 7-1; USCG 1991, xiv).

Electronic aids to navigation have existed in the U.S. for some sixty years. They constitute a diverse and numerous group of increasingly safety-enhancing devices. They have not eliminated visual and acoustical aids though they have greatly reduced their importance for more than short-range operations (USCG 1977, 19-25 TISRPS; Keeler 1987, 290, 291, 293 TISRPS; Olsen 1989, 329-332).

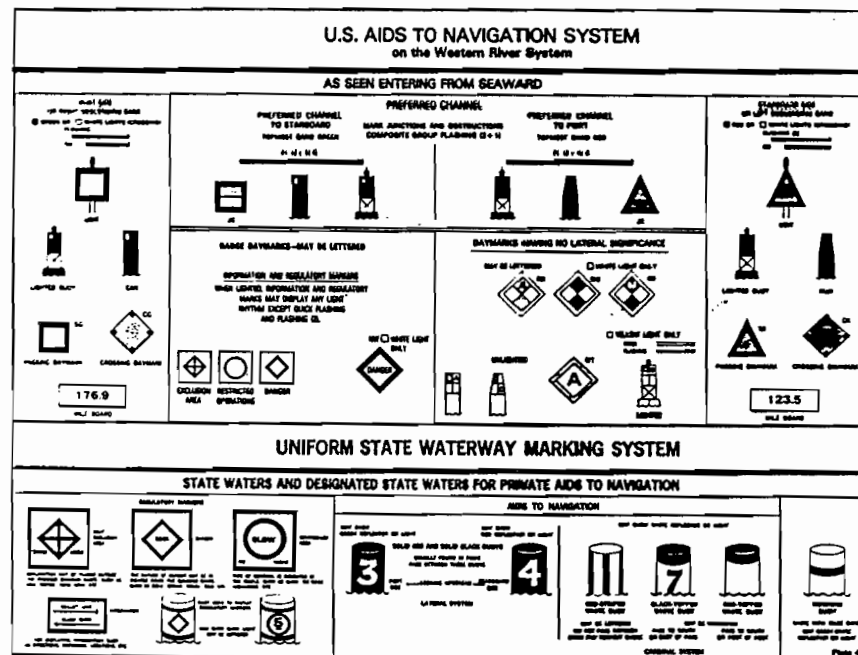
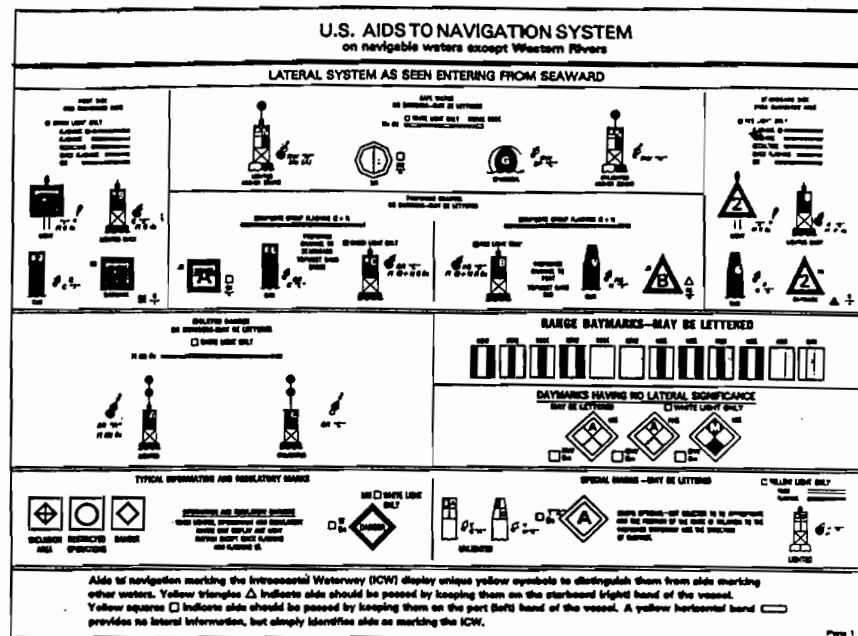
Radiobeacons are the oldest part of electronic aids. They continue to have importance though they are in the process of being scaled-back. Marker radiobeacons are being eliminated and some other radiobeacons are

also being removed from service (for example, Umpqua River Radiobeacon has been removed, LNM # 19, 6, 6-20-92; this is also true of James Island). The radiobeacon is a single-unit station and does not provide intersecting lines or impulses by which a mariner can determine position; the radiobeacon is akin to the lighthouse in this regard, as its name suggests.

The radiobeacon is a shorter range aid with a maximum receiving distance of 175 miles, though accuracy is lessened after about 50 miles. U.S. radiobeacons are either sequenced or continuous. "Distance finding stations", which synchronized radiobeacons and fog signals, have been eliminated.

Loran (LONg RANGE Navigation) is a pulse differential measurement aid to navigation. Loran-A, an older form, has been eliminated and even Loran-C is undergoing retrenchment. The mariner, by receiving lines of position from two Loran stations can determine position. Loran-C operates on 90-110 kHz frequency which is lower than that of Loran-A. Loran-C has proven to be a more accurate aid. A Loran-C installation is comprised of at least three stations: one master and two or more slaves. All transmit on one frequency so changing channels in order to gain the incoming data is not necessary. Loran-A required changing channels.

A longer range radio-navigation system is that of Omega. It is comprised of just eight stations world-wide. It functions by sending out signals requiring measuring phase-differences instead of time-differences as with Loran. It is a VLF system transmitting on the 10-14 kHz band; it is also a continuous wave



CHARACTERISTICS OF LIGHTS

Illustration	Type Description	Abbreviation
	1. <b>FIXED.</b> A light showing continuously and steadily.	F
	2. <b>OCCULTING.</b> A light in which the total duration of light in a period is longer than the total duration of darkness and the intervals of darkness (eclipses) are usually of equal duration.	Oc
	2.1 Single-occulting. An occulting light in which an eclipse is regularly repeated.	Oc
	2.2 Group-occulting. An occulting light in which a group of eclipses, specified in numbers, is regularly repeated.	Oc(2)
	2.3 Composite group-occulting. A light, similar to a group-occulting light, except that successive groups in a period have different numbers of eclipses.	Oc(2+1)
	3. <b>ISOPHASE.</b> A light in which all durations of light and darkness are equal.	Is
	4. <b>FLASHING.</b> A light in which the total duration of light in a period is shorter than the total duration of darkness and the appearances of light (flashes) are usually of equal duration.	Fl
	4.1 Single-flashing. A flashing light in which a flash is regularly repeated (frequency not exceeding 30 flashes per minute).	Fl
	4.2 Group-flashing. A flashing light in which a group of flashes, specified in number, is regularly repeated.	Fl (2)
	4.3 Composite group-flashing. A light similar to a group flashing light except that successive groups in the period have different numbers of flashes.	Fl (2+1)
	5. <b>QUICK.</b> A light in which flashes are produced at a rate of 60 flashes per minute.	Q
	5.1 Continuous quick. A quick light in which a flash is regularly repeated.	Q
	5.2 Interrupted quick. A quick light in which the sequence of flashes is interrupted by regularly repeated eclipses of constant and long duration.	IQ
	6. <b>MORSE CODE.</b> A light in which appearances of light of two clearly different durations (dots and dashes) are grouped to represent a character or characters in the Morse code.	Mo (A)
	7. <b>FIXED AND FLASHING.</b> A light in which a fixed light is combined with a flashing light of higher luminous intensity.	FFI
	8. <b>ALTERNATING.</b> A light showing different colors alternately.	AJ RW

system. Transmissions are one second in length and occur every ten seconds. The nature of Omega allows a mariner to calculate hyperbolic lines of position or circular lines of position. But even Omega is marked for eventual elimination.

More important for future long-range navigation is satellite navigation. One system in use is that of Transit but it may be functioning for only a few more years. More important is GPS or Global Positioning System. It will have a high level of accuracy so that only inland navigation of a restricted character will not benefit from it. GPS is such a simple system that user can turn on the receiver and immediately begin to receive the needed data. Eventually 18 satellites will be in orbit. The system provides latitude, longitude and time information. It employs a pseudo-range and time measurement approach rather than a hyperbolic one.

Racon or RADAR beaCON is a secondary form of radar and transmits when triggered by a shipboard radar unit. The activated racon emits a specific signal broadcasting information of bearing, range, and identification data. A more passive device is the radar reflector. It is a specially designed and geometrically shaped unit attached to many buoys. It has markedly superior radar reception enhancing qualities as compared with conventionally shaped buoys and other objects.

9A2 Floating Aids to Navigation

The first edition of this study was prepared not long after the final U.S. lightship was

removed from its station and during the time of the final stages leading to the I.A.L.A. buoyage and beaconage system. This coverage will be markedly different though some resonance with the first edition remains.

Automatic Power's (a key U.S. aids to navigation supplier; now merged with Pharos Marine) current catalogue (Pharos Marine ca. 1989) offers both automatic and human-operated light vessels (lightships) but those products are found in Europe not here; the lightship is a dead issue for this nation. The Coast Guard appears to be trying to scale back the Large Navigational Buoys (LNBS) that replaced the Lightships (see, for example, proposal to replace Columbia River LNB with standard buoy, LNM, 13th CG District, LNM, #08, 2-18-92, 5). This proposal has become a reality: CRLNB is to be removed (LNM, #45, 11-03-92, 5).

The U.S. maintains a large and complex fleet of buoys. These range from lighted buoys for very exposed locations at sea to small plastic and foam buoys on gentle inland waters (USCG 1990, 2-1, 2-2). The classifications of this study contain many details on the forms of buoys. Despite great differences in size, materials of construction and message-producing equipment the messages of the buoyage system are of a limited and relatively simple character. This study will focus on messages since details on the many buoys types will not significantly alter the message. Current Coast Guard publications offer a succinct summary of the U.S. buoyage and beaconage system of the present era (USCG 1991, vi-vii, TISRPS).

In the U.S. the color red is assigned to aids marking the starboard hand of a channel and green is assigned to port (for IALA this is true throughout Region B which is generally the Western Hemisphere; Eastern Hemisphere is largely within Region A where green is to starboard). Starboard and port are determined from the seaward point of navigation; when that is not the case it "follows a clockwork direction around landmasses."

A summary of lateral marks bears this configuration: Port hand marks are green with buoys either can or pillar. Any topmark would be a square or cylinder. Reflectors and light color is green and any numbers are odd. Starboard hand marks are red with nun or pillar buoys. A topmark would be triangular or cone shaped. The color for both light and reflector is red and numbers are even.

An important subdivision of the system relates to preferred channel marks. These mark junctions or bifurcations in channels and also wrecks or other obstructions. Their message patterns are similar to lateral marks save for two key provisions: the port hand buoy is green with a broad red band and the starboard hand buoys display the reverse pattern. Daymarks have the standard shape except that the port board has a green upper half and a red lower half while the starboard has the reverse arrangement. A specific light phase characteristic is prescribed: Composite group flashing (2+1).

Other subdivisions include safe water marks, isolated danger marks and special marks. Safe water marks are striped in red and white with a

red spherical topmark. Lighted safe water marks display a Morse code "A" pattern. Isolated danger marks display black and red bands with a Group flashing(s) white light. Topmarks have two black spheres. Special marks are yellow in color with a light yellow.

The Coast Guard also speaks of "information and regulatory marks." These have geometric shapes in orange on a white background. The messages include a diamond shape for danger; a circular shape for operational restrictions; and a square or rectangular shape gives directions or instructions which are within the bounds of the sound. While the Coast Guard does not say these marks come from the Uniform State Waterway Marking System they are identical to USWMS markings.

USWMS has two category of aids. The first is a system of buoys and accompanying messages which are apart from those of the Coast Guard. Buoys include black cylindrical buoys for port with odd numbers and red cylindrical buoys for starboard with even numbers. A green reflector or light may be added to the port buoy and red reflector or light to the starboard buoy.

Other buoys include a red and white striped buoy indicating it is unsafe to navigate between buoy and shore. The system includes a cardinal system as well: white buoy with black top and band indicating pass to north or west of buoy, and a white buoy with red top and band indicating pass to south or west of buoy. The striped buoy may be lettered and the banded buoys may be numbered. The second category of USWMS includes buoys with regulatory markings. These are white buoys with the standard orange message patterns. These are in use by the Coast Guard as well.

## 9B Aeronautical Navigation Aids

### 9B1 Introduction

Aeronautical transportation markings has an identification problem though less than that of railway signals/signs/targets/indicators; at least there are possible overarching terms available for aeronautical aids. The most promising is that of Navigation Aids. This was offered as a general term by **Airman's Information Manual** (AIM) in the 1973 edition. That general term was divided into "Air Navigation Radio Aids" and "Airport, Air Navigation Lighting and Marking Aids" segments (FAA 1973, Chapter 2). Newer AIM editions have dropped the general term and speak only of subcategories ("Navigation Aids" excluding visual aids, and "Aeronautical Lighting & Other Airport Visual Aids" which subdivides visual aids into three segments) (FAA 1991, Table of Contents). This basic subdivision of the aero safety aids appears to be a general practice. The word "Aids" is a connecting link for aero aids but also for marine aids and therefore cannot be an adequate overarching general term for aero safety devices. This study has chosen to adopt the older usage of Navigation Aids for the entire field of aero aids.

Aero navigation aids include airport lighting and beacons, electronic aids, signs and pavement and elevated markings, obstruction lighting and marking. Many of the lighted aids are partially-lighted (akin to marine aids in that sense) but approach lighting aids are generally a fully-lighted device and in some portions of the classifications approach lights are affiliated with road and rail signals.

The purposes of aero navigation aids are, in general terms, those of any form of transportation markings. More specifically, a large portion of these aids serve location-finding and regulatory purposes. Obstruction aids are exclusively focussed on the giving of warnings. Many aero markings are gathered together at airports which are contrary to spatial configurations of other forms of transportation markings. The encompassing gridwork of national airway beacons has become largely defunct.

Aero aids are the youngest "family" with transportation markings. Many of the earliest developments occurred in the era of World War I. The 1920s and especially the 1930s were an era of experimentation that laid the foundations for more contemporary developments. There is probably more change in aero navigation aids in the last 60-70 years than in any other part of transportation markings. Virtually all aspects of lights and electronic devices have undergone change, even drastic change. Only in relatively recent times has some measure of stability been achieved and then only to a degree. The aero situation contrasts with that of lighthouses, railway signals and traffic signals which have had substantial stability over many decades. Some constancy is seen in message systems but rarely with equipment. Part G in this Series will present a vignette of aero aids history.

## 9B2 Lighted Navigation Aids

Beacons refer to a narrow range of lights rather than to all lighted aids. Beacons mark the location of airports and identify the specific airport. Some obstruction lights can

also be termed beacons though perhaps less precisely. There are three versions of the beacon: the medium intensity version (with variant forms for airports, heliports, and seaplanes), an high intensity form (with the same three variations), and an identification beacon (with airport and seaplane variations). Airport beacons display alternate white and green flash. Seaplane beacons exhibit alternate white and yellow flashes; heliport beacons flash a message of alternating white, green and yellow. Identification beacons emit green messages for airports and yellow for seaplanes (FAA 1984-1, TISRP).

A point of confusion exists, at least for this writer, over the identification beacon (L-803). According to recent information (Dornbos 1992) the identification beacon has been dropped though FAA sources apparently fail to announce that change. Yet the older code beacon, which served as an identification beacon, seemingly has not been dropped. FAA sources may not mention the CAA-446 beacon (by that title or a variant title) yet AIP and AIM continue to include the code beacon (FAA 1991-7, 2-2-1; FAA 1990 AGA 0-5, AGA 0-6). Various manufacturers (including ADB-Alnaco, Hughey & Phillips, and TWR Lighting) continue to produce a beacon that resembles the code beacon (ADB-ALNACO 1990; H & P, 1991, 1-2; TWR 1991). This compiler has not yet gained a full understanding of the matter yet, at the very least, it can be said that the beacon exists. The old CAA-446 specification was under the heading of Code Beacon with five different forms including a hazard version (CAA 1942). The FAA in 1980 cancelled CAA-446 in favor of a new document yet the hazard beacon was only one



segment of the old specification (FAA 1980-6 TISRP).

Airport and seaplane location beacons have a flash rate of 24-30 per minute; heliport beacons is 30-45 per minute. Identification beacons display a three or four character Morse code message at a rate of six to eight character sets per minute.

Approach Lighting Systems are of two basic forms though some variations are present. All forms display a series of precisely arranged steady burning white lamps; these are often accompanied by a smaller number of flashing white lights. The two basic systems are Approach Light System with Sequenced Flashing Lights (ALSF) and Medium Intensity Approach Light System (MALS). The former is divided into ALSF-I (Category I navigation) and ALSF-II (Category II) with three short-forms: Simplified Short Approach Light System (SSALS, SSALS with Sequenced Flashes (SSALF) and Simplified Short Approach Lights with Runway Alignment Indicator Lights (SSALR). Medium Intensity Approach Light System (MALS) has two variant forms: Medium Intensity Approach Lighting system with RAIL (Runway Identification Lights) (MALRS), and MALSF; SF signifying Sequenced Flashing Lights. A final approach system is that of ODALS: Omnidirectional Approach Lighting System (FAA 1969 [1974-10]; FAA 1970-6, FAA 1976-3, FAA 1991-8, TISRPS).

The ALS systems are adjuncts of electronic navigation aids for IFR precision and non-precision approaches. During nighttime VFR visibility situations they act as visual guides. ALSF-I has 28 rows of fixed burning lights with five lamps in each row. One of these (the

eighth from the threshold light bar) is joined by flanking bars of lamps with eight lamps in each bar. All light bars up to, and including the eighth row, are joined by a single flashing lamp. Between the threshold bar and the first row of white lamps are two rows of fixed red lamps. One consists of two side bars with five lamps in each; the second consists of three rows of red lamps: a center row straddling the centerline with five lamps flanked by two bars with three lamps each. The ALSF-II contains 30 rows of light bars. In addition to the white lamps of the previous system are two side bars adjoining the fifth row from the threshold light bar. The first nine bars from the threshold light bar are accompanied by side bars of red lamps; each row contains three fixed burning red lamps.

Medium Intensity Approach Lighting System with RAIL is the official system for Category I visibility conditions. It is made up of seven bars of steady burning lights with five lamps per bar. There are five flashing lamps below the light-bars. MALSF also has seven bars with flashing lights accompanying the first three rows of fixed lights.

The equipment consists of PAR-56 lampholders which are high intensity units (500 watt) for ALSF operations and PAR-38 (300 watt) lampholders for MALS operations. The only other lamp unit is the sequenced flashing lights which is a condenser-discharge lamp.

The condenser-discharge lamps have two modes of operation when conjoined with fixed lights: as a sequenced flashing light when integrated with steady burning lamps, and in the runway alignment indicator lights when they are

independent though adjoining the fixed lamps (FAA 1981-8 TISRPS).

There are two other flashing light systems: Omnidirectional REILS and the Omnidirectional Approach Lighting System (ODALS). The former consists of two units at the corners of the approach end of a runway and the latter consists of five flashing light units on the approaches to a runway and accompanied by two units at the corners of the approach end of the runway.

The VASI (Visual Approach Slope Indicator) and SAVASI systems described in the first edition have been replaced as the primary system by Precision Approach Path Indicator (PAPI). PAPI has light units akin to those of VASI. PAPI, however, has one row of two or four lights instead of VASI's two rows. A four lamp PAPI has this message pattern: four white lamps indicate pilot is high (more than 3.5 degrees) while three white and one red indicate the pilot is slightly high (3.2 degrees). Two white lamps and two red lamps indicates the pilot is on the glide path (3.0 degrees). One white and three red indicate the pilot is slightly low (2.8 degrees) while four red lamps indicate pilot is definitely low (2.5 degrees). A two lamp version has three messages: two red means too low, one white and one red indicates the pilot is on the glide path while two white means high (FAA 1985-).

PAPI was originally intended to be the only glide slope path indicator. But a protest against this relatively costly system and for a simpler and cheaper system has led to approval of Generic Visual Glideslope Indicator (GVGI) for general aviation airports. One of these is a VASI system and the other a PLASI system. The

VASI system labelled a L-882 is a multiple-projector system while the PLASI, L-883, is a single-projector system. The light units in a VASI system are arranged in bars which are called the upwind and downwind bar. The light units in each bar are located on a line perpendicular to the runway centerline. The downwind bar is the nearest to the runway threshold and the upwind bar is the farthest. Each light unit projects a split beam of light, the upper segment being white and the lower red. If the approach is too high, both bars are seen as white while a low approach is indicated by both bars appearing red (FAA 1988-6).

The Pulse Light Approach Slope Indicator (PLASI) projects a single light signal. If the pilot is on the glideslope a steady white light is visible; if above the glideslope a pulsing white light is seen. But if the pilot is below the glideslope a steady red light is present; if much below the glideslope the red light pulses. The PLASI is made exclusively by one firm, Devore Aviation (Devore 1990; see also Devore 1991, and FAA 1988-6).

Airport runway and taxiway lighting constitutes a single though large and diverse field. This study divides these lights into **elevated and inpavement (formerly semi-flush) lights**. Runway and taxiway lighting readily suggests a sensible bifurcation point and that easily leads to a four-part subdivision. But for this monograph elevated and inpavement are the primary dividing points with both runway and taxiway within each group. Inpavement lights are not more than 1.25 inches above the surface of the pavement and elevated lights are little more than 12 inches in height. Limited usage of inpavement lights are employed with approach

lighting configurations (FAA 1975-5; FAA 1975-9; 1984-6; 1968-11 TISRPS).

Some functions of airport lighting are the exclusive province of either elevated or in pavement lights; other functions can be shared between them. For example, runway edge lights at intersections preclude elevated fixtures and in pavement fixtures must necessarily be substituted.

In pavement lights consist of four groups: runway centerline and touchdown zone lights, edge and threshold/end lights, taxiway centerline lights, and taxiway intersection lights. Centerline lights are white except for the ending portion. The last 1000 feet of these lights are bidirectional with red in one direction and white in the other. The 3000 to 1000 foot portion alternates white with red/white lights. All in pavement lights are steady burning. Threshold lights provide landing assistance while centerline lights provide rollout and takeoff guidance after touching down.

Taxiway in pavement centerline lights are green with yellow employed as a caution signal. These include both unidirectional and bidirectional, narrow-beam and wide-beam. Taxiway intersections display omnidirectional yellow lights.

Touchdown zone lights consist of two rows of unidirectional lights 3,000 feet in length. The lights are spaced 100 feet apart; each of the two rows contains three lamps displaying a white, steady burning message.

Threshold lights are found in both in pavement and elevated versions. These are considered with elevated lights. One form of in pavement threshold lighting is associated with MALS; this form is unidirectional.

Elevated lighting cover three functions with three intensities for each: edge and threshold/end lamps in high, medium and low intensity. Taxiway lights are medium intensity (MI) only (the low intensity form has been dropped). There are two special lights as well: the MI threshold light-special and the holding position edge light. High intensity lights are found at airports with precision IFR operations while medium intensity have nonprecision IFR operations. Low intensity lights are in use at airports with VFR and lacking planned approach procedures.

Runway edge lights outline the sides and end of the landing area. There are two rows of light equal distance from the centerline. These are fixed white lights though the final portion of the runway displays yellow lights. Yellow lights are also in use at the end of the runway ("opposite the landing threshold"). Caution zone lights are yellow toward the approach end and white for the other direction. Threshold lights are green toward the approach direction while the runway end lights display red toward the runway. Taxiway edge lights are omnidirectional and in blue.

Special lights include the Elevated Threshold Light-Special. This unit has an extra wide beam. It helps to improve visibility of MI thresholds that lack approach lighting. The Holding Position Light displays unidirectional

yellow flashing lights. It is designed to improve visibility at taxiway holding positions.

Obstruction lighting has undergone substantial change in the space of little more than a decade. The high intensity strobe or condenser-discharge lamp has been in use for some time. But strobe lights are becoming commonplace for medium intensity white lights as well. The traditional fresnel red lens with flashing mechanism continues in use though it may be entering into decline. The fixed red light continues in use for lower priority uses. Many obstruction lighting situations require dual systems: white strobe lights at night and red lights during the day. Strobe lights are too powerful at night and may annoy the neighbors. High intensity units are unidirectional and employ linear flash tubes, while MI have employed lenses and helical (spiral) tubes and are omnidirectional. A recent development (EG &G) creates a MI unit with linear tubes and in both red and white. This unit is a flashing unit and has red and white in one housing; that development may threaten the long-established fresnel lens (FAA 1991-8).

### 9B3 Signs & Pavement and Elevated Markings

This segment deals with various forms of non-sign markings and with signs, both lighted and unlighted. Lighted signs are a partially-lighted aid and thereby akin to airport and obstruction lights. Yet the nature of the message and the existence of unlighted forms places them here.

Taxiway and runway signs, though they carry out a variety of functions, can be briefly

summarized in regard to messages. Signs of an informational character have a yellow background and black alphanumeric symbols. Mandatory Instruction signs have a red background and white symbols. Runway distance remaining signs have a black background and white symbols. Signs for the first two groups can be 18 to 30 inches in height with 12 to 18 inch symbols. The last form includes some sizes not available with the other forms. The first two forms can have unlighted forms but not the runway distance remaining sign (FAA 1984-12; FAA 1969-5; FAA 1989-9, Ap. 4).

Wind cones and wind tees are both partially lighted aids. Wind cones are illuminated by white lights and accompanied by a fixed red obstruction light. The wind tee is equipped with green lights outlining the shape of the wind tee. The wind tee is painted yellow for day use. The wind tee is no longer an officially-sanctioned aid though one major supplier (ADB-Alnaco specification A.08.410e in **Aviation Lighting Systems**) continues to market wind tees and to refer to the defunct FAA advisory circular (FAA 1969-5).

Runway markings are a complex issue when the level of aviation operations are considered; nonetheless, general comments can be outlined here. The essential element in all runway marking is the centerline stripe and runway directional number. The centerline stripe is at least one foot in width and made up of 120 foot long "dashes" separated by 80-foot long blank spaces. Numbers for runways can be augmented by letters (L for left, R for right, C for center) when needed. All runway markings are white (FAA 1987 TIRSPS).

Threshold markings consist of an area 130 by 150 feet containing eight stripes measuring 12 by 150 feet with three-foot intervening spaces. Side stripes are continuous markings at least three feet wide. Landing zone markings are made up of four sets of stripes with four stripes in the set nearest the centerline and one stripe less in each succeeding set.

Longitudinal stripes and taxiway holding line markings are the principal taxiway markings. The longitudinal stripe is a centerline marking at least six inches in width. There are various qualifying norms for curved taxiways, intersections and other special situations. Holding lines are 100-200 feet "from the nearest edge of the runway or taxiway which the taxiway intersects." It has the shape of a double line running the width of the taxiway paralleled by a double row of dashes three feet wide and three feet apart. All taxiway markings are yellow in color.

There are two forms of retroreflective markers for airport usage. One form is low-profile and very similar to TCD markers. The other is elevated. The elevated markers display either cylindrical shape or a flat surface. Centerline markers emulate centerline light colors. The markers are either bidirectional or unidirectional. Elevated markers include white, red, green and yellow colors (FAA 1980-12).

Two special markings are the segmented circle airport marker system, and the compass calibration pad. The segmented circle in itself attracts attention to obscure airfields. Accompanying aids always include a wind cone and can include landing directional indicator,

landing strip indicators and a closed field signal. The compass calibration pad aids pilots in determining and correcting magnetic compass errors or deviations; this is especially important for pilots of small planes. The pad consists of 12 radials painted on the pad surface. Each radial represents 30 degrees beginning with magnetic north (FAA 1984). The compass calibration pad is no longer the subject of its own advisory circular; however it is listed in the book-length circular, **Airport Design** (FAA 1989, Appendix 4).

Obstruction markings constitutes the final area of markings. That can be a complex topic since the basic patterns can be applied not only to towers but to obstructions of many different designs. Obstruction marking is somewhat less significant than in former times because flashlamp technology provides daytime lighting that eliminates painted markings requiring periodic renewal. Two colors are employed for obstruction marking: aviation surface orange and aviation white; in many instances the colors are used conjointly. Orange is frequently utilized when a single color is required. Obstruction markings are divided into patterns and markers; the latter consist of flags and sphericals (FAA 1991-8, Ch. 3 TISRPS).

Solid orange hue is applied to smaller obstructions. Bands of orange and white are used on communication transmission towers, power transmission structures, poles, smokestacks, skeleton frameworks for storage tanks, and other structures projecting a narrow appearance. Checkerboard patterns are employed on storage tanks (water, grain, gas, etc.) and buildings and structures manifesting a wide appearance. Teardrop patterns are used on spherical shaped

storage tanks. Not all obstructions can be painted. Sphericals have proven to have considerable value in these instances. Spheres, at least 20 inches in diameter, are dotted along power lines every 150 feet near airports and every 600 feet away from airports. Flags are substituted when both paint and sphericals are not feasible. Flags can be rectangular and, if small, are solid orange. A triangular pattern is also permissible and can display both orange and white. Checkerboard patterns are acceptable for large flags.

#### 9B4 Electronic Navigation Aids

The first edition of this study was prepared at about the same time that a basic restructuring of aero electronic aids was underway. That edition therefore reflected both established norms and the changes. Prior to 1980 electronic aids were divided into non-precision instrument approaches and precision instrument approaches. The non-precision form offered "course guidance and position location only," while precision form added "electronic descent guidance" to the non-precision processes. The changes brought both approaches into one system. Instrument Landing Systems (ILS) has been the standard system for aviators though Microwave Landing Systems (MLS) has been introduced and may eventually replace ILS. ILS continues to have substantially more units in place of the MLS (FAA 1990-8; FAA 1973; FAA 1991-7, Ch. 1 TISRPS).

The first facet of ILS is the localizer which offers course guidance. It is used by the aviator to determine and maintain "horizontal direction until visual contact is made with the runway." The message is a signal in Morse code;

it is a three-letter transmission beginning with the letter "I". Some localizers cannot be placed in the preferred location. These units are termed off-set localizers or localizer-type directional aid. They are not acceptable for more sophisticated levels of aviation operations.

The Glide Slope "provides vertical guidance" which allows the pilot to determine and hold the rate of descent until visual contact is established. The Glide Slope is a UHF transmissions whose path beam flares out above the runway.

Marker beacons "radiate a cone or fan shaped signal vertically to activate both aural and visual indicators in the cockpit." Marker beacons indicate specific locations in the approach path. There can be as many as four beacons. The outer beacon (4-7 nautical miles from runway threshold) denotes the point where the glide slope signal should be encountered and where the descent for landing begins. The signal consists of continuous dashes (two per second). A middle beacon indicates where the glide slope for decision height (DH) for category I operations should be encountered. It transmits dots and dashes at a rate of 95 per minute. The inner beacon performs the above function for Category II and III level of operations. It broadcasts continuous dots with six per second. Some non-precision airports have a fourth beacon termed a backcourse beacon.

It has messages that approximate those of the outer beacon. It transmits a two dot sequence 72-95 times per minute.

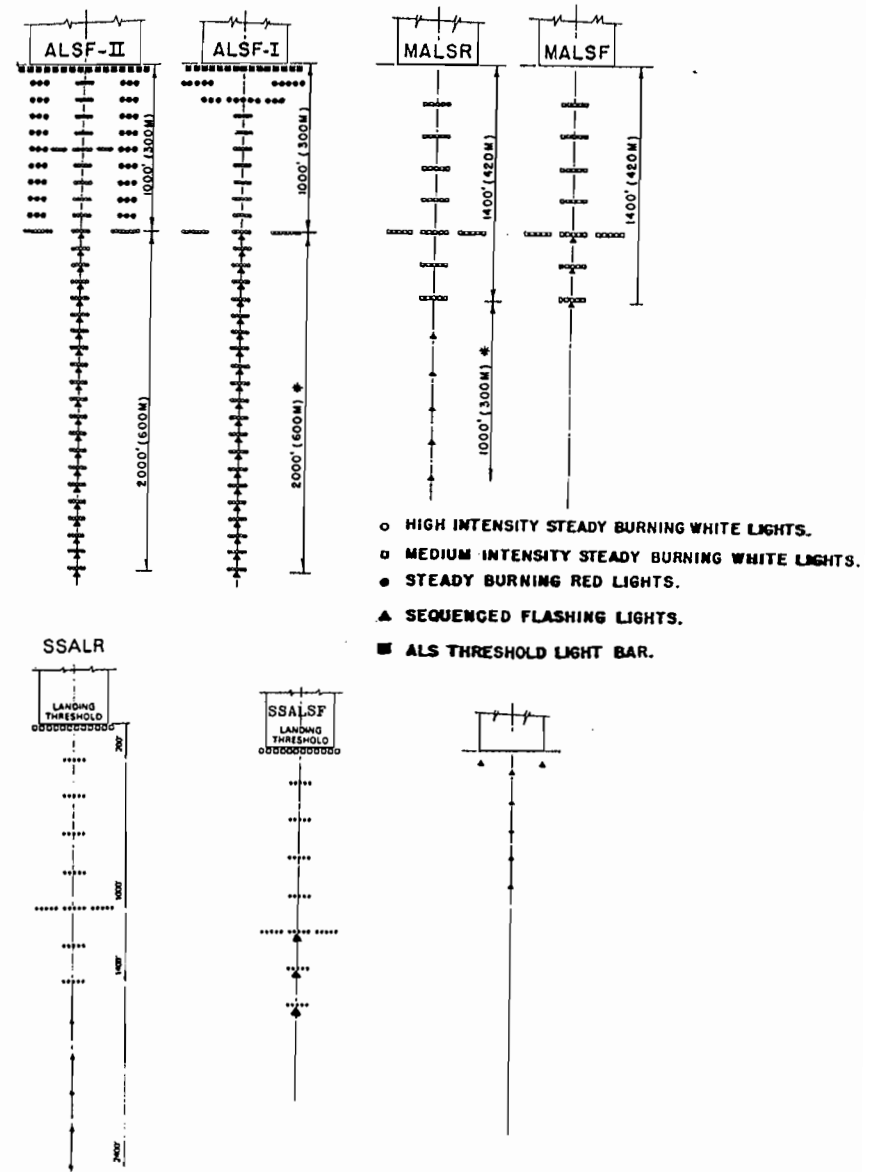
Distance Measuring Equipment (DME) emits messages of "paired pulses." These messages indicate to pilots a continuing flow of distance measurements to the airport being approached. It is comparable to the military TACAN (Tactical Air Navigation Systems). DME are located at localizer sites and can be "colocated" with the localizer. Terminal Very High Frequency Omnidirectional Range (TVOR) emits azimuth data and can be used for non-precision instrument approaches to complement IFR services at an airport. Signals are in Morse code "or by the recorded voice identification" mechanism.

Nondirectional Beacons (NDBs) are under two "flags": as a nondirectional beacon or under a compass locator (Comlo) unit. Comlo transmissions are of short range. NDBs can reach a distance of 25-75 miles. NDB has a continuous carrier transmission while "... Comlo transmits two-letter identification groups. The outer locator transmits the first two letters ... and the middle locator transmits the last two letters" (FAA 1991-7, 1-1-8). Both systems provide directional information to the transmitting site. Comlo was a precision flight aid while NDB was a non-precision aid in the older bifurcation of U.S. electronic aids.

MLS is supposedly the replacement system for ILS but delays have occurred and its utilization has proceeded at a slower pace. ILS units are continuing to be added. MLS does not require utilization of the ground for its transmissions (as does ILS) and there are fewer potential interference difficulties. MLS employs a localizer and a glide slope. Course and descent guidance is also provided in the MLS system. "Co-located" DME or standard marker beacons will provide position information.

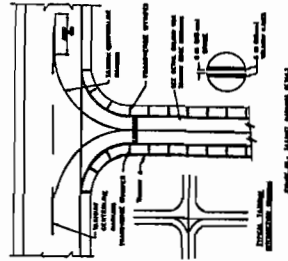
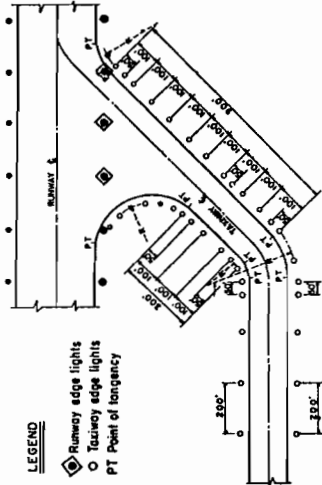
VORTAC combines civilian VOR system with the military's TACAN. TACAN was developed to meet special situation such as the rolling deck of an aircraft carrier. The integrated VOR and TACAN system provides azimuth information from both VOR and TACAN, and TACAN distance (DME) at one location.

## Approach Lighting Configurations

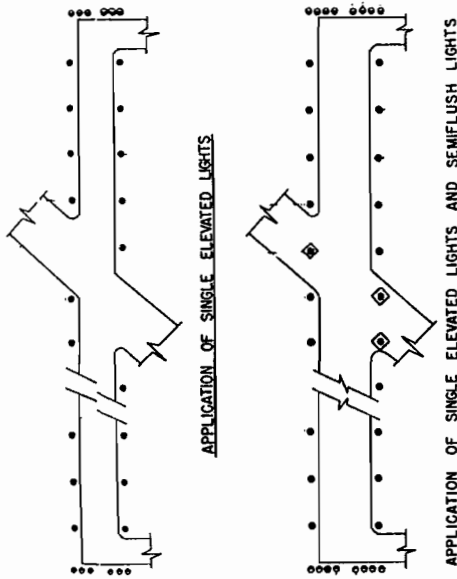


(clear squares in lower pictures denote ALS Threshold Light Bar)

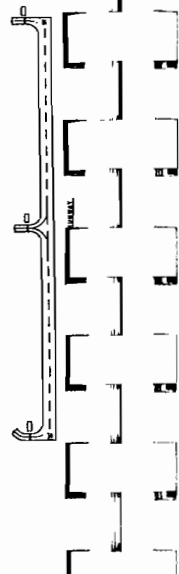
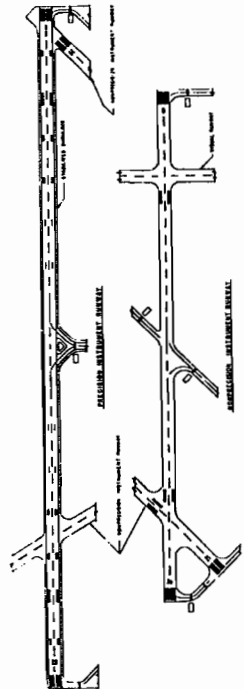
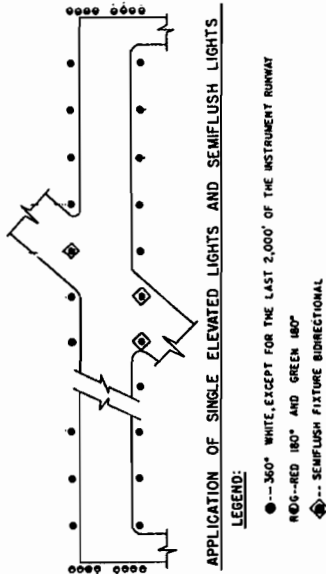
LIGHTING AND MARKING CONFIGURATIONS



(FAA 1987-10, Ap.1)



(FAA 1975-9, Ap. 2)



CHAPTER 10

DESCRIPTIVE TREATMENT OF U.S. TRANSPORTATION  
 MARKINGS: SURFACE MODES OF TRANSPORTATION

10A Traffic Control Devices

10A1 Introduction & Traffic Control Signals

Transportation markings for roads and streets have - contrary to railway markings - an overarching term: Traffic Control Devices (TCD). These devices include traffic signals, signs, pavement and curb markings, delineators, barricades and channelizing devices. TCDs are a ubiquitous form of marking and are found in some form throughout both urban and rural America.

Ultimately the general purposes of any grouping of transportation markings are similar though specific purposes manifest differences. The aims of TCDs are to warn, to give guidance, to regulate. Traffic signals exhibit, though not simultaneously, all of these aims. Traffic signs normally express a single purpose; this allows the classification of signs to be arranged according to their function of warning, guiding or regulating. Pavement and allied markings, like their sign counterparts, have specialized functions; though marking functions may be less precise than those of signs (MUTCD 1988, 1A-1).

Traffic Control Devices are probably the oldest facet of transportation markings and originated in prehistory; TCDs are mentioned in ancient written records including that of the



Bible. Early forms included milestones, road markers and simple signs. Actual traffic signals originated in Victorian England; the earliest U.S. mechanical signals occurred in the early pre-World War I era. Many of the foundations of modern signals, signs and traffic control standards were established in the 1920s and current equipment and practices reflect that period.

The U.S. has substantially reduced word symbol messages for warning and other signs in favor of graphic images. That significant change has been greatly influenced by the 1968 UN Conference on traffic control devices which was the first truly global meeting on the topic. Volume IIE in this Series provides coverage of the development of TCDs and especially the UN Conference (see IIE in this Series).

The first edition of this work spoke of the term of traffic signals as having two meanings: Traffic Signals in "caps" referring to full traffic control signals at intersections, and traffic signals without caps encompassing all forms of traffic signals. TCDH (**Traffic Control Devices Handbook**) explains it more clearly by noting that "The MUTCD [**Manual on Uniform Traffic Control Devices**] describes a highway traffic signal as any power-operated traffic control device, other than a barricade warning light or steady burning electric lamp, by which traffic is warned or directed to take some specific action". TCDH further notes that "[a] large percentage of highway traffic signals are traffic control signals which are defined as a type of highway traffic signal by which traffic is alternately directed to stop and then permitted to proceed." (TCDH 1983, 4-2).

The colors and messages of signals, put succinctly, are green for proceed, yellow for caution, red for stop. However, there are many explications of those basic messages. Green (circular lens) indicates proceed: either straight through or to right or left (excluding prohibitions); green (arrow) permits movement as signified by the arrow (straight through, turn to right, left). This also pertains to pedestrians when special pedestrian signals are absent. Yellow (circular or arrow) indicates the immediate actualization of the red indication. Red (whether in a circular, fixed or flashing), or arrow pattern denotes stop. Right turns (or left in a one-way traffic pattern) are permitted after stopping when prohibitions are not present. Flashing red allows entrance into the intersection after stopping and when safe. Flashing yellow permits cautious entering of the intersection (MUTCD 1988, Part IV, TIRSPS).

Colors for signals include green, yellow and red. Colors for pedestrian signals include Portland orange and lunar white. Lenses for signals are circular and either eight or twelve inches in diameter; pedestrian signals are of different shapes. Traffic control signals lamps are usually arranged vertically with red in the top position, yellow in the middle and green at the bottom. Horizontal arrangements have red at the left, yellow in the middle and green on the right. MUTCD does not specify dimensions for pedestrian signals though standards exist for the word or graphic symbols employed: crossings of under 60 feet require 3 inch high word or 6 inch high graphic symbols. Crossings of over 60 feet require 4.5 or 9 inch symbols respectively.

There are many variations within the basic matrix of the traffic control signal. Not only the size of the lens but the number of signal units and the positioning of those units can vary considerably according to traffic patterns. Traffic control signals are frequently divided into two forms: pre-timed and traffic-activated; that division is employed in the Multiple and Variant Classification of this study.

Older pedestrian signals often displayed messages of Wait and Walk. The similarity of the messages - especially in limited visibility or for persons of limited vision - caused a change to Walk and Do Not Walk. Increasingly word messages have been replaced by graphic messages: a raised hand to signify halt and a human representation signifying motion.

The term "beacon" covers a variety of flashing signals. Traffic beacons are usually one or more segments of a standard traffic signal. Though older beacons (and this was also true of traffic control signals) were of a unitary construction. Traffic beacons include a hazard identification beacon that exhibits a circular lens in yellow. It is found at or near obstructions, at selected warning and regulatory signs, and at mid-block crosswalks. A second form of the beacon is the speed limit beacon. This displays two smaller or one larger circular lens in yellow; it is employed at selected speed limit signs and at school speed limit signs.

The more common and familiar of the traffic beacons is the intersection control type. These display circular red lamps for one or more directions and circular yellow lamps for the remaining directions of traffic. There are two

versions of this beacon: either yellow for the major direction of traffic with red for all other directions, or red in all directions; the latter is known as an all-way stop indication. A final form of the traffic beacon is the stop sign beacon. Lamps are red and circular. Two lamps are deployed when smaller lenses are utilized and a single lamp is employed with a larger lens. The beacon, when arranged horizontally, displays synchronized flashes but alternating flashes if vertical.

Other signals include lane-control signals, movable bridge signals and gates, one-way/two lane signals, railway crossing signals, school signals and freeway ramp control signals.

Lane-control signals, frequently employed with reversible-lane operations, are of three interconnected forms: a downward pointing green arrow indicating use of lane permitted; a yellow-x in a fixed pattern indicating lane to be vacated; a yellow-x in a flashing mode indicating left-turns allowed; and a red-x in a fixed pattern indicating lane not to be used.

Moveable bridge signals are similar to standard traffic control signals if bridge movements are frequent, or two flashing red lamps for less-used spans. Railway crossing type gates can be added and these may include flashing red lights. The freeway ramp signal is a somewhat newer form. The device admits autos onto the freeway at metered intervals. The signal can be similar to a standard traffic signal or it can exhibit green and red lights only. One-way signals are an adaption of standard signals used for single lanes shared by

two-way traffic. These situations include narrow bridges, tunnels and sections of roadway.

Railway grade crossings can be equipped with a variety of signals and allied devices. Signal lights are two horizontally mounted flashing red circular signals and can be either post-mounted or cantilever-mounted. Gates, which, in turn, may include flashing red lights and bells, may also be a feature of crossing protection. School signals are standard traffic control signals at school crossings. Signals and meanings are adapted to the specific situation but this does not result in markedly different equipment or messages.

#### 10A2 Signs, Markings & Related Devices

The first edition of this work noted the increase in pictographic (or graphic) symbols but focussed more on traditional word forms since the changes were far from complete. Many of the changes have been made and this edition includes more graphic forms. The issue of word versus graphic of course pertains more to warning signs than to other types.

Signs are of three major types: regulatory, which provide information on traffic regulations; warning signs, which alert motorists to hazardous or potentially hazardous situations; and guide signs, which provide various items of information (including routes, destinations, directions, services, scenic features). Guide signs follow a tripartite division of conventional roads, expressways, and freeways. Some forms of these signs overlap which permits exclusion of replicated forms from

the classification. (MUTCD 1988, Part II TISRPS).

Shape constitutes a key ingredient for road signs. Shapes include: octagon-shaped signs (stop signs only), downward pointing equilateral triangle (yield signs only), and round signs (railway crossing advance signs and civil defense route signs). Other sign shapes include the isosceles triangle with long axis horizontal [also known as the pennant sign] (no passing zones), diamond-shaped signs (warning), rectangular-shaped signs with emphasis on vertical dimension (many regulatory signs), rectangular-shaped signs with emphasis on horizontal dimensions (many guide signs).

Yet other shapes include the trapezoid-shaped sign (recreational use), pentagons (school advance and school crossing signs), shields (route markers), crossbuck (railway crossings), and square-shaped signs (some route markers). Variant forms of the trapezoid and pentagon are employed for forest and county route markers respectively.

Sign colors offers a wide range of colors and accompanying means. Red is employed as a background color for stop, wrong-way, and do-not enter signs. It is used as a graphic and word symbol color on yield and parking prohibitions signs; it is further used for the diagonal bar prohibition symbols and accompanying circle. Black is utilized as a background color for one-way, weigh station and nighttime speed limit signs. It is used for messages for signs with background of white, yellow or orange. White backgrounds are associated with many guide, and regulatory signs and for sign messages on

backgrounds of brown, green, blue, black and red.

Other color usage includes orange for backgrounds of construction and maintenance signs. Yellow is employed with backgrounds of warning and school signs; it is the message color of the county route marker which has a blue background. Brown backgrounds are found with recreational and cultural interest signs. Green is a frequently used background color for guide signs and mileposts. "Permissive parking regulations" with a white background use green for messages. Blue backgrounds are found with motorist service signs and evacuation route markers. Four other colors are viewed as possible future traffic sign use: purple, light, coral and a "strong" yellow-green.

Lettering for U.S. signs is normally in upper-case letters though destination signs are in lower-case with the first letter upper-case. The size of letters varies with size of sign which in turn is determined by location; freeway and similar applications exhibit the largest signs and letters.

Many signs in critical areas are illuminated. This can be accomplished through a light behind a translucent sign panel, through special light fixture(s) focussed on the sign, or other means including neon tubing. Many other signs, though lacking lighting, utilize some form of retroreflective material which improves night effectiveness. Illuminated signs are an on-going bane of the classifications of this Series. They become both lighted and unlighted transportation markings and simultaneously neither. No solution has been found, with the

result that signs float among classification categories, confusing the reader and blurring distinctions.

Markings (pavement and curb markings, delineators, object markings, colored pavements, barricades and channelizing devices) constitute the third component of the TCD triad. The on-going problem of what is a marking and how does that differ from a transportation marking has been exercised in other places (See Volume II, Part F for an exposition of that matter and also Chapter 8 of this study). It may be enough to say that marking minus transportation or marking in the lower case refer to largely horizontal entities that by and large lack alphanumeric symbols and lighting dimension. MUTCD includes allied objects (delineators, barricades, etc.) within the material on markings. In a narrower sense markings refer to pavement and curb markings (MUTCD 1988, Part III TISRP).

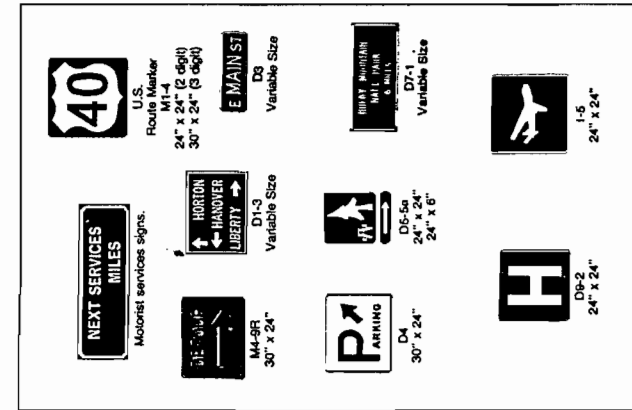
The most extensive part of markings are pavement markings (there are two forms: longitudinal lines and transverse lines). These include centerline markings, lane lines, edge of pavement limits, crosswalk lines, stop lines and some graphic and word symbols. Curb markings are largely concerned with parking regulations. Object markings includes both in roadway objects, and objects adjacent to the roadway: bridge and exit abutments, signals and sign supports, bridge piers, railings, trees and anything else that may be dangerous to the flow of traffic. Delineators mark roadway edges and denote roadway alignment. Barricades mark ends of roadways, closed ramps and areas closed for a period of time. Channelizing devices, traffic

cones and tubular markers are found primarily in construction and maintenance situations.

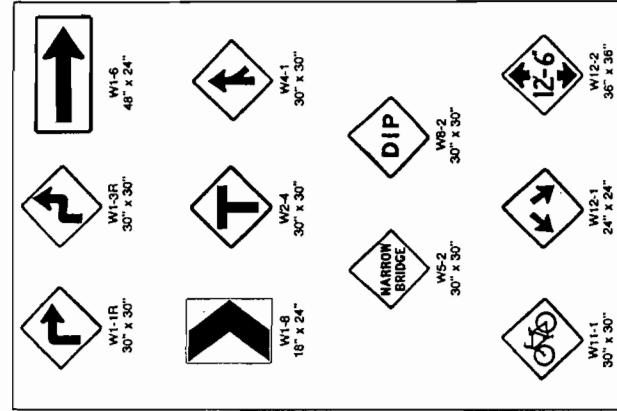
Pavement markings are frequently in a paint medium but delineators are increasingly employed; colors include white, yellow and red. White denotes centerlines, lane lines, turn and stop lines, and a variety of word symbols. Yellow is to be found with no passing lines, double center lines, approaches to railway crossings and curb markings. Yellow projects the meaning of caution, warning and prohibition. Red indicates areas not to be entered. Colored pavements follow the same color and meaning pattern: red for stop lines, yellow for medians, and white for delineation. The color black is employed where contrast for the markings of other colors is required.

Object markings consist of painted symbols or reflectors or a combination of both. They mark obstructions in or near roadways. There are three basic types: a diamond-shaped panel with nine yellow reflectors (Type 1), three reflectors in a rectangular arrangement with either a horizontal or a vertical emphasis (Type 2), or a rectangular panel with vertical emphasis displaying diagonal stripes (Type 3). Type 1 and Type 2 have yellow reflectors; Type 3 displays black and yellow or white stripes.

Delineators are guidance rather than warning devices. Most are mounted on vertical supports though some are affixed to curbs. White and yellow are the principal colors though red is sometimes employed on the back of standard delineators to indicate wrong direction for motorists.

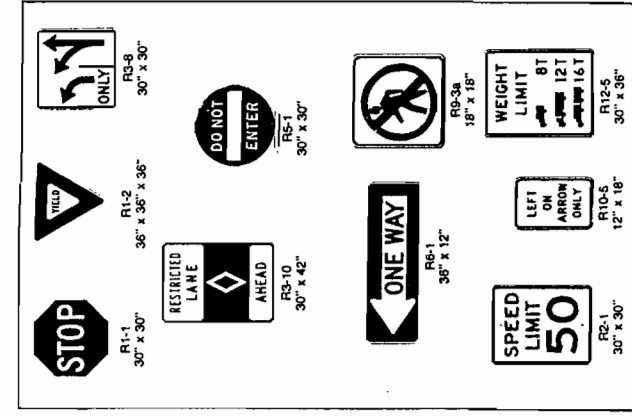


Commonly Used Guide Signs



Commonly Used Warning Signs

REPRESENTATIVE SIGNS:  
GUIDE, WARNING & REGULATORY



Commonly Used Regulatory Signs

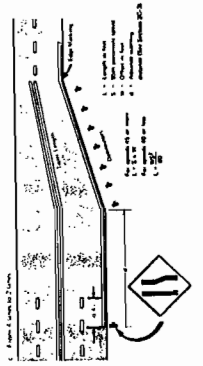
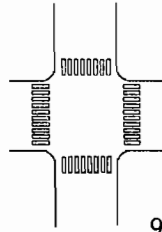
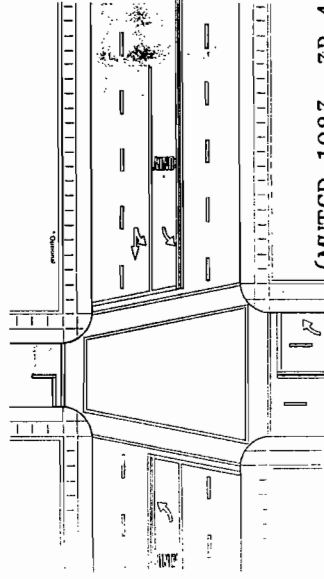
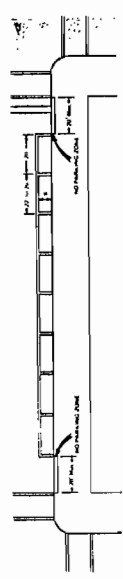


Figure 2-10 Typical pavement with intersection markings and signs



96



(MUTCD 1983, 3B 4, 12, 13, 20, 23, 27)

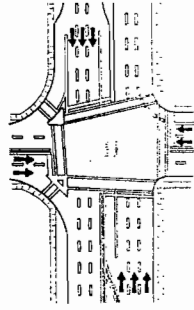
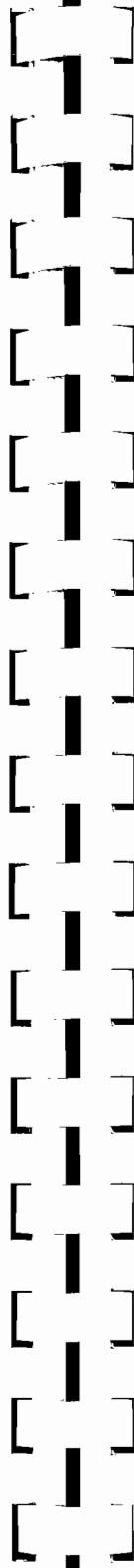



Figure 2-15 Typical arrangements of bars in signal faces

(MUTCD 1983, 4B-9)



Barricades consist of one to three bars (labelled Type 1, 2 or 3 according to the number of bars) covered with striped red and white reflectorized material. Channelizing devices - largely associated in construction and maintenance - are often tubulars or cones but they can also take the form of vertical panels, drums, or barricades. Cones and tubulars are largely or entirely in orange. Barricades have white and orange diagonal stripes; vertical panels have a similar pattern. Drums have white and orange horizontal stripes. Channelizing devices outside of construction display the color pattern of the pavement markings they are replacing or supplementing.

## 10B Railway Signals, Signs & Indicators

### 10B1 Introduction & Lighted/Partially-Lighted Signals

There is no central and overarching term for railway transportation markings in contrast to most other modes of markings. The lack of such a term may possibly be due to the dominance of one form of device in railways: the signal whether partially (semaphore) or fully-lighted. The Association of American Railroads (AAR) focusses almost exclusively on signals; the American Railway Engineering Association offers some guidelines for signs - including grade crossings - and targets but little on signals. The choice is to use the term signal in a loose sense that includes the full range of devices or to use a bulky phrasing of words that eventually envelops everything (AAR Foley 1975, AREA 1983, Part 2, AREA 1979 in AREA 1990, Part 7).

The purpose of signals (and allied devices) is that of regulation; this regulation pertains to economic train management and movement as well as safety regulation. In some sense the warning function is subsumed into regulation. Guidance is more a function of railway signs.

The semaphore signal was the major form of signal in the nineteenth century. The gradual development of the signal did not reach its zenith until the early years of this century. By that time various forms of all-lighted signals were appearing which eroded the position of the semaphore in its most advanced form. Many present-day signals were introduced in the first three decades of the twentieth century. Many targets, and probably signs as well, are

direct descendants of nineteenth century models; not infrequently they are unchanged from that era.

Widespread use of electronics has not taken place in any direct sense though microprocessors and other aspects of computer technology have a major role in the operation and management of signals. The use of the semaphore has greatly declined though considerable numbers are still in use. The forms of all-lighted signals are dominant and have changed little over many years. The color-light signals, either multiple-lens or some form of searchlight signal, are the primary forms in use.

The first edition of this study described signal messages in inordinate detail and barely considered the forms of signals and their specific means of portraying messages. This edition will instead focus on the second topic and present the first topic in a more summary form. A simpler version of a signal message chart of AAR (altered and simplified with the aid of Canadian sources) and a brief review of those two systems prepared for Volume II, Part F is reprinted in a Note at the end of this subsection (CNR 1975; AAR 1956, ARSPAP II, SA I, 41ff).

The semaphore has two primary versions: the upper quadrant and the lower quadrant. The upper quadrant is the far more common of the two. The spectacle and the arm form one unit in contrast to many European semaphores. The essential messages are green for proceed, yellow for caution and red for stop. In traffic signals the arrangement has red at the top, yellow in the UQ semaphore: on the arm in the

horizontal position the red indication is displayed; in the intermediate position (at 45 degrees), the yellow is illuminated. The vertical indicate of the arm displays green. This pattern is followed throughout North American railway practice. In fact, the positions of semaphore arms undergird the entire field of signal messages. The common form of the LQ requires two arms in order to gain three messages, and the pattern of messages is then reversed since the arm in the horizontal position is at the top and as the arms descend the other messages come into view (Train Shed, 14-17).

The color-light signal (multiple-lens) has three lamps in the basic form though two signal housings with three lamps in each housing are required for more complex messages. The searchlight signal contains three movable lenses within one compact unit; each lens moves into position in front of the lamp as commanded by signal indications. A newer form of the searchlight employs fiber optic cable and computer technology to supply the correct color without physical movement of lenses (Safetrans 1991).

The era of experimentation early in the century produced many kinds of signals. Two of these are the position signal and the color-position signal. The former produced semaphore type indications through multiple lights. For example, a row of three vertical lamps denoted a proceed message and a row of horizontal lamps indicated stop. Marker lamps added to the basic signal expanded the range of messages. Color-position displayed messages through a double means: position (from semaphore

arm positions) and the standard colors. Neither signal has enjoyed widespread use though both are significant within restricted systems. Position signals employ yellow though some sources state that amber is used. Amber is a form of more saturated yellow in use for railway signal operations.

Dwarf signals for color-light signals have two lamps: for green and red though searchlight indicates can produce three indications. Dwarfs for position and color-position are physically at variance with full-size forms and produce fewer messages (AAR 1949, 18, 20).

While individual railways exhibit considerable variation in target designs and colors there is much less in switch signals. Switch signals exhibit red and green colors and corresponding messages. Other colors associated with railway practices, including lunar white, purple, yellow and blue, are on occasion employed with switch signals. Switch signal messages are predicated on simple proceed or stop indications. Switch signals are frequently integrated with targets. Many of these targets are of the stand alone type though some are smaller circular units that fit around the signal lamps (Western-Cullen; Adlake 1952).

Track indicators (also known by other names including block indicators, switch indicators and track car indicators) are a device that often employs miniature semaphore arms or graphic symbols to indicate whether or not a train is approaching. They are primarily for the benefit of train crews working on the tracks or maintaining switches for divergent lines. They are a largely obsolete device though of significance because of the variety of forms and messages (Clearman 1991, 182).







not so classified it can be a stand-alone unlighted device, yet with a switch lamp it becomes an integral unit of a partially-lighted signal. Switch lamps are contained with partially-lighted coverage and targets are considered here but they belong together as well.

While a full source of information on targets (AREA offers illustration though seemingly not a full treatment) is not extant there is at least one substantial source available: W.M. Camp's massive tome, *Notes on Track* published in 1903. It remains an important source as many current targets are represented in Camp. Further validation is seen in Merriam-Webster's use of Camp (see especially WNID 1934). AREA was made available through publications of Bethlehem Steel Company (1955, 1981).

Targets are of three basic types: color, position, or shape. A position target is frequently a single vane and often of a circular shape. The blind edge indicates proceed and is parallel with the tracks that are open for use. A shape target denotes its message via a shape more than the color or position of the target. Color targets rely on color over shape or position. Targets are frequently a combination of shape and color as Camp has noted; many combine all three features. Most targets have double vanes which differentiate shape, position, color for intersecting tracks.

Targets are also differentiated by size. Low targets, for example, require much smaller targets than middle or high forms. An alphanumeric dimension may be added to the targets of some railways.

There are few guidelines for the meanings of shapes, position, colors; no doubt meanings have been worked out by individual rail systems. Meanings from other mediums can probably suggest the meaning in use on railways.

APPENDIX

CLASSIFICATION EXPANSIONS & EXPLICATIONS

i

i) Multiple & Variant Classification

- .1 Floating Aids to Navigation
  - .10 Most Exposed and Exposed
    - .100 Standard 1987 Pillar Buoy, Most Exposed Locations
      - 9x35 LWR
      - 9x35 LR
      - 9x35 LHR
    - .101 Non-Standard, Exposed Locations 1983 9x35 LHR (ELB= Exposed Location Buoy)
      - 1962 9x32 LWR
      - 1952 9x32 LWR
      - 1942 9x38 LW
      - 1942 10x39 LW
    - .102 Standard 1989 (1962) Buoy, Most Exposed Locations
      - 9x32 LR
      - 9x32 LBR
      - 9x32 LGR
      - 9x32 LHR
    - .103 Non-Standard
      - 1952 9x32LR
      - 1942 9x32L
      - 1928 9x32L
    - .104 Standard 1989 (1962) Buoy, Exposed
      - 8x26LR
      - 8x26LBR
      - 8x26LGR
      - 8x26LHR
    - .105 Non-Standard

1952 8x26LR  
1942 8x26L  
1928 8x20L  
1928 8x23L  
.106 Standard 1989 (1962) Buoy, Exposed  
Location  
8x26LWR  
.107 Non-Standard  
1952 8x26LWR  
1942 8x26LW  
1928 8x23LW  
.11 Semi-Exposed, Protected &  
Most Protected  
.110 Standard 1962 Buoy, Semi-Exposed  
Location  
7x20LI  
.111 Non-Standard  
1980 6x16LI  
1952 6x24LI  
.112 Standard 1989 (1962) Buoy,  
Semi-Exposed Location  
7x17LR  
7x17LBR  
7x17LHR  
.113 Non-Standard  
1952 7x17LR  
1942 7x15L  
1928 7x18L  
.114 Standard 1962 Buoy, Semi-Exposed  
Location  
6x20LR  
6x20LBR  
6x20LHR  
.115 Non-Standard  
1952 6x20LR  
1942 6x20L  
.116 Standard 1965 Buoy, Protected  
5x11LCR  
5x11LNR

.117 Non-Standard  
1962 5x11LR  
1952 5x11LR  
1942 5x10L  
.118 Standard 1965 Buoy, Most Protected  
3.5x8LCR  
3.5x8LNR  
.119 Non-Standard  
1962 3.5x8L  
1952 3.5x8L  
1942 3.5x8L  
1928 3.5x10L  
.13 1st & 2nd Class Unlighted Buoys  
.130 Standard 1988 Can, Most Exposed  
1CR  
.131 Non-Standard  
1952 1CR  
1942 1CT  
1928 1C  
.132 Standard 1988 Nun, Most Exposed  
1NR  
.133 Non-Standard  
1952 1NR  
1942 1NT  
1928 1N  
.134 Standard 1988 Can, Exposed  
2CR  
.135 Non-Standard  
1952 2CR  
1942 2CT  
1928 2C  
.136 Standard 1988 Nun, Exposed  
2NR  
.137 Non-Standard  
1952 2NR  
1942 2NT  
1928 2N  
.14 3rd Class Unlighted Buoys  
.140 Standard 1988 Can, Semi-Exposed

- 3CR
- .141 Non-Standard
  - 1952 3CR
  - 1942 3CT
  - 1928 3C
- .142 Standard 1988 Nun, Semi-Exposed
  - 3NR
- .143 Non-Standard
  - 1952 3NR
  - 1942 3NT
  - 1928 3N
- .144 Standard 1988 Can, Ice
  - 3CI
- .145 Non-Standard
  - 1942 1CS
  - 1942 2CS
- .146 Standard 1988 Nun, Ice
  - 3NI
- .147 Non-Standard
  - 1942 1NS
  - 1942 2NS
- .15 4th, 5th, 6th Class Unlighted Buoys
- .150 Standard 1952 Can, Western Rivers
  - 4CR
- .151 Standard 1952 Nun, Western Rivers
  - 4NR
- .152 Standard 1981 Can, Ice
  - 5C1
- .153 Standard 1981 Nun, Ice
  - 5N1
- .154 Standard 1952 Can, Western Rivers
  - 6CR
- .155 Standard 1952 Nun, Western Rivers
  - 6NR
- .156 Standard 1952 Can, Swiftest Western Rivers
  - 6CT
- .157 Standard 1952 Nun, Swiftest Western Rivers

- 6NT
- .16 Foam Buoys
- .160 Standard Can, Foam, Semi-Exposed
  - 1CFR (Under Development)
  - 2CFR
  - 3CFR
  - 4CFR
- .161 Standard Nun, Foam, Semi-Exposed
  - 1NFR (Under Development)
  - 2NFR
  - 3NFR
  - 4NFR
- .162 Standard 1989 Can, Foam, Protected
  - 5CFR
- .163 Standard 1989 Nun, Foam, Protected
  - 5NFR
- .164 Standard 1989 Can, Foam, Most Protected
  - 6CFR
- .165 Standard 1989 Nun, Foam, Most Protected
  - 6NFR
- .17 Plastic Buoys
- .170 Standard 1972 Can, Temporary, Protected, Plastic (Rolyan)
  - 5CPR
  - Alternate Design (Automatic Power)
  - 5CPR
- .171 Standard 1972 Nun, Temporary, Protected, Plastic (Rolyan)
  - 5NPR
  - Alternate Design (Automatic Power)
  - 5NPR
- .172 Standard 1972 Can, Temporary, Most Protected, Plastic (Rolyan)
  - 6CPR
  - Alternate Design (Automatic Power)

- 6CPR
- .173 Standard 1972 Nun, Temporary, Most Protected, Plastic (Rolyan)
  - 6NPR
  - Alternate Design (Automatic Power)
  - 6NPR
- .174 Standard 1978 Can, Fast Water, Plastic
  - FCPR
- .175 Standard 1978 Nun, Fast Water, Plastic
  - FNPR
- .176 Discrepancy Buoy, Temporary, Most Protected, Foam-filled Plastic 1977, Can or Nun Daymark, Radar Reflector
- .18 Sound Buoys
  - .180 Standard 1962 Buoy, Exposed
    - 9x20BR
    - 9x20GR
  - .181 Non-Standard
    - 1952 9x20BR
    - 1942 9x13B
    - 1942 8x13B
    - 1952 9x20GR
    - 1942 9x13G
    - 1942 8x13G
- .2 Fixed Marine Structures
  - .20 Major Light Structures
    - .200 Marine Sites
      - Monolithic Stone Towers
      - Skeleton Wrought Iron Towers
      - Offshore Light Platforms
    - .201 Low Elevation Sites
      - Skeleton Wood Towers
      - Iron Enclosed Towers
    - .202 High Elevation Sites

- Granite Towers
- Brick Towers
- Iron Plate Towers
- Concrete Towers
- .21 Minor Light Structures: Land
  - .210 Skeleton Towers
    - Free-standing
    - Guyed
    - Semi-guyed
  - .22 Unlighted Structures (Daybeacons)
- .3 Marine Acoustical Signals
  - .30 Standard
    - .300 Diaphragm
      - FA-232
      - SA-850
      - CG-1000/ELG-300
      - CG-1000/ELG-500
      - SA-3C
      - AB-860
    - .31 Non-Standard
      - .310 Diaphragm, Two-tone
      - .311 Diaphone, Chime
- .4 Electronic Aids
  - .40 Long-Range
    - .400 Loran
      - "A"
      - "C"
    - .41 Short-Range
      - .410 Radiobeacons
        - Marker
        - Continuous
        - Sequenced
- .5 Aeronautical Navigation Aids
  - .50 Beacons, Airport and Heliport
    - .500 Medium Intensity (L-801A, H, S)
      - Airport; Heliport; Seaplane

- .501 High Intensity (L-802A, H, S)  
Airport; Heliport; Seaplane
- .502 Code (Identification)
- .503 Airway Beacon
- .504 Course Lights
- .51 Approach Lighting
  - .510 Discharge Flashing Light  
REIL (L-849), Unidirectional,  
Omnidirectional  
ODALS (L-859)  
ALS, I & II, Elevated, Inpavement
  - .511 Lampholders  
PAR 38  
PAR 56  
PAR 56-Inpavement
  - .512 Generic Visual Guideslope Indicator  
Single Projector  
Multiple Projector
  - .513 Precision Approach Path Indicator  
Two Light Units  
Four Light Units
- .52 Runway Inpavement Lights
  - .520 Runway Centerline (L-850A)  
Bidirectional & Unidirectional
  - .521 Runway Touchdown Zone; Medium  
Intensity Approach Lighting System  
(L-850B) Unidirectional
  - .522 Runway Edge (L-850C) Bidirectional
  - .523 Runway Threshold/End (L-850D)  
Bidirectional & Unidirectional
- .53 Taxiway Inpavement Lights
  - .530 Taxiway Centerline  
Straight Sections; Caution Bar  
(L-852A) Bidirectional &  
Unidirectional  
(No Category III)  
Curved Sections (L-852B)  
Bidirectional & Unidirectional (No  
Category III)

- Straight Sections; Caution Bar  
(L852C) Bidirectional &  
Unidirectional (Category III)
- Curved Sections (L-852D)  
Bidirectional & Unidirectional  
(Category III)
- .531 Taxiway Intersections  
Omnidirectional (L-852E)  
(No Category III)  
Omnidirectional (L-852F)  
(Category III)
- .54 Runway & Taxiway Elevated Lights
  - .540 Runway Edge Lights  
Runway Edge (L-860) Omnidirectional  
& Bidirectional (VFR Runways)  
Runway Edge (L-861) Omnidirectional &  
Bidirectional (Non-precision IFR  
Runways)  
Runway Edge (L-862) Bidirectional  
(Precision IFR Runways)
  - .541 Runway Threshold/End Lights  
Runway Threshold/End (L-860E)  
Bidirectional & Unidirectional  
(VFR Runways)  
Runway Threshold/End (L-861E)  
Bidirectional & Unidirectional  
(Non-precision IFR Runways)  
Runway Threshold/End (L-861SE)  
Bidirectional & Unidirectional  
(Non-precision IFR Runways)  
Taxiway Edge (L-861T) Omnidirectional  
Runway Threshold/End (L-862E)  
Bidirectional & Unidirectional  
(Precision IFR Runways)
  - .542 Taxiway Edge (L-861T) Omnidirectional
  - .543 (Holding Position Edge (L-804)  
Unidirectional has one form only;  
also given in Main Classification)
- .55 Obstruction Lighting

- .550 Steady-burning (L-810)
  - Class 1, Low Intensity
  - Class 2, High Intensity
- .551 High Intensity
  - (L-856) [40 FPM]
  - (L-857) [60 FPM]
- .552 Flashing Red Obstruction Light
  - (L-864)
- .553 Medium Intensity
  - (L-865, 40 FPM)
  - (L-866, 60 FPM)
- .56 Taxiway Guidance Signs
  - .560 Mandatory Instruction
    - Holding Position: Taxiway/Runway Intersections
    - Holding Position: Runway/Runway Intersections
    - Holding Position: ILS Critical Areas
    - Holding Position: Runway Approach Areas
    - No Entry
  - .561 Location, Direction & Destination
    - Taxiway Location
    - Runway Location
    - Runway Safety Area/ OFZ & Runway Approach Boundary
    - ILS Critical Area Boundary
    - Taxiway Direction
    - Runway Exit
    - Outbound Destination
    - Inbound Destination
- .57 Obstruction Markings
  - .570 Patterns
    - Solids
    - Bands
    - Checkerboards

- Teardrops
- .571 Markers
  - Spherical
  - Flags
- .6 Electronic Aeronautical Aids
  - .60 Instrument Landing System
    - .600 Localizer
      - Offset Localizer
      - Localizer-type Directional Aid
    - .601 Marker Beacon
      - Inner
      - Middle
      - Outer
    - .602 VOR/DME
  - .61 Microwave Landing System
    - .610 Localizer Facility
    - .611 Glide Slope Facility
    - .612 Marker Beacon
- .7 Traffic Control Devices
  - .70 Traffic Control Signals
    - .700 Traffic Control Signals
      - Pre-timed Signals
      - Traffic-actuated Signals
  - .71 Traffic Beacons
    - .710 Hazard Identification Beacon
    - .711 Speed Limit Beacon
    - .712 Intersection Control Beacon
    - .713 Stop Sign Beacon
  - .72 Railroad Crossing Signals
    - .720 Lighted Signals, Post-mounted
    - .721 Lighted Signals, Cantilever-mounted
    - .722 Lighted Signals with Gates and Fixed Lights
      - (Bell may accompany any of the above)



(All Traffic Signs, outside of 8A3, are included in the Message Classification rather than in this Multiple and Variant Classification; Category reserved: .72)

(A case can be made for including at least some portion of Pavement and Curb markings in this classification. However, all elucidations of those categories are to be found in the Message Classification; Category reserved: .73)

.8 Railway Signals, Signs, & Targets

.80 All-Lighted Signals

.800 Color Light Signals

Vertical arrangement (standard)

Triangular arrangement

Horizontal arrangement

.801 Cab Signals

Color-light

Position-light

(Signs, outside of the main classification, are included in the message classification since signs, beyond general categories, are closely bound up with the message dimensions; subcategory reserved for signs: .810)

.82 Targets, shape

.820 Mask

Mask and Obround

Mask and Mask

Mask and Prism

.821 Arrow

Arrow and Mask

Arrow and Circle

Arrow and Obround

Arrow and Diamond

Arrow, single vane

.822 Obround

- Obround and Mask
- Obround, single vane
- .823 Rectangle
- Rectangle and Obround
- Rectangle and Circle
- .824 Diamond
- Diamond, single vane
- .825 Square
- Square and Square

.9 Sound Signals TCD & Rail

.90 TCD

.900 Grade Crossing Bell

.91 Rail

.901 Cab Signal Bell

b) Explanatory Notes

The multiple and variant classification follows an alternative number/letter system somewhat patterned after that of the variant classification of Volume II, Part F. Markings are divided into ten primary categories:

- .1 All floating marine transportation markings
- .2 All fixed marine " "
- .3 All sound marine " "
- .4 All electronic marine " "
- .5 All fixed aero " "
- .6 All electronic aero " "
- .7 All visual tcd " "
- .8 All visual railway " "
- .9 All sound tcd & rail " "

The subcategory of .100-.109, Most Exposed and Exposed buoys, expands the material of 12. It follows, to a substantial degree, the USCG treatment of buoys. The subcategory is in two segments: Most Exposed and Exposed. Most Exposed is divided into two segments, each

segment containing a standard and a nonstandard component. The buoys are classified by location which is determined by size of the buoy. Buoys with a sound dimension signify that state by inclusion of the sound type in the title. The USCG includes the date of the buoy type and that is also listed. In the former classification light and sound combined buoys were in a separate category termed Combination Buoys but light buoys with a sound dimension are now included in this subcategory along with light-only buoys. Exposed buoys are divided into three segments each with a standard and non-standard element. The other comments about Most Exposed buoys apply to Exposed as well.

Semi-exposed, Protected and Most Protected constitute a second subcategory: .110-.119. Semi-exposed is divided into three standard and three non-standard segments. Protected and Most Protected are equipped with can or nun daymarks and thereby have lateral significance contrary to other lighted buoys (and to historic practice). None of these buoys has a sound signal.

Unlighted buoys constitutes a large and diverse crowd of buoys including metal, foam and plastic versions. Buoys are also classified by location (as is the case with lighted and lighted sound buoys) and some by special circumstances (ice conditions, and western rivers). Buoys are classified by size which are represented by class rather than by diameter and length. Buoys are divided into classes; classes are determined by the size of the buoy.

There are 42 groupings of unlighted buoys and this proves to be an unwieldy mass to deal

with. The 42 groups are divided into six subcategories: 1st and 2nd class buoys (.130-.137), 3rd class (.140-.147), 4th, 5th and 6th class buoys (.150-.157), Foam buoys (.160-.167), and Plastic buoys (.170-.179).

All 1st class buoys are in the Most Exposed designation. There are two standard components: one can and one nun with an accompanying non-standard group for each. Exposed buoys include all 2nd class buoys and these follow the format of the 1st class buoys.

Semi-exposed (SE) and a portion of ice buoys are members of the 3rd class. SE and Ice groups each contain can and nun buoys which are divided into standard and non-standard forms. This sub-category includes .140 to .147.

The more limited forms of 4th, 5th, and 6th class buoys form one subcategory: .150-.157. This category includes ice, western rivers and swiftest western rivers buoys. The non-standard forms are no longer in use and the USCG has dropped them from the Manual; this classification follows suit.

The information of the introductory summary of buoy types should suffice for foam and plastic buoys. It can be noted that some plastic buoys (.170-.173) have alternative forms made of fibre glass.

The Manual does not give details on spar, sphere, barrel and drum buoys and for that reason these forms are restricted to the terse entries in the main classification.

Fixed aids, lighted and unlighted, constitute the .2 category. Fixed-major entries are brief since major aids (lighthouses) do not have standard forms, are very much individualized and hence can be described only in general terms. These aids are listed under the .20 designation with subdivisions according to major shapes and locations. Minor aids, when lighted, offer some standard forms though considerable individuality and singularity are present here though declining. These aids are within the .21 category. Fixed unlighted aids (daybeacons) are also marked by standard forms yet also have many individual forms. The category of .22 has been reserved for daybeacons though non-standard forms are not listed in the Manual.

Sound signals, a small group, are designated .3. There is only one standard form at present though there are several variations. Many older and non-USCG forms are in use at bridges, piers and other locations. Standard forms are grouped under .30 and non-standard under .31.

Electronic aids (.4), are small numerically though highly significant. They are divided into two categories (.40 and .41) with further subdivisions where required. Loran A is included though largely obsolete. Radio-beacons, though declining, continue as a common aid.

Aeronautical navigation aids afford a considerable degree of precision including official designation numbers. The main classification provides principal forms with a minimum of detail. Additional forms and

official designation material are added in this classification.

Beacons are found within .500-.502 designations. Subforms are listed but within the bounds of the principal forms. There is uncertainty over the status of the identification beacon as some current publications include while others omit it. A partial explanation is found in Chapter 9B, page 69. The airway beacon and course lights are also included since AIP and AIM both mention the continued existence of a few members of those once abundant forms of aero aids.

The brevity of approach lighting in the main classification belies its complexity and diverse elements. Each of the four subdivisions of this classification has two or more subunits or variant forms. The entire category is found within .510 and .513.

Runway and Taxiway Inpavement Lights form a unit but require separate subcategories: .520-.523 for runways and .530-.531 for taxiways. The runway forms are of a unitary pattern and sometimes exhibiting two types: bidirectional or unidirectional. The taxiway units prove to be very complex since they are tied to different levels of aviation activity.

Runway and Taxiway Elevated Lights (.520-.523) manifests considerable complexity in the main classification and even more complexity here. A variety of light units have multiple purposes which allows some conflation in the main classification. Light units with multiple purposes are considered separately in this classification.

Obstruction lights (.55) are somewhat truncated in the main classification but the full panoply is to be found in this classification. Types and subtypes, FAA designations and flash rates are all included and divided between .550 and .553.

Signs constitute an extension, and an extrapolation, of the main classification with virtually all entries referring to taxiway matters. The subcategory designation of .56 is further divided into .560 and .561.

Obstruction markings consist of patterns and markers for the main classification. Each of those groups is broken down into its constituent elements for this classification. The designation is .57 and further subdivided into .570 and .571.

Electronic devices are listed by individual units in the main classification but in this classification they are grouped according to system: ILS (.60) and MLS (.61); few devices of an electronic nature are outside of those systems. ILS devices are grouped under .600 and .601; MLS under .611, .612, and .613.

Traffic Control Devices and Railway Signals and allied devices are numerous though not requiring lengthy classifications. Traffic Control Signals (.70) are frequently bifurcated into Pre-timed Signals and Traffic-actuated Signals; that designation is employed in this classification under .700. Traffic Beacons can be divided into four subsections (.710 to .713).

Traffic signs are found in the message classification but a category is reserved for

possible future use: .72. This is also true for markings for which .73 has been reserved.

All-lighted railway signals are found within the category of .80; they can be further divided into several nuanced segments (.800-.801); cab signals are also bifurcated. Railway signs are treated in the manner of traffic signs. Targets, a form of unlighted signal, are assigned to the .82 segment (.820-.825).

ii Double Transition Classification

a) Markings Within Forms of Energy

All-Lighted

- 322 Approach Lighting
  - 3220 Lampholder Unit
  - 3221 Discharge Flashing Light
  - 3222 Generic Visual Glideslope Indicator
  - 3223 Precision Approach Path Indicator
- 410 Traffic Signals, Single
  - 4100 Traffic Control Signals
- 411 Specialized Use
  - 4110 Traffic Beacons
  - 4111 Lane-Control Signals
  - 4112 Moveable Bridge Signals
  - 4113 Railroad Crossing Signals
  - 4114 Ramp Control Signals
  - 4115 Pedestrian Signals
  - 4116 Emergency Traffic Signals
  - 4117 One-Lane/Two-Way Signals
- 510 Trackside Signals
  - 5100 Searchlight-Color Light
  - 5101 Color-Light
  - 5102 Position-Light
  - 5103 Color-Position Light
- 511 Dwarf Signals
  - 5110 Searchlight-Color Light
  - 5111 Color-Light
  - 5112 Position-Light
  - 5113 Color-Position Light
- 512 Cab Signals

Partially-Lighted

120 Lighted & Lighted Sound Buoys,  
     Most Exposed  
     1200 Lighted  
     1201 Lighted Whistle  
     1202 Lighted Horn  
     1203 Lighted Bell  
     1204 Lighted Gong  
 121 Exposed  
     1210 Lighted  
     1211 Lighted Whistle  
     1212 Lighted Horn  
     1213 Lighted Bell  
     1214 Lighted Gong  
 122 Semi-Exposed  
     1220 Lighted  
     1221 Lighted Horn  
     1222 Lighted Bell  
 123 Protected  
     1230 Lighted  
 124 Most Protected  
     1240 Lighted  
 125 Discrepancy Buoy  
     1250 Lighted  
 126 Major Aids  
     1260 Large Navigation Buoy (LNB)  
 220 Major Lighted Structures  
     2200 Enclosed Towers  
     2201 Skeleton Towers  
     2202 Houses/Towers on Special  
         Foundations  
 221 Minor Structures: Marine Sites  
     2210 Single Pile  
     2211 Multiple Pile  
     2212 Standard Structures on  
         Special Foundations  
 222 Minor Structures: Land Sites  
     2220 Post  
     2221 Spindle  
     2222 Skeleton Tower

    2223 Cylindrical  
     2224 Small House  
     2225 Pyramidal  
 321 Beacons, Airport  
     3210 Rotating/Flashing  
     3211 Code  
 323 Runway & Taxiway Inpavement  
     Lighting  
     3230 Runway Centerline &  
         Touchdown Zone Lights  
     3231 Edge, Threshold/End Lights  
     3232 Taxiway Centerline Light  
     3233 Taxiway Intersection Lights  
 324 Runway & Taxiway Elevated  
     Lighting  
     3240 High Intensity Runway Edge &  
         Threshold/End Lights  
     3241 Medium Intensity Runway Edge,  
         Threshold/End & Taxiway Lights  
     3242 Medium Intensity Threshold  
         Light-Special  
     3243 Low Intensity Edge,  
         Threshold/End Light  
     3244 Holding Position Edge Light  
 325 Obstruction Lighting  
     3250 Steady-burning Light  
     3251 Flashing Light  
     3252 High Intensity Light  
     3253 Medium Intensity Light  
 326 Lighted Signs: Taxiway Guidance &  
     Runway  
     3260 Mandatory Instruction  
     3261 Location  
     3262 Direction  
     3263 Taxiway Ending Marker  
     3264 Destination  
     3265 Roadway  
     3266 Information  
     3267 Runway Distance Remaining

- 327 Wind Indicators
  - 3270 Wind Cone
  - 3271 Wind Tee
- 520 Semaphore Signals
  - 5200 Trackside
  - 5201 Dwarf
- 521 Switch Signals

Unlighted

- 130 Unlighted Buoys Most Exposed
  - 1300 Can
  - 1301 Nun
- 131 Exposed
  - 1310 Can
  - 1311 Nun
- 132 Semi-Exposed
  - 1320 Can
  - 1321 Nun
- 133 Ice
  - 1330 Can
  - 1331 Nun
- 134 Western Rivers
  - 1340 Can
  - 1341 Nun
- 135 Swiftest Western Rivers
  - 1350 Can
  - 1351 Nun
- 136 Foam-Filled Buoys
  - 1360 Can, Protected
  - 1361 Nun, Protected
  - 1362 Can, Most Protected
  - 1363 Nun, Most Protected
- 137 Plastic Buoys
  - 1370 Can, Protected-Temporary
  - 1371 Nun, Protected-Temporary
  - 1372 Can, Most Protected-Temporary
  - 1373 Nun, Most Protected-

- Temporary
- 138 Discrepancy Buoy, Most Protected-Temporary (Foam-filled Plastic)
  - 1380 Unlighted, Can daymark
  - 1381 Unlighted, Nun daymark
- 139 Other Unlighted Buoys
  - 1390 Spar
  - 1391 Sphere
  - 1392 Drum
  - 1393 Barrel
- 230 Unlighted Aids, Marine Sites
  - 2300 Single Pile
  - 2301 Multiple Pile
- 231 Land Sites
  - 2310 Post
  - 2311 Spindle
  - 2312 Stake
  - 2313 Tripod
- 330 Unlighted Runway Markings
  - 3300 Centerline
  - 3301 Designation
  - 3302 Threshold
  - 3303 Fixed Distance
  - 3304 Holding Position
  - 3305 TDZ
  - 3306 Side Stripes
- 331 Taxiway Markings
  - 3310 Centerline
  - 3311 Edge
  - 3312 Holding Position
- 332 Runway & Taxiway Retroreflective Markers
  - 3320 Inpavement-Centerline
  - 3321 Elevated-Edge
- 333 Obstruction Markings
  - 3330 Patterns
  - 3331 Markers
- 334 Single Types
  - 3340 Segmented Circle Airport

Marker System  
 3341 Compass Calibration Pad  
 430 Regulatory Signs  
 4300 Dominant Model, Rectangles  
 (vertical emphasis)  
 4301 Secondary Model, Squares  
 431 Warning Signs  
 4310 Dominant Model, Diamonds  
 4311 Supplemental Model,  
 Rectangles (vertical emphasis)  
 4312 Supplemental Model, Squares  
 4313 Supplemental Model, Triangle  
 (isosceles)  
 432 Guide Signs  
 4320 Dominant Model, Rectangles  
 (horizontal emphasis)  
 4321 Special Shape, Shields  
 4322 Special Shape, Rectangles  
 (elongated-vertical emphasis)  
 4323 Supplemental Model,  
 Rectangle (vertical  
 emphasis)  
 433 Markings  
 4330 Pavement  
 4331 Curb  
 4332 Objects-within roadway  
 4333 Objects-adjacent to roadway  
 4334 Objects-end of roadways  
 4335 Delineators-curb  
 4336 Delineators-upright  
 4337 Barricades  
 4338 Channelizing Devices  
 530 Targets  
 5300 Color  
 5301 Shape  
 5302 Position  
 5303 Color-shape  
 531 Miniature Graphic Symbols  
 532 Signs

5320 Location  
 5321 Advanced Location  
 5322 Speed Control  
 5323 Safety  
 5324 Maintenance of Way

Electronic

240 Marine Electronic Short Range  
 2400 Radiobeacon  
 2401 Racon  
 2402 Radar Reflector  
 241 Long Range  
 2410 Loran  
 2411 Omega  
 2412 Global Positioning System (GPS)  
 340 Aero Electronic Course and  
 Distance  
 3400 Glide Slope  
 3401 Localizer  
 3402 VOR  
 3403 VORTAC  
 3404 TACAN  
 3405 DME  
 341 Location Identification  
 3410 Non-directional Beacon  
 3411 Marker Beacon  
 3412 Compass Locator (COMLO)

Sound

150 Sound Buoys Single Types  
 1500 Bell  
 1501 Gong  
 1502 Whistle  
 250 Marine Sound Single Types  
 2500 Diaphragm [Pure tone, Bell  
 tone, Gong tone]  
 2501 Diaphone



2502 Siren  
2503 Air Horn

b) Markings Within Marking Forms

Signals

- 41 Traffic Signals
  - 410 Standard
    - 4100 Traffic Control Signals
  - 411 Specialized Use
    - 4110 Traffic Beacons
    - 4111 Lane-Control Signals
    - 4112 Moveable Bridge Signals
    - 4113 Railroad Crossing Signals
    - 4114 Ramp Control Signals
    - 4115 Pedestrian Signals
- 51 Railway Signals, All-Lighted
  - 510 Trackside Signals
    - 5100 Searchlight-Color Light
    - 5101 Color-Light
    - 5102 Position-Light
    - 5103 Color-Position
  - 511 Dwarf Signals
    - 5110 Searchlight-Color Light
    - 5111 Color-Light
    - 5112 Position-Light
    - 5113 Color-Position Light
  - 512 Cab Signals
- 52 Partially-Lighted Railway Signals
  - 520 Semaphore Signals
    - 5200 Trackside
    - 5201 Dwarf
  - 521 Switch Signals
- 53 Unlighted Signals
  - 530 Targets
    - 5300 Color

- 5301 Shape
- 5302 Position
- 5303 Color-Shape
- 531 Miniature Graphic Symbols

Beacons

- 12 Lighted & Lighted Sound Buoys
  - 120 Most Exposed
    - 1200 Lighted
    - 1201-4 Lighted Whistle/Horn/Bell/  
Gong
  - 121 Exposed
    - 1210 Lighted
    - 1211-4 Lighted Whistle/Horn/Bell/  
Gong
  - 122 Semi-Exposed
    - 1220 Lighted
    - 1221-2 Lighted Horn/Bell
  - 123 Protected
    - 1230 Lighted
  - 124 Most Protected
    - 1240 Lighted
  - 125 Discrepancy Buoy
  - 126 Major Aids
    - 1260 Large Navigation Buoy (LNB)
- 13 Unlighted Buoys
  - 130 Most Exposed
    - 1300 Can
    - 1301 Nun
  - 131 Exposed
    - 1310 Can
    - 1311 Nun
  - 132 Semi-Exposed
    - 1320 Can
    - 1321 Nun
  - 133 Ice
    - 1330 Can

1331 Nun  
134 Western Rivers  
1340 Can  
1341 Nun  
135 Swiftest Western Rivers  
1350 Can  
1351 Nun  
136 Foam-Filled Buoys  
1360 Can, Protected  
1361 Nun, Protected  
1362 Can, Most Protected  
1363 Nun, Most Protected  
137 Plastic Buoys  
1370 Can, Protected-Temporary  
1371 Nun, Protected-Temporary  
1372 Can, Most Protected-Temporary  
1373 Nun, Most Protected-Temporary  
138 Discrepancy Buoy  
Most Protected-Temporary  
(Foam-filled Plastic)  
1380 Unlighted, Can daymark  
1381 Unlighted, Nun daymark  
139 Other Unlighted Buoys  
1390 Spar  
1391 Sphere  
1392 Drum  
1393 Barrel  
22 Lighted Aids  
220 Major Structures  
2200 Enclosed Towers  
2201 Skeleton Towers  
2202 Houses/Towers on Special  
Foundations  
221 Minor Structures: Marine Sites  
2210 Single Pile  
2211 Multiple Pile

2212 Standard Structures on  
Special Foundations  
222 Minor Structures: Land Sites  
2220 Post  
2221 Spindle  
2222 Skeleton Tower  
2223 Cylindrical  
2224 Small House  
2225 Pyramidal  
23 Unlighted Aids  
230 Marine Sites  
2300 Single Pile  
2301 Multiple Pile  
231 Land Sites  
2310 Post  
2311 Spindle  
2312 Stake  
2313 Tripod  
32 Lights  
321 Beacons  
3210 Rotating/Flashing  
3211 Code  
323 Runway & Taxiway Inpavement  
Lighting  
3230 Runway Centerline &  
Touchdown Zone Lights  
3231 Edge, Threshold/End Lights  
3232 Taxiway Centerline Lights  
3233 Taxiway Intersection Lights  
324 Runway & Taxiway Elevated Lighted  
3240 High Intensity Runway Edge &  
Threshold/End Lights  
3241 Medium Intensity Runway  
Edge, Threshold/End &  
Taxiway Lights  
3242 Medium Intensity Threshold  
Light-Special

- 3243 Low Intensity Edge,  
Threshold/End Light
- 3244 Holding Position Edge Light
- 325 Obstruction Lighting
  - 3250 Steady-burning Light
  - 3251 Flashing Light
  - 3252 High Intensity Light
  - 3253 Medium Intensity Light
- 326 Wind Indicators
  - 3260 Wind Cone
  - 3261 Wind Tee

Beacons in a Different Modulation:  
Acoustical and Electronic Forms

- 24 Electronic Aids to Navigation
  - 240 Short Range
    - 2400 Radiobeacon
    - 2401 Racon
    - 2402 Radar Reflector
  - 241 Long Range
    - 2410 Loran
    - 2411 Omega
    - 2412 Global Positioning System (GPS)
- 34 Electronic Aids
  - 340 Course and Distance
    - 3400 Glide Slope
    - 3401 Localizer
    - 3402 VOR
    - 3403 VORTAC
    - 3404 TACAN
    - 3405 DME
  - 341 Location Identification
    - 3410 Non-directional Beacon
    - 3411 Marker Beacon
    - 3412 Compass Locator (COMLO)
- 25 Fixed Sound Signals

- 250 Single Types
  - 2500 Diaphragm (Pure tone, Bell tone, Gong tone)
  - 2501 Diaphone
  - 2502 Siren
  - 2503 Air Horn

- 15 Sound Buoys
  - 150 Single Types
    - 1500 Bell
    - 1501 Gong
    - 1502 Whistle

### Signs

- 430 Regulatory Signs
  - 4300 Dominant Model, Rectangles (vertical emphasis)
  - 4301 Secondary Model, Squares
- 431 Warning Signs
  - 4310 Dominant Model, Diamonds
  - 4311 Supplemental Model, Rectangles (vertical emphasis)
  - 4312 Supplemental Model, Squares
  - 4313 Supplemental Model, Triangle (isosceles)
- 432 Guide Signs
  - 4320 Dominant Model, Rectangles (horizontal emphasis)
  - 4321 Special Shape, Shields
  - 4322 Special Shape, Rectangles (elongated-vertical emphasis)
  - 4323 Supplemental Model, Rectangle (vertical emphasis)
- 532 Signs
  - 5320 Location
  - 5321 Advanced Location

- 5322 Speed Control
- 5323 Safety
- 5324 Maintenance of Way

Markings

- 33 Unlighted Aero Navigation Aids
  - 330 Runway Markings
    - 3300 Centerline
    - 3301 Designation
    - 3302 Threshold
    - 3303 Fixed Distance
    - 3304 Holding Position
    - 3305 TDZ
    - 3306 Side Stripes
  - 331 Taxiway Markings
    - 3310 Centerline
    - 3311 Edge
    - 3312 Holding Position
  - 332 Runway & Taxiway Retroreflective Markers
    - 3320 Inpavement-Centerline
    - 3321 Elevated-Edge
  - 333 Obstruction Markings
    - 3330 Patterns
    - 3331 Markers
  - 334 Single Types
    - 3340 Segmented Circle Airport Marker System
    - 3341 Compass Calibration Pad
- 433 Markings
  - 4330 Pavement
  - 4331 Curb
  - 4332 Objects-within roadway
  - 4333 Objects-adjacent to roadway
  - 4334 Objects-end of roadways
  - 4335 Delineators-curb
  - 4336 Delineators-upright
  - 4337 Barricades
  - 4338 Channelizing Devices

c) Explanatory Notes

The first portion of this classification, energy forms, is probably self-explanatory: the markings are divided up according to the form of energy waves through which a given marking's message is emitted and received. One point that can be noted are differences in visual markings. Some of these generate and emit light waves which contain the messages. But other markings do not emit waves of energy but depend on natural light or indirect light to illuminate the messages. The message systems of these latter markings can be in the form of shape, color, alphanumeric and/or graphic symbols.

Despite this key difference visual markings are considered together; they are not divided into those relying on their own powers and those relying on outside energy forces. Electronic markings employ "invisible" energy which has to be translated into visual/and or acoustic energy in order to be perceived but the central form of energy, waves neither seen nor heard, dictates this part of this classification schema. Of course electromagnetic waves are a different energy form than that of acoustic. Further, waves are also particles but that need not be gone into here.

The second phase of this classification has an unusual, or perhaps controversial, format: a division that is based on the forms of markings, whether signals, beacons, signs or markings. There is apparently no source that has divided up the various kinds of transportation markings into these categories. Yet over and over again these terms (signals, beacons, signs, markings) are applied to markings and consistently so. Even if exceptions can be found there are many more instances in which those categories are in use. While it is relatively easy to divide markings into these four categories, it is important to offer an explanation of what the

terms mean, and to consider various subcategories, nuanced differences, and interpretations. The explanatory notes will take up this second task.

There is no universal definition of the term "Signal" yet an examination of markings can quickly uncover where that term is employed: markings with changing messages (the nature of message classification in Ch 7B explains the various types of messages). The term "Signal" is applied to traffic control signals, to railway signals without regard to whether they are fully-lighted, partially-lighted, or unlighted. Flashing messages are not unknown though most are of a fixed character. Much more central to the meaning of signal is the changing character of the message: lights, mechanical arms, color, position, or some combination thereof, all bring about different messages.

There is a subdivision of the signal known as an "Indicator". This term appears to be exclusively applied to small, now largely obsolete, signals displaying graphic symbols and other small message configurations. They were directed to train crews and indicated the conditions of tracks. Seemingly they were not termed signals yet they easily conform to the idea of signal in this study. Indicator also forms a part of the titles of several aero approach lighting systems: VASI, PAPI, PLASI and RAILS. Some of these are fixed lights while others are flashing or pulsing. All have the characteristic of providing a narrowly focussed beam of light for incoming aircraft. They are not designated as beacons even though some are flashing. The key characteristic of narrowly focussed as opposed to the omni-directional and nonfocussed characteristics of aero beacons may be the point of differentiation.

The term "Beacon" has less precision attached to it. Beacon can be applied to all visual marine aids to navigation; it is also applied to traffic beacons (where the message is unchanging) and it is applied to aeronautical airway, airport and some obstruction lights. Characteristics of beacons include a substantial structure (a marine aid whether or not lighted can be a beacon; it also includes buoys); it is often lighted and oftentimes the light is flashing. Beacons can be easily distinguished from signals which have changing messages. A problem arises with aeronautical runway and taxiway, approach, and some obstruction lights which are not regarded as beacons. These can be considered as beacons if the marine perspective is employed, though the lack of structure, and the lack of a flashing mechanism - often a part of a marine beacon - seemingly disqualifies them from the beacon category.

Perhaps one can speak of two types of beacons: those that can be easily agreed upon as having the character of a beacon, and those, that, while having some of the characteristics of beacons, are not fully so, or are not recognized as being beacons, or - at the very least - are not signals. Runway, taxiway, and approach lights are examples of the second form of beacon.

"Beacons in a different modulation" with its reference to acoustic and electronic devices may constitute an atypical usage of the term beacon. However, the unvarying nature of messages for both forms of markings suggests a beacon form of message; the oldest electronic marking, the radio beacon, includes that word in its title. Fog signals, not fog beacons, is a standard designation for that aid to navigation, yet the nature of its messages reflects the beacon form rather than the signal form.

The word "Sign" may appear to be self-explanatory though closer examination can uncover problems. Signs have a physical form that requires a separate supporting structure. Signs display a flat surface with both significant vertical and horizontal dimensions. The message does not encompass the totality of the surface of the physical sign. The messages may include numbers and almost always include either words or graphic symbols. The messages usually do not refer to the sign itself or the location of the sign (this last characteristic can perhaps be debated). These characteristics not only define what signs are, but also what they are not; they further define what non-signs are (non-signs: that is, "markings" when not capitalized). The following discussion of non-signs/markings can, in turn, also illuminate the character of signs.

Markings (more precisely, Transportation Markings) is employed as an overarching term for all markings of whatever description. Since "Markings" or "Transportation Markings" lacked a built-in title, and because the word marking/mark/marker appears in all modes of transportation, it seemed reasonable - in the beginnings of this Monograph Series - to use it as the general term. Admittedly, that has created confusion since there are as well specific markings designated by that term. The term marking, when coupled with the word transportation, will be the general term while the term markings by itself (especially in lower case) will designate a specific form of transportation marking.

The word marking is especially associated with traffic control devices and in particular pavement markings. Pavement markings (and also curb markings) generally lack a vertical dimension, and consist of various configura-

tions of lines with occasional employment of alphanumeric and graphic symbols. A second form of marking, more specifically termed "Object Markers", have a vertical dimension. Object markers - and this is perhaps paradoxical - have a vertical dimension as much as or more than a horizontal dimension. The word markers then can suggest non-pavement markings and objects lacking signage characteristics. Another form of marking is termed a delineator, and even though it is associated with pavement markings it remains a separate unit and lacks the specific name of either marking or marker.

A point of confusion is generated by route markers and junction markers. They bear more of the characteristics of signs than of markings and are included under the heading of signs. Route markers de-emphasize word messages and that may have a bearing on their name. Perhaps further study of that object would create a nuanced understanding of a sign bearing the dual character of sign and marking. Aeronautical aids contain pavement markings as well and the term is also extended to obstruction markings.

The variant term of marker can refer to raised objects (reflective markers attached to the pavement and to elevated forms) and also to spheres serving as obstruction markings on electric cables. Railways employ the term marker for certain non-sign safety aids. Both road and rail usage includes objects known as mileposts and they too constitute a form of marker even though not so designated.

Marine aids to navigation present a more complex situation: the term beacon may appear to include objects that can be regarded as markings/markers though not so labelled. Possibly the key element of structure moves those objects from a category of marking to one

of beacon or perhaps such objects can fit either or both categories. The term mark does appear in marine circles in the variant form of daymark. The daymark can qualify as a marking though the existence of a sign-like physical dimension may blur the distinction. The presence of an identifying number on the daymark may suggest a milepost or other numbered locational object and bolster the contention that daymarks are more mark than sign.

It may be noted that the word mark designates any aid in the lateral system of beaconage and buoyage (aids to navigation mark a navigable body of water but that use of mark becomes too general). The additional marine term of dayboard is very much a marking. Dayboards are attached to range lights and display vertical stripes; they can also be termed "range daymarks". Buoys are numbered as well and can be regarded as a marking of a floating nature. Some marine aids display letters instead of numbers.

In summary, the term marking designates a non-sign/non-beacon/non-signal object which is frequently a largely horizontal object. The term marker can be a separate category or a subcategory of marking with a vertical dimension (and often little horizontal dimension). Markings, both in broader and in narrower senses, display stripes, bands, numbers or letters, but only rarely word or graphic symbols beyond simple geometric forms.

#### Special Note

There are two other terms that need to be noted even though they are not part of the classification: Light and Lamp. The term light is curious since it can mean a message, or the equipment that produces the message, or the

total installation that makes up a marking. Light, in the sense of an installation, is commonplace in marine and aero modes of transportation. It is less important for rail and road modes.

The term light is probably the most elusive of any of the terms that have application to transportation markings. It could not be employed in the classification since it would have generated confusion and not increased clarity: light is an independent category for aero, within the category of beacon for marine, a qualifying term for rail, and a peripheral term for road. This statement requires amplification. Aero usage restricts beacons to specific flashing and rotating aids of an independent nature and regards light as separate from beacons. Marine usage of beacon encompasses all visual aids whether lighted or unlighted.

The rail use of the word light is especially complex. Not infrequently railway or railroad signal is a term that stands alone unembellished and unencumbered. However, the term signal can be qualified with the term light: signal light meaning a signal that transmits a message through light, or light signal which distinguishes all lighted signals from semaphore partially-lighted signals. The word light is also an integral part of the title of specific forms of signals: color-light, searchlight, color-position light and position-light signals.

Traffic control devices employ the term light in a less complex manner. The term is most often associated with construction safety aids: Warning Lights (portable lights either flashing or fixed), Hazard Identification beacons with a secondary title of Flashing Electric Lights, and Steady Burning Lamps; the



latter moves the discussion toward the second term of this note. The term light is not used with traffic signals or beacons in regular traffic control situations.

The term lamp often refers to an artificial means of illumination. But it occasionally refers to a form of transportation marking. The most common usage is that of railway Switch Lamps. Aero Lampholder units in approach lighting is a variation on the unadorned term lamp. The unit holds a lamp and the complete unit, including a lamp, constitutes a navigation aid.

iii Classification of Messages:  
Signs and Markings

a) Traffic Control Devices

This classification encompasses most, if not all, signs and markings (pavement and object). Few, if any, other transportation markings require this form of classification. Therefore Appendix iii can be regarded as a general classification of messages for those categories.

I. Traffic Signs

A. Traffic Signs: Regulatory

1. Symbol Code (Shapes in Main Classification)

- a) Black letters on white ground in most cases.
- b) White letters on red ground for stop and wrong-way signs.
- c) Red letters and border on white ground for yield signs.
- d) Green letters on white ground for parking limits; red letters for prohibitions.

2. Right of Way Series

- a) Stop Sign (Supplemental plate: 4-Way and All Way)
- b) Yield

3. Speed Series

- a) Speed Limit Sign
- b) Night Speed Sign
- c) Minimum Speed Sign
- d) Reduced Speed Ahead Sign (Reduced Speed Ahead, Reduced Speed \_\_\_)

- M.P.H., Speed Zone Ahead)
4. Movement Series: Turning
    - a) Turn Prohibition Signs
      - 1) No Right Turn Sign
      - 2) No Left Turn Sign
      - 3) No Turns Sign
    - b) U-Turn Prohibition Sign
    - c) Lane-Use Control Signs
      - 1) Mandatory Movement Sign
      - 2) Optional Movement Sign
      - 3) Mandatory Turn Sign (Right Lane Turn Right, Left Lane Must Turn Left)
      - 4) Double Turn Sign (Double Right, Double Left)
      - 5) Two Way Left Turn Only Signs [Additional Begin, End Signs permitted]
  5. Movement Series: Alignment
    - a) Preferential Lane Signing
      - 1) Format for basic sign: top lines: lane(s) applicable; middle lines - if applicable; applicable vehicles - bottom lines; applicable time and day.
      - 2) Restricted Lane (Begins, Ends)
    - b) Do Not Pass Sign
    - c) Pass With Care Sign
    - d) Slower Traffic Keep Right Sign
    - e) Uphill Traffic Lanes Signs (5 can be employed)
      - A) Trucks Use Right Lane Sign
      - B) Truck Lane 500 Feet Sign
    - f) Keep Right (Left) Sign
  6. Movement Series: Exclusion
    - a) Do Not Enter Sign
    - b) Wrong way Sign
    - c) Selective Exclusion Signs [No Trucks, No Bicycles, Non-

- motorized Traffic Prohibited, Motor-Driven Cycles Prohibited, Pedestrians, Bicycles, Motor-Driven Cycles Prohibited, Pedestrians and Bicycles Prohibited, Commercial Vehicles Prohibited, Vehicles with Lugs Prohibited]
7. Movement Series: One Way
    - a) One Way Sign
    - b) Divided Highway Crossing Sign
  8. Parking Series:
    - a) Message format: Restriction Prohibition; Time (when applicable); Days (when applicable)
    - b) Examples: No Parking Any Time; No Parking \_\_\_ to \_\_\_; No Parking Except Sundays & Holidays; No Standing Any Time; \_\_\_ Parking \_\_\_; No Parking Loading Zone; No Parking Bus Stop
    - c) Rural Parking:
      - 1) Examples: No Parking on Pavement; No Stopping on Pavement; No Parking Except on Shoulder; No Stopping Except on Shoulder; No Parking
      - 2) Supplemental plates and graphic symbols
    - d) Emergency Parking
      - 1) Emergency Parking Only
      - 2) Emergency Stopping Only
  9. Pedestrian Series
    - a) Walk on Left Facing Traffic
    - b) No Hitchhiking
    - c) Pedestrian Crossing Signs
      - 1) Cross Only at Cross Walks
      - 2) Supplemental plate: Use Crosswalk
  10. Miscellaneous Series: Traffic Signal

Signs

- a) Pedestrian signs: Cross on Green Light Only; Cross on Walk Signal Only; Push Button for Green Light; Push Button for Walk Signal
  - b) Pedestrian alternates: To Cross Street ([with arrow) Push Button Wait for Green (Walk) Signal
  - c) Signal Instruction Signs: Left on Arrow Only; Left (Right) Turn Signal Stop Here on Red; Do Not Block Intersections; Use Lanes with Green Arrows; No Turn on Red
11. Miscellaneous Series: Other Forms
- a) Keep Off Median Sign
  - b) Road Closed Sign
  - c) Local Traffic Only: Road Closed \_\_\_ Miles Ahead--Local Traffic Only; Road Closed to Thru Traffic [urban]; Bridge Out
  - d) Weight Limit Signs: Weight Limit \_\_\_ Tons; No Trucks Over \_\_\_ Lbs Empty Wt; Weight Limit \_\_\_ Tons Per Axle \_\_\_ Tons Gross; Bridge Weight Limits [accompanied by three weight limits].
  - e) Weigh Station Signs: All Trucks/ Commercial Vehicles/Next Right
  - f) Truck Route Sign
  - g) Hazardous Cargo Signs
  - h) National Network Signs
12. Other Regulatory Signs Outside MUTCD
- Examples: Keep Off Wet Paint, No Dumping Allowed, Do Not Throw Litter, No Fishing From Bridge, Emergency and Authorized Vehicles Only
- B. Warning Signs
1. Symbol Code
    - a) Black symbols on yellow ground

- b) Symbols can be graphic or alpha-numeric
2. Turn, Left or Right
  3. Curve, Left or Right
  4. Reverse Turn, L or R
  5. Reverse Curve, L or R
  6. Winding Road, L or R
  7. Large Arrow, Single or Double
  8. Chevron Alignment, L or R
  9. Cross Road Sign
  10. Side Road Sign
    - a) 90 degrees, L or R
    - b) 45 degrees, L or R
  11. T Symbol
  12. Y Symbol
  13. Stop Ahead
  14. Yield Ahead
  15. Signal Ahead
  16. Merge
  17. Pavement Width Transition Signs
    - a) Pavement Width Transition Sign
    - b) Lane Ends Merge Left (Right) (supplement to a))
    - c) Right (Left) Lane Ends (Advance Sign to a) or b))
  18. Road Narrows
  19. Narrow Bridge
  20. One Lane Bridge
  21. Divided Highway (Road)
  22. Divided Highway (Road) Ends
  23. Two-Way Traffic
  24. Hill Signs
    - a) Hill
    - b) Supplemental plaques
      - 1) Trucks Use Lower Gear
      - 2) \_\_\_ % Grade
      - 3) Next \_\_\_ Miles
      - 4) \_\_\_ % Grade \_\_\_ Miles
    - c) Runaway Truck Ramps

- 1) Runway Truck Ramp \_\_ Mile
  - 2) Runway Truck Ramp
  - 3) Supplemental plaques: Sand, Gravel, Paved
25. Bump and Dip Signs
    - a) Bump
    - b) Dip
  26. Pavement Ends Sign
  27. Soft Shoulder
  28. Slippery When Wet
  29. Advance Crossing Signs
    - a) Examples: Bicycles, Pedestrians, Deer, Cattle, Tractors
    - b) Supplemental signs: Crossing Signs: Pedestrians, Bicyclists, Cattle
  30. Double Arrow
  31. Low Clearance
  32. Advisory Speed Plate
  33. Advisory Exit Speed
    - a) Exit Speed
    - b) Ramp Speed
  34. Dead End Signs
    - a) Dead End Sign
    - b) No Outlet
  35. No Passing Zone
  36. Limited Sight Distance
  37. Playground
- C. Traffic Signs: Guide-Conventional Roads
1. Symbol Code
    - a) General norm calls for white symbols on green ground.
    - b) Route markers employ black symbols on white ground; interstate types add partial red ground.
  2. Route Markers
    - a) Interstate
    - b) Off-Interstate
    - c) U.S.

- not on regular interchange signing, park and ride)
4. Exit Direction Signs
  5. Gore Signs
  6. Distance Signs
  7. Community Interchanges Identification Signs
  8. Next (X) Exits Area Sign
  9. General Motorist Services Signs (See C. 22)
  10. Rest and Scenic Area Signs (See C. 19 & 20)
  11. Mileposts (See Also E. 8 and C. 23)
  12. Wrong-Way Traffic Control (Wrong Way, One Way, Do Not Enter)
  13. Miscellaneous Guide Signs (See C. 25)
  14. Weigh Station Signs (See C. 21)
- E. Traffic Signs: Guide-Freeways
1. Symbol Code: See Guide-Conventional Roads.
  2. Interchange Guide signs (See C. & D.)
  3. Distance Signs (See Also D. 5)
  4. Diagrammatic Signs
  5. General Motorist Services (Gas, Food, Lodging, Telephone, Hospital, Camping)
  6. Rest and Scenic Area Signs
    - a) Rest Area Next Right
    - b) Rest Area
    - c) Scenic Area
    - d) Scenic View
  7. Tourist Information and Welcome Centers
    - a) Tourist Info Center
    - b) Welcome Center
  8. Weigh Station Sign (Also C. 21)
  9. Milepost Markers (Also C. 23)
- F. Traffic Signs: Guide Signs - Other Forms
1. Symbol Code
    - a) Recreational & Cultural shapes are

rectangular and trapezoidal with white symbols on brown background though rectangular shapes may have white on green

b) Specific Services displays white symbols on blue background

2. Recreational & Cultural Interest Signs
3. Specific Services ("Business identification and directional information for essential motorist services")
4. Tourist Orientated Directional Signs (similar to 2. but for tourists)

G. Traffic Signs: Special Situations - Construction and Maintenance, School, Bicycle and Railroad Crossings

1. Symbol Code
  - a) Construction displays black symbols on an orange background.
  - b) Other special situations follow standard symbol codes
2. Construction Approach Warning Signs
3. Advance Road Construction Signs
4. Advance Detour Signs
5. Advance Road Closed Signs
6. Advance One Lane Road Sign
7. Advance Flagger Signs
8. Two-Way Traffic Signs
9. Worker Sign
10. Fresh Oil Sign
11. Road Machinery Sign
12. Road Work Sign
13. Shoulder Work Sign
14. Survey Crew Sign
15. Blasting Area Signs (Blasting Zone, Turn Off 2-Way Radio, End Blasting Zone Signs)
16. Advisory Plate Sign

17. Length of Construction Sign
18. End of Construction Sign
19. Detour Signs/Markers
20. Pilot Car Sign
21. Bicycle Prohibition Sign
22. Motor Vehicle Prohibition Sign
23. Bicycle Restrictions (Use Pedestrian Signal, Yield to Pedestrians) Signs
24. Designated Lane Signs (Bike Lane Ahead, Right Lane Bikes Only)
25. Travelpath Restrictions
26. No Parking Bike Lane
27. Lane-use Control (Begin Right Turn Lane Yield to Bikes)
28. Bike Route  
Bike Route Marker
29. Bike Crossing
30. Hazardous Condition Signs (Slippery When Wet, Steel Deck, Rough Pavement, Bridge Joint, Ford, Bikeway Narrows, Steep Descent)
31. School Advance Sign
32. School Crossing Sign
33. School Bus Stop Ahead Sign
34. Speed Limit Signs (Periods of time, day; When Children Are Present; School - attached to speed sign; When Flashing - attached to flashing beacon)
35. Parking and Stopping Signs (Hours, days, loading limits)
36. Railroad Crossbuck Sign
37. Advance Warning Sign

II. Markings

- A. Markings: Pavement and Curb - Center Lines
1. Two-lane, two-way highways
    - a) Broken yellow line: passing permitted
    - b) Double line (one broken, one solid):

- passing permitted in one direction
- c) Double solid yellow line: no passing
- 2. Four-lane, undivided highway: double solid line
- 3. Three-lane rural highway: double solid line (dividing highway into one lane/two configuration)
- 4. Centers are found:
  - a) Rural two-lane highways with speeds over 35 mph
  - b) Through highways in residential and business districts
  - c) Undivided highways four or more lanes
  - d) Other roads requiring center lines

B. Markings: Pavement and Curb - Center Lines

- 1. Two-lane, two-way highways
  - a) Broken yellow line: passing permitted
  - b) Double line (one broken, one solid): passing permitted in one direction
  - c) Double solid yellow line: no passing
- 2. Four-lane, undivided highway: double solid line
- 3. Three-lane rural highway: double solid line (dividing highway into one lane/two configuration)
- 4. Centers are found:
  - a) Rural two-lane highways with speeds over 35 mph
  - b) Through highways in residential and business districts
  - c) Undivided highways four or more lanes
  - d) Other roads requiring center lines

C. Markings: Pavement and Curb - Lane Lines

- 1. Lane lines: white, broken lines
- 2. Interstate highways
- 3. "All other multi-lane highways"
- 4. Congested areas

- 5. Solid white lines: separate through lanes from special lanes (trucks, buses, turns)
  - 6. Double white lines: no lane changing
- D. Markings: Pavement and Curb - Other Forms
- 1. Pavement Edge Lines
    - a) white solid lines
    - b) except for divided highways where they are yellow
  - 2. Channelizing Line
    - a) Double or wide solid white line
  - 3. Median Islands
    - a) Two double solid yellow lines
  - 4. Obstruction Avoidance Lines
    - a) Between opposite directions of traffic: solid yellow and solid diagonal lines -tapered
    - b) Within one direction of traffic: solid white line and tapered chevron pattern
  - 5. Stop Lines
    - a) Wide solid white lines
  - 6. Crosswalks and Crosswalk Lines
    - a) Standard: double white solid lines across all lanes of traffic
    - b) Alternatives:
      - 1) Diagonal lines within solid lines
      - 2) Longitudinal lines
      - 3) Solid lines and added lines outlining pedestrian corridors
      - 4) Single line outlining perimeter of area traversed by pedestrians
  - 7. Parking Space Markings
    - a) White lines
    - b) Patterns: solid and delineating outline of car; plus-shaped corner markings, single lines delineating length of car
  - 8. Word and Graphic Symbol Markings
    - a) Purpose: guide, warn, regulate

- b) White
- c) Maximum of three lines of information
- d) Messages
  - 1) Regulatory: Stop/R or L Turn  
Only/25MPH/ Symbol Arrow
  - 2) Warning: Stop Ahead/Signal Ahead/  
School/School X-ing/Ped X-Ing/  
R X R
  - 3) Guide: US 40/Route 40/State 135
- 9. Curb Markings for Parking Restrictions
  - a) Special colors (other than white,  
yellow) supplemental signs  
permissible
  - b) Curb stencils can replace signs
- 10. Preferential Lane Markings
  - a) Preferential Lanes refers to use of  
lane by class(es) of vehicles part or  
full time
  - b) Marking consists of white elongated  
diamonds
- 11. Speed Measurement Markings
  - a) White markings paralleling center-  
line or edge of pavement for one mile  
at 1/4 mile intervals

E. Object Markings

- 1. Design
  - a) Type 1 consists of nine yellow  
reflectors. Each is 3" across and  
arranged in a symmetrical pattern on a  
yellow or black diamond 18" across.  
Can be substituted by a diamond that  
is completely yellow and reflective.
  - b) Type 2 consists of three yellow  
reflectors each 3" across horizontal  
vertical or a reflective panel in  
yellow that is 6 by 12 inches.
  - c) Type 3 consists of striped markers  
that are 1 by 3 feet displaying

striped and downward sloping stripes that are alternating black and either yellow or white. The downward slope is towards the side of the obstruction to be passed. "Right" markers have stripes that commence at upper right side while "Left" object markers have the reverse pattern.

- 2. Objects in the Roadway
  - a) Employs Type 1 or Type 3 markers.
  - b) Large objects can be marked by painted stripes in the aforementioned pattern.
  - c) Signs can replace the markings.
- 3. Objects Adjacent to the Roadway
  - a) Objects can include Underpass Piers, Bridge Abutments, Handrails, Culvert Headwalls; also narrow shoulder with abrupt drop-off, small islands, abrupt alignment changes.
  - b) Type 2 or Type 3 markers employed.
- 4. End of Roadway
  - a) Consists of 18" diamond to which are affixed 9 red reflectors (3" across). The diamond itself is to be red or black.
  - b) A single 18" diamond shaped panel that is reflectorized can be substituted.

F. Delineation

- 1. Described:
  - a) Delineators are retroreflecting devices found at the sides of roadway in groups.
  - b) They indicate the alignment of road and are guidance rather than warning devices.
- 2. Dimensions: 3" across; elongated units can be substituted.

3. Curb Markings for Delineation:

- a) These are reflectorized solid yellow marks denoting island curbing in traffic flow when traffic should go to right.
- b) Reflectorized solid yellow markings if passage on either side of curbing is permitted.

4. Applications:

- a) Colors for edgemarking use colors found with painted edge lines.
- b) Single delineators employed at edges of expressway roadways and interchange ramps.
- c) Double rows of yellow delineators can be employed at crossovers on divided highways.
- d) Red delineators can be used on back side of delineators where wrong-way motorists can see it.

G. Colored Pavements

- a) They constitute a TCD when serving a guidance or regulatory role.
- b) Code color includes these provisions:
  - 1) Red indicates approaches to stop sign.
  - 2) Yellow denotes separating of medians.
  - 3) White marks shoulder delineations, channelizing islands, crosswalks.

H. Barricades and Channelizing Devices

- a) Barricades are red and white.
- b) Mark dead-end roads or cul-de-sacs.
- c) Closure or termination of roadway.
- d) Design follows Type III barricade.
- e) Construction barricades can be Type I (one horizontal bar) or Type II

(two bars) or Type III (three bars) and display orange and white diagonal stripes.

- f) Construction barricades can also employ drums, vertical panels, cones and tubular markers.
- e) Channelizing Devices

- 1) Consist of traffic cones and tubular markers.
- 2) Colors are those of pavement markings.
- 3) Reflectors are in bands with a minimum of two bands that are 3" in width.

I. Markings: Special Situations

- Bike Lane (Word and Graphic symbol)
- School (Word symbol)
- Transverse Lines (Approaches to Railroad Crossing)
- No Passing
- Railroad Crossing (Word and Graphic symbols)
- [See Barricades and Channelizing Devices for Construction]

b) Signs and Markings:  
Aeronautical, Railway & Marine

I. Aeronautical Signs and Markings:  
Taxiway Guidance Signs

- A. Mandatory Instruction Signs (2. through 5. are Holding Position Signs)
  - 1. Color Code (if not general then a) color; b) message description for each one).
  - 2. Taxiway/Runway Intersection Signs display the runway number (for example, 10-15) with the number to the left of the hyphen indicating the threshold for that



runway is to the left while the second one is to the right.

3. Runway/Runway Intersection signs have identical messages.
  4. ILS Critical Areas sign consists of the letters "ILS" in the established color code.
  5. Runway Approach Area sign is made up of the runway numerical designation, a dash and the abbreviation "APCH".
  6. The No Entry Sign is similar to the TCD graphic form: a circle containing a broad white bar.
- B. Location signs identify runway or taxiway where the aircraft is located. They also identify runway safety area/OFZ boundary or ILS critical areas.
1. Taxiway Location signs display the letter designating the taxiway; this is in yellow upon a black background with yellow edge.
  2. Runway Location signs are installed when two runway ends are close together and may cause confusion. The signs have yellow numbers on a black background with yellow edge.
  3. Runway Safe Area/OFZ (Obstacle Free Zone) and Runway Approach Boundary Signs indicate the boundary of either situation for pilots leaving those areas. The sign follows a graphic pattern of two black horizontal lines above two lines of black dashes on a yellow background with a black edge. The graphic design displays the holdline marking.
  4. ILS Critical Area Boundary Sign indicates the boundary in question. The design is of two horizontal black lines connected by three sets of vertical black lines on a

yellow background with black edge.

- C. Direction Signs denote other taxiways which lead out from an intersection.
  1. Taxiway Direction Signs are indicated by the appropriate letter accompanied by an arrow. Both are in black on a yellow background with black edge.
  2. Runway Exits Signs are very similar.
- D. Taxiway Ending Marker is not a sign. It consists of a retroreflective barrier in the form of a rectangular shape with horizontal emphasis and diagonal black and yellow stripes.
- E. Destination Signs contain black symbols on a yellow background. "These signs indicate the general direction to a remote location." (FAA 1991-7, 11).

Taxiway direction signs usually eliminate the need for destination signs.

  1. Outbound Destination Signs denote direction to takeoff runways. Symbols include runway number and a directional arrow.
  2. Inbound Destination indicate principal destination areas. These destinations can include: apron (and subcategories such as passenger, cargo, military, geographical subdivisions such as north or east apron), fuel, terminal, civil, military, passenger, cargo, international, fixed-based operator.
- F. Information signs follow the pattern of black symbols on yellow backgrounds. Lighting is not required for these signs. They provide specialized information (for example,

announcing noise abatement procedures).

#### G. Runway Distance Remaining Signs

1. The purpose of these signs is to indicate distance remaining for takeoffs and landings.
2. Signs are located on runway side. Symbols are composed of white numbers on black background. Distances are denoted in 1000 foot increments.
3. The numbers represent 1000 and are cumulative so that 1 equals 1000 feet, and 5 equals 5000 feet.

#### H. Runway Markings:

1. Runway Markings are white in color. An alternative can be applied for light-colored pavement consisting of white markings enclosed in a black outline.
2. Runway Designation Markings are designated by numbers based on "the nearest 10-degree increments of the azimuth of the runway centerline." (FAA 1987-10, 3). Supplemental letters are added to parallel runways.
3. Runway Threshold Markings display eight longitudinal stripes; they are parallel to the centerline.
4. Runway Centerline Markings are, obviously, centered on the centerline with evenly spaced intermittent stripes. The stripes are 12 by 150 feet with the gaps 3 feet in length.
5. Runway Touchdown Zone Marking consist of a series of bars: two pairs of a three bar set; four pairs of a two bar set; four pairs of a single bar set. Narrower and shorter runways may require fewer bars.

6. Runway Side Stripe Markings display solid continuous stripes on both sides of the runway. They delineate pavement that is of full strength or establish contrast with the terrain; side stripes may perform both functions at some locations.
7. Displaced Threshold Markings consist of four arrows which include arrow shafts. These markings are white except for the bar which is white.
8. Relocated Threshold Markings for an abandoned runway not used as taxiway displays bar only; when used for taxiway arrow heads are added.
9. Markings for blast pad and stopway display runway wide chevrons in yellow.

#### I. Taxiway Markings

1. Taxiway Centerline Markings display yellow double lines, which are 6" in width, separated by spaces of 6". All taxiway markings are in yellow.
2. Taxiway Edge Marking emulate the design of centerline markings. They are employed where full strength pavement is not clearly seen or is part of a larger paved area.
3. Holding Position Markings consist of a painted hold line accompanied by the appropriate sign. Solid lines denote the hold side with other lines in a spaced pattern.
4. Retroreflective Markers are of two forms:
  - a) Semiflush (or Inpavement) Marker for centerline marking and
  - b) Elevated marking for edge marking.
  - c) Color is determined by usage and

conforms to non-retroreflective markings previously discussed.

## II. Railway Signs

### A. Color code

1. American Railway Engineering Association (AREA) recommends black symbols on white or yellow reflectorized background.
2. AREA recommendations do not constitute a standardized code and individual railways may have their own codes. All of the signs and messages listed herein are from AREA.
3. Legends are to be short with easily read characters that are bold and amply spaced. A minimum of words should be employed.

### B. Location

1. Mile Posts denote the location of a physical object along the right of way.
2. Political Subdivision signs denote the point where the railway crosses over any political boundary line.
3. Standard right of way & monument markers define limits of the right of way.
4. No Trespassing signs indicate areas where trespassing is notably undesired or unsafe.

### C. Maintenance of Way

1. Maintenance Limit Signs indicate track ownership/maintenance boundaries between railways, and between railways and industrial operations.
2. Roadway Structures Signs indicate the location of bridges, trestles, tunnels and culverts.
3. Snow Signs indicate obstructions to snow plows. These can be of two forms:

flanger signs indicate that flanges ought to be lifted while wing markers indicate that wings should be closed. One sign can indicate both if applicable.

4. Alignment Signs or Markers indicate "the exact location and limits of easement spirals and curves." (AREA 1990, Ch. 1, Part 7 TISRP).
5. Elevation Markers "define top of rail elevations at special locations." Also define top of rail elevation above which tracks under grade separations cannot be raised."

### D. Transportation Signs

1. Speed control signs indicate slow order limits and places where trains are to stop. Signs can be permanent or temporary.
2. Whistle Posts have several functions all of which define or indicate advance locations: highway grade crossings, stations, railway grade crossings, and other places where the sounding of locomotive whistles is required.
3. Location signs indicate advance locations: railway grade crossings, drawbridges, tunnels, junctions, frequent rock, snow slides, stations. They are also found at yard limits, switch limits, signal territory limits, station limits, derail limits and capacities of tracks.

### E. Safety Signs

1. Restricted Clearance Signs indicate horizontal or vertical clearances (or both) at "clear points of turnouts,

- buildings, platforms or other structures.
2. Fire Hazard Signs, Electrical Hazard Signs, Highway Grade Crossing Signs, Barricade Signs, Highway and Barricade Signs, while important to railways are not actual transportation markings and messages and are therefore not included.
  3. Power Operated Switch signs. It may seem contradictory to leave out the signs of the previous section and then include this device. It is included because of the possible harm the switch can inflict on a pedestrian. The transportation marking itself is a hazard and the sign a warning of that hazard.

### III. Marine Aids to Navigation Signs

1. "Rough Bar" is the only standardized sign in use in federal service. The words "Rough Bar" are displayed in black letters on a yellow background. Flashing yellow lights accompany the sign.
2. Mile Boards are provided on Western Rivers. They display black numbers on a white background with a black edge. Some markers may contain the word "Danger" in black letters on a white background.
3. Many buoys and beacons (lighted and unlighted) display numbers and sometimes letters. This is part of the standard buoyage and beaconage system and is discussed in Chapter 9. Words are not included.
4. Uniform States Waterways Marking System (USWMS, 1966) includes words with some aids. These are black on a white ground with orange graphics.

### c) Explanatory Notes for Classification of Messages

These Notes are briefer and more general than most Explanatory Notes of this Series since messages often require less specific, and less lengthy observations, than do the types of markings. The pattern follows the general categories of Appendix iii a) and b); the classification numbering system follows a traditional outline pattern found in the **Chicago Manual** and many other sources.

The principal categories for TCD signs and markings begin with Regulatory Signs, continue with Warning Signs, and end with Guide Signs. Guide Signs are more complex and include four subcategories. Because of the many forms of Pavement and Curb Markings it has been necessary to subdivide them into nearly a dozen segments. Object Markings, Delineations, Colored Pavements, and Barricades and Channelizing Devices add another four segments.

The second section on messages includes aeronautical, railway, and marine aids to navigation. The aero portion is in five principal segments: taxiway signs, runway signs, taxiway markings, runway markings, and obstruction markings. The railway portion is confusing and requires more extensive notes. The marine aspect contains brief numbers of several forms of signs.

Regulatory signs are both complex and simple. MUTCD provides an extensive classification and that is followed here. Signs are a difficult area of transportation markings to describe since the physical marking and the

message dimension are closely united: to speak of one is virtually to speak of the other. The Main classification considers only major physical forms gathered into groups based on primary function (regulatory, warning, guide). All of the remainder of the coverage is in the multipart Appendix. But taking up the message also trespasses on physical forms. This is a problem that is not fully resolved. The focus of Appendix iii is the message, not the physical sign even though the physical sign may intrude on the proceedings. The outline numbers and letters of MUTCD classification are somewhat at variance with that of this monograph though the word content is very similar. It should be noted that the Miscellaneous series constitutes a unitary category for MUTCD but it is divided into three subcategories for this study.

Warning signs prove to be a complex and fragmented entity. MUTCD lists functions for warning signs without a classification. Classifying warning signs is a perennial problem. For example, turns, curves, reverse turns and reverse curves, winding road, and even large arrows and chevron alignment signs are overlapping categories, yet to classify them as a single cohesive unit can blur their role. Since there are no more than a few dozen primary forms this study follows MUTCD patterns which place adjoining forms side by side in most instances.

Guide signs included three major subcategories in pre-1988 editions of MUTCD. The 1988 edition alone added three special subdivisions. This compiler has grouped them together under the heading of "Guide Signs:

Other Forms" since all were formerly part of Guide Signs.

Pavement and Curb Markings lack a "formal classification" in MUTCD. Instead MUTCD lists the types of markings under the heading of "Applications of Pavement and Curb Markings". The classification of this study is based on that listing. Several limited types have been grouped under the heading of "Other Forms".

Object Markings form a separate category both for MUTCD and this study. The blurred line between types and messages is very blurred here and probably part of the treatment could be moved to the Main Classification; yet the material is very much concerned with messages and therefore retained here. The final three segments of markings in MUTCD are separately treated here as well: Delineation, Colored Pavements, and Barricades and Channelizing Devices.

Aeronautical signs present a lopsided appearance since taxiway guidance signs represent 80% of the message types while runway signs are a fifth of the message types and a slender 20% at that. In addition, taxiway signs are of numerous forms while runway forms afford only a restricted range of purposes.

Aeronautical markings offers a nearly reverse situation: markings for runways are abundant while taxiway markings are limited in scope. Runway markings cover eight major functions; the range of functions depends on the level of aviation at a given airport: small fields may display only a basic range of markings while large international airports have

a full complement of pavement markings. Markings coverage concludes with retroreflective markers with both semiflush (in pavement) and elevated forms.

Railway signs is a more uncertain business than other forms of signs. Both AAR and AREA provide information but it is often more a matter of recommendations than mandatory injunctions. Railway signs suggest color, shapes and alphanumeric and graphic messages but no more than that. AREA provides a classification of signs but this compiler has found it to be at times confusing. For that reason a reconstruction of the elements of the classification has been undertaken for the railway monograph and for this study in the main classification. However, the message classification faithfully follows the AREA classification; no reconstruction has been attempted in this classification. It seems important at some point to present the AREA view of signs and to refrain from tampering with the official view.

Signs are a small part of marine aids to navigation: only one regular sign is extant in Coast Guard usage. Possible or near signs can be found with the USWMS. Markings, if one uses the term generically and outside of a TCD context, are commonplace in marine usage. Buoys as well as fixed daymarks can be viewed as markings. Markings are here described as an unlighted object denoted by color and possibly graphic symbols and letters or numbers affixed to the object for purposes of indicating the location of the object and/or the location of the observer. Mile boards are similar to TCD and railway mileposts.

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## COLOPHON

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