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2nd Edition

Brian Clearman

INTERNATIONAL
RAILWAY SIGNALS

2nd Edition

Brian Clearman

Mount Angel Abbey

Saint Benedict, Oregon

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Dedication:

For Bonnie
No More
No More Does the Whistle Blow
In The Lonesome Valley
No More

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PREFACE

This monograph is the second edition of *International Railway Signals*. While it bears a substantial resemblance to the original study (1991) there are substantial changes.

Terminology is a significant problem with railway safety devices. Signals, sign and markings were included in that first edition but a wide range of T-M forms were omitted including acoustical, radio aids and level/grade crossings. This is true both of terms and content. The summary of terms in this study contrasts with those of the railway database volume (2009): signals, signals, markers. That newer work includes a variety of terms not listed in the title and other apparatus. The diversity of railway devices is compounded by the lack of a more precise general term of railway signals that can encompass other forms.

The earlier preface provided a sharp distinction between signals and signalling (the former is primary; the latter is peripheral). The latter term refers to the control and operation of signals and accompanying safety appliances and procedures (e.g., systems, block systems, interlockings, CTC, electronic configurations). While signalling is not a core issue in this study of apparatus devices producing messages and meanings it is an integral element of this study.

The older edition often refers to messages but not the meaning. While message might encompass the meaning it is more accurate to speak of the physical appearance of the messages, and the semiotic meaning that becomes attached to the physical dimension.

Source materials in the first edition employed many national systems of signals as well as a broad scope of information sources. This edition retains the older sources and adds additional sources that broaden the range of information (e.g., IRSE) and select internet resources are also included (e.g., Railway Technical Web Pages). Statistics have been retained but newer sources can alter adjust the original information.

This study is not intended to be a “super signal code” nor a general compendium of signals. Rather it is an introduction to safety devices including messages and accompanying meanings. (It is also an informal semiotics if one can agree with the view of some practitioners of semiotics that analysis of any kind of sign can be semiotics even without the jargon). A mere describing and classifying of signals may fall short of even informal semiotics but it may provide a first beginning of a semiotics of railway signals.

This monograph is more than twenty years old. That may suggest an extensive updating is required. Nonetheless, the original study manifests a coherent and integrated form and changes have been cautious. That may prove to be a feasible approach since many railway devices and systems have often maintained a stable state in which alterations are gradually implemented. And the traditional has often a long-enduring history even after replacement.

ABBREVIATIONS*

COLORS

G	Green
Y	Yellow
R	Red
B	Black
BL	Blue
W	White
P	Purple
LW	Lunar White

Combinations: GY, RG, RGY, etc: formed from single colors; see above list

MESSAGE CAPABILITY PATTERNS

C3M	Changing Message/Multiple Message
CMSM	Changing Message/Single Message
U3M	Unchanging Message/Multiple Message
UMSM	Unchanging Message/Single Message

TECHNICAL TERMS

SGTMOOT	Signal Governing Train Movements on One Track
SGTMFOTTAT	Signals Governing Train Movements From One Track to Another Track
BSFI	Blade/Spectacle Fully-Integrated
BSITL	Blade/Spectacle Integrated Through Linkage
BLPI	Blade/Lamp Partially-Integrated

KM/H	Kilometers Per Hour
F.	Fixed
FL.	Flashing
FFL	Fast Flashing
LQLH	Lower Quadrant/Left-Hand
LQRH	Lower Quadrant/Right-Hand
UQLH	Upper Quadrant/Left-Hand
UQRH	Upper Quadrant/Right-Hand
URH-LLH	Upper-Right-Hand/Lower-Left-Hand
URH-LRH	Lower-Right-Hand/Upper-Left-Hand
LLH/LRH	Upper-Right-Hand/Lower-Right-Hand

MISCELLANEOUS TERMS: DICTIONARY

OED	<i>Oxford English Dictionary</i>
RHD	<i>Random House Dictionary</i>
WTID	<i>Webster's Third International Dictionary</i>
EB	<i>Encyclopedia Britannica</i>
ODPGED	<i>Oxford-Duden Pictorial German-English Dictionary</i>

*Abbreviations for sources are on pages 235-237

CHAPTER ONE

RAILWAY SIGNALING: INTRODUCTION, HISTORY AND METHODOLOGY

1A Introduction, Physical Properties and Semiotics of the Signal

1A1 Introduction

The railway signal (and accompanying signs and non-sign markings) present a diverse and variegated appearance. The railway signal is not only very complex but has a reduced commonality when compared with marine, road, and aeronautical Transportation-Markings. This means that this monograph is not based on an already existing cohesiveness. It is therefore necessary to include several perspectives in order to integrate the existing fragments of railway signals.

One area of fragmentation is the strongly national, or at best regional, character of signal systems. Other Transportation-Markings have achieved substantial convergence through global organizations or special conferences -- with their resulting signal codes -- while only limited agreements have taken place in railway signals. One can speak of “schools” of signals (e.g., the historical underpinings of UK, North America, Russia, Europe). An overview of the “schools” may not create convergence but it can manifest various approaches together thereby providing a degree of convergence (Ch 1A provides introductions to the “schools” of signals).

A perspective that can explain the dimensions of signal is found in semiotics/semiology. A practitioner of this discipline, Roland Barthes, offers an approach. He has written an essay (1988, 180-190) in which he notes that a human-made object is the focus of two coordinates (see also Ch 1B2 of Part A, 6th ed in this Series). The coordinates are those of the symbolic and of classification. Those coordinates form a vital core of the study. In addition, there is the object in itself. For this study the object in its own right focusses on the dimension of physical properties. Ch 1A2 will examine that dimension within the headings of signal mediums, the signal configurations within those mediums, and the nature of message capabilities. Technology in itself is not a focus of this study though a degree of technology is inherent within any study of T-M.

The symbolic (or semiotic) coordinate of the signal, examined in Ch 1A3, places emphasis on the semiosis and signification dimensions of the sign and how they can relate to railway signals. Ch 1A3 gives only brief treatment of the classification coordinate since all of Ch 2 is devoted to signal taxonomy.

Chapter 1B centers on a review of the history of signals. That segment illustrates some areas of commonality and shared developments for signals. Methodology, Ch 1C, has importance for this study because of the fragmentation both in signals and in documentation, The integrated methodology can help to bridge the fragmentation in signals and sources.

1A2 The Physical Properties of the Signal

The physical properties of the railway signal, sign and marking includes the specific medium signals can adopt, the configuration of the signal, and the nature of the message that the signal can produce and emit. The technological mechanism is not examined in this study since communication and the symbols is the focus of the study.

Specific mediums have reference to how the signal produces and emits a message. The basic mediums are the visual, electronic and acoustical. The visual signal continues to predominate despite inroads by electronics. That visual medium contains all-lighted, partially-lighted, and unlighted variants.

All-lighted mediums can take several forms. These include color-lighted, position-lighted, color-position lighted, graphic, geometric, alphanumeric (the last form can be alpha and/or numeric) signal forms. There are differences between graphic, geometric and alphanumeric signals though precise distinctions are difficult to articulate. This matter is further discussed in Ch 4.

Partially-lighted forms include the semaphore and what is termed signal-board in the monograph. Other forms are found at points, switches and other locations. Partially-lighted forms usually have very different physical means for displaying day and night aspects. Unlighted mediums are often found with signs and markings. Acoustical devices are less common and are often associated with cab signals and detonators.

For many signals the medium does not have a single and

unvarying appearance. For example, an all-lighted color signal can have one of several forms; one may have three lamps and another a half-dozen or more. One signal can have a square housing or backplate while another is circular in design. These variations are termed configurations in this study. There are other possible differences in symbols: how the lamps are arranged, the presence or absence of marker lamps and other supplemental lights, the location of the signal.

Chapter 2B, Variant Classification of the Signal, describes the types of differences found within the mediums accompanied by illustrations of shapes which are notably different. The amount of complexity within a given system constitutes a second area of differences. A system using only basic message indications requires a simple housing but a more complex system may need multiple signal heads and other features including marker lamps, light strips or flashing lights. Chapter 4B provides information on these more complex systems.

There is a narrow and uncertain line between the physical properties of the signal and the semiotics of a signal. Signs closely integrate the physical and symbol but for many signals it is possible to distinguish between the physical properties and semiotic dimensions. However, the nature of the message capability of a marking includes both the physical and the symbolic. Yet the nature of the message that a signal can produce is tied more to the physical production of a message than the semiotic meaning. That topic is therefore placed with signal meanings and configurations while not denying the role of symbols.

The nature of the message concept is first found in Volume I, Part Ai. It is reproduced here to provide a context for railway messages. The nature of the message that a railway or traffic signal can produce a variety of messages (proceed, caution, stop). A marine aid to navigation, by contrast, can produce only one message and that message is single and unvarying. The basic construct of these message capability natures follows this pattern:

1. Multiple capability that permits Changing Message/Single Message (CMSM);
2. Message capability that permits only Changing Message/Single Message (CMSM);
3. Message capability that includes and Unchanging Message but with Multiple Messages (U3M);
4. Message capability that is restricted to Unchanging Message and Single Message (UMSM).

The fourth form (UMSM) includes the following sub-categories:

- I. Programmable Transportation-Markings;
- II. Unitary Markings includes several variants.
 - A. Single and unchanging message
 - B. Intermediate which permits one of several predictable versions;
 - C. Individual which includes markings with few, if any, predictions can be made.

C3M is the most important element for railway signals since those signals emit a variety of message in an alternating order (e.g. for example, caution follows proceed and stop follows caution). CMSM, a rare category for any type of transportation marking, includes a few railway signals (e.g. UK

has installed signals at some secondary locations which operate when that track is in use). The message is a single form.

It is unlikely that there are any U3M forms among railway signals. This form refers mainly to road traffic beacons. A possible variant form for railways may be those signals at junction of tracks where a proceed message for one track is joined by a halt message for the second track. UMSM-I, a mainstay of marine and aeronautical aids to navigation, has no role in railway systems. But the II subcategory includes railway transportation-markings and especially signs. Variant A includes the system of electric traction signs common in Europe. Variant B includes speed signals since they encompass a limited number of differences. Variant C includes station identification signs because of the singular character of proper names, and also variant forms of graphic signals.

1A3 The Semiotics of the Railway Signals

There is no need to review semiotics for this study nor the semiosis (or sign process aspect) of semiotics. Semiotics can be briefly defined as the study of signs in whatever form. There are numerous works available on semiotics; there is also a brief survey in Volume I. However, two phases of semiosis need to be reviewed in this work: sign and signification. Sign (in a semiotic sense) can be viewed as the aspect that a marking (or other semiotic sign) displays. In some markings, such as unlighted signs, the semiotic sign and the physical dimension of the marking are virtually fused into one unit while in other markings the message and physical properties can be separated. Signification can be regarded as the meaning that a message conveys,

for example, a fixed green light signifies or has the meaning of proceed. It may be noted that semiotic professionals may prefer physical sign, form or designator in place of sign, and they may further prefer message/meaning or designatum in place of signification (Givón 1990).

Within railway signals there are two terms important to a semiotic analysis: aspect and indication. It may be an overstatement to state without reservation that aspect = signification, yet there is a strong correlation of those semiotic and railway terms. And for the limited scope of this study it should suffice to regard aspect as equaling sign, and indication equal signification in meaning.

It would be an overstatement to suggest that every rail system employs aspect and indication (and comparable terms) in an identical manner. Nevertheless, a high degree of correlation exists. This can be seen in a comparison of signal codes employing those terms or similar ones. Regrettably not all codes contain an illustrated chart of signals that head the chart with the appropriate terminology; for example, the “Codigo Fundamental de Sinais” of Portugal (CP 1981, 19) contains the headings of “Aspecto” and “Indicacao.” Other codes without charts infrequently employ these terms. A representative of sampling of codes from various systems indicate the already mentioned consensus of terminology.

English-language systems and Romance-language systems use the same terms in almost all instances. Dutch and German codes, among others, employ equivalent terms (NS 1975-83, 36, DB 1981, 16). France, however, uses indications in place of aspect though the meaning is that of systems using the latter term (SNCF 1981). SNCF utilizes the word

signification instead of indication and in translation the word holds to the meaning in English including that of the semiotic usage. A few systems including those of South Africa, and New Zealand substitute the word meaning for indication and meaning can serve as a brief definition for semiotic signification (SAR 1964, 16; NZ 1989, 117).

The Netherlands uses “Afbeelding” in place of the English aspect which can be translated as picture or representation, and the phrase “Omschrijving van het sein beeld” can be translated as the definition of the sign image (NS 1975-83). The Germanic form (in this case for SBB) employs “Signalbild am” and “Bedeutang” or meaning or significance (SBB Signale 1982). The terms in translation when coupled with the illustrations in the codes suggest a substantial degrees of correlation with systems using aspect and indication.

Within the topic of signification, two additional perspectives can be included: the role the signification may perform, and type of symbol the signification can be expressed in. The roles of signification can be explained (in terms borrowed from traffic control devices), are one of three: a marking fulfills a regulatory, warning or an information role. For many railway signs the role is one of information, though regulatory functions and some warning roles may be present with some signs. For railway signals the primary purpose is often a regulatory one (though a warning role is frequently subsumed within regulatory); in other words, the regulatory is primary and only when a train crew fails to heed it does a warning function become important.

The second perspective centers on the form of the symbol by which the signal’s signification is emitted. These

forms are speed categories or speed values (see Mashour 1974, 34). Speed categories attach word symbols to the signal message; for example, a yellow aspect in North America has the meaning of “Proceed preparing to stop at next signal. Train exceeding medium speed must at once reduce to that speed” (AAR SAI 1956, 48; Canadian BOTC 1961 has similar rules). There is a lack of agreement on what yellow indicates and what medium speed indicates. There is a need on the part of the train crew to mentally shift gears from color to word to number and then to adjust when the meaning changes. This issue also pertains to the arbitrariness/naturalness of sign meanings. Word descriptions which need to be translated into a numerical code (and one that can vary) are more arbitrary than signs that immediately portray the numerical speed value that the train is to follow. What this compiler refers to as the intrinsic or extrinsic meaning of messages (and also partially impacts on the issue of stability of meaning) is considered in Chapter 3B.

Speed values refer directly to numerical values: a green fixed light refers to 90 km/h and a green over yellow indication denotes 40 km/h and without words such as medium, limited or restricted. It can be noted that a numerical symbol for a color may differ from system to system. There is no complete and standard nomenclature of color and number. (OSShD 1962, 13ff).

OSShD publications is an example of a complex system employing number symbols (OSShD 1962). Canada and the US are examples of a complex system based on word and number symbols (AAR SAI 1956, BOTC 1961). Other systems use a smaller range of signification and symbols whether speed categories or speed values.

Chapters 1A2 and 1A3 are separate yet closely inter-related topics. The physical and the semiotic parts of signals ought to manifest some relationship in this chapter as well as a distinction in identify. This can be easily done by a series of illustrations of the signals in their physical shape with the basic messages representing semiotics. This also provides an opportunity to illustrate how different forms of signals can convey the same messages. The illustrations and messages include all-lighted (search-light and multi-lens, position-light, color-position light), and partially-lighted (semaphore, and signal board).

1A4 Note on Design

A chapter of Part A (Transportation-Markings and Designs, Ch 5 (2003) will focus on Transportation-Markings as an aspect and manifestation of design for this Series. However, brief comments on railway signals and design and are included in this note.

The railway signal in many of its forms may appear very dated; an example of simpler technology may suggest signal forms that are quaint and a reminder of the Victorian and Edwardian eras and what they may conjure up. Computer systems and train control adds a patina of modernity to the great assemblage of visual signals but no more than that. Despite some modernizing inroads, many signals -- at least in design -- are little changed from nineteenth and twentieth centuries. Many other signals follow designs that are derivatives of the early signals. Dire predictions of the imminent demise of visual signals of many forms lasted longer than the vanishing trains before the signals have.

In many instances, signals do not, upon close inspection, manifest an outdated appearance. Often they are marked by a stark simplicity: form closely follows function. They are a notable example of minimalism accentuating clean and unencumbered lines. Simplicity, function-inspired form and minimalism contradicts neo-traditionalist design especially in architecture of both the 1880s and 1990s. Yet many other forms of design also exhibit characteristics found in signal design including transportation equipment, communications technology, running/biking/aerobics gear with their "second skin" look. Much of contemporary design has not swerved

from simplicity and functionalism and may have focussed more strongly on those characteristics.

If one separates the signal in itself from railway transportation that can appear archaic; at least in the US. If no longer a trend-setter it may be possible to view the signal as an object that, if not timeless, is at least an object that follows a path of simple geometric shapes with economical usage of materials. It may exclude superficial and useless decorations; and less often influenced by what is momentary.

The signal parallels not only contemporary design but that of past eras as well. The signal is then part of the present and not a musty anachronism of the past. This does not eliminate the need to study the meaning of sign and changes in their meaning.

1B Aspects of the History of Railway Signals

1B1 The Formative Period, 1830-1920

The history of signals can prove to be elusive. Only limited independent treatments exist, and no global treatment has been attempted or so it would appear. Brian Hollingsworth, in his *The Pleasures of Railways*, notes that even for the UK there is a large gap in railway literature for the topic of signals and this is true of few other railway topics (Hollingsworth 1983, 43). While the story of the railway signal exists it is frequently embedded in the larger history of railway development. Much quarrying is required to unearth even fragments of that history. The effort can prove to be worthwhile since even scattered shards can illumine contemporary patterns. And the past and present are often fused together in railways. The following few pages, while only cursory, may suggest some of the unfolding of signal history. Chapter 1B1 may give undue coverage to UK and US (See note at end of sub-chapter). However, many developments and their applications took place in those nations. Developments that came about in other locales in earlier decades were often based on UK and US foundations. Chapter 1B2 will give greater attention to other systems. (See Note).

The formative period of 1830 to about 1920 can be divided into three unequal parts: early developments, 1830s-1860s; further advances, 1870s-1890s; early modern phase, 1900-1910s. Of course these are somewhat arbitrary divisions and can be debated both as periods of time and of content. A common thread running through the phases will be the persistence of signals and colors and meanings once they have been established. Some systems continue to maintain

signals and indications established in the nineteenth century; if not by the founding system then by some other system (s) (e.g. signals with a blind-edge which fell out of use in the UK are in use in other systems to the present; Ellis 1966, 35).

Early UK signals were often boards or flags for day use and lamps at night. The dominant color scheme was white for clear (which continued in UK and the continent of Europe until the later nineteenth century, later in the US); green for caution and red for danger. The cross-bar signal used the “edge-on” (signal parallel to tracks for proceed) approach for a clear signal as do many signals boards (Allen 1982, 140). O.S. Nock notes the on-edge approach in early twentieth century France yet UK is the probably source of that signal even if it died out in the UK (Nock 1962, 89). A ball signal was employed in UK for a limited time and more extensively and for a longer period of time in the US. (Allen 1982, 140). In one version of this signal a raised white ball designated that the train had left the station while a black ball indicated a delay or other problem (AAR, HDRS 1953, 21). White was the line clear color in that time. Black is not a signal color though it forms part of the color indications for contemporary French cab signals; it is unlikely that any historical connection exists (Ch 4B4). US practice moved away from balls to large red discs which employed the edge-on indications for line clear. UK and US left behind non- semaphore signals but other systems adopted and kept the old pattern.

Semaphores can be traced to ancient Greece though it was in eighteenth century France that Chappe developed the semaphore as a long-distance system of communications (Nock 1978, 329). It was in the UK that they first had

a railway signal system (Nock 1978 HT, 329). The earliest semaphores were three-position lower-quadrant forms (in contrast to later UK-US practice which has two-position LQ (however, some three-positions LQ semaphores were made in the US; SSS 1975, 15), and if more than two-position, then two arms are in use (there are some three-arm LQ semaphores with extended capabilities; e.g. Southern Pacific, Signal Rules, 130-132, 137). The early version required the clear indication to be located in a slot in the signal post (an additional type of passive or invisible messages for the clear indication; Blythe 1951, 52). This form of signal, which indicated clear for the normal position not danger, did not always function when a heavy snow weighed down the control cables. This meant that the clear indication position could not change to the danger indication. A serious accident caused by this malfunction led to the demise of the slotted signal (Blythe 1951, 53-54).

The first twenty years or so of railway signals was a fertile time of development. The next two decades were seemingly much less so. Signal types were sometimes added, sometimes dropped, but notable developments -- other than expansion of existing forms -- were limited. The 1870s-1890s by contrast was a time of great change. Germany adopted a signal code in 1875 (Signal-ordnung). While a brief document it presents a complete system of signals. Other forms of signals in the present code (DB 1981) date back to the nineteenth century. France did not adopt a code until 1885 (Rapport). Again, a variety of increasingly marginal signals in present practice (SNCF 1981) stem from that document. The diamond-shaped and checked signal boards were replaced by square checks that are still in use (Allen 1982, 146-47, SNCF 1981 and 1985).

White became a liability as a clear color, and gradually faded out in favor of green. Red remained as the halt and danger color. The commonly employed two-position signals of UK did not require yellow or other caution indication. UK resorted to the tumble-arm signal which caused the signal to return to danger; breakage of the signal's connection would also cause the signal to return to that position (Shackleton 1976, 232). German semaphores were of the upper quadrant form and two positions; these signals are of a different design than those of UK. UK employed few aspects but provided bracket signals at junctions while Germany increased the number of aspects and thereby addressed signal needs at junctions (Allen 1982, 144). French semaphores, were only one element in the panoply of French signals, employed LQ signals. "Blind-edge" signals in French practice and some other systems are vertical units on a pivot while Germanic practice (and also that of the Netherlands) employed a signal board that was hinged in the middle so when clear the signal would lay flat instead of presenting the narrow edge to the track (DB 1981, NS 1975-83). British practice extended to systems outside of Europe including the rapidly expanding system in India (India, IR 1896).

The earlier part of the twentieth century is marked by further change in the semaphore (high point, and decline occurred almost simultaneously), by notable advances in color science and glass manufacture, and a near explosion of forms of all-lighted signals both color and position.

The semaphore began as a simple mechanism in the nineteenth century and developed into a sophisticated and automated machine. The products of the Industrial Revolution, electricity production and transmissions, motors,

even gas-powered devices, brought the semaphore to its zenith. But the technical improvements were unable to change its basic character: one means of message production were needed during the day, and a separate one during the night. As with refinements in horse-drawn transport or steam locomotives, the advances were really little more than sophisticated tinkering. The last stage -- at least in the American experience -- was possibly reached in 1911 and in 1912 with the introduction of electric upper-quadrant semaphores with the mechanism of operation occupying the top of the mast rather than the bottom (AAR, HDRS 1953, 69; the 1981 Brigano and McCullough study, though commissioned by a single railway signal works, is also an important source).

Color-light signals existed but only as a rarity in the nineteenth century; UK, for example, was the site of such signals underground in London in 1906 (Ellis 1966, 84), but most applications were above ground and color-light signals were too weak to be seen very far in the daytime; though it was determined that all-lighted signals were feasible (AAR, HDRS 1953, 69). It would take the same technological impetus that was futilely applied to the semaphore to bring about a revolution in all-lighted signals. Lamps, lenses, reflectors high quality and consistent grades of glass were all required to produce a mechanism that could be seen a satisfactory distance in the daylight hours. Possibly the earliest daylight all-lighted signals were produced in the US. in 1904 though it required an incremental development to finally produce long-range signals in about 1914 (AAR, HDRS 1953, 70; also Brigano 1981, 139).

A new form of all-lighted signal, the position-light,

began service in 1915 on the Pennsylvania Railroad. This signal employed rows of lights corresponding to the position of semaphore arms (Armstrong 1957, 12). The lights were of one color, yellow (which is sometimes referred to as amber since railway signal yellow is less saturated, Kopp 1987, L.A. Provenzano, 8-14-87).

At the end of the 1900-1920 period a searchlight signal was invented (Brigano 1981, 140). This contained a more complex mechanism in that three lenses were installed and programmed to slip into position as required instead of three or more independent mechanisms within one housing (Armstrong 1957, 12). This was to become a significant signal for a variety of systems though little known on the continent of Europe. Finally, and slightly more into the modern era, was the color-position signal. This too was a US development. It combined rows of lights (corresponding to the semaphore positions as with the position-light signal) but in color. This signal has met with only limited interest and is largely confined to the Baltimore and Ohio, Chicago Terminal, and Gulf, Mobile, and Ohio, and Chicago-Springfield-St Louis lines (AAR, HDRS 1953,139; McKnight 7-15-1990). What are termed position-light signals in many systems (and often for non-mainline purposes) are often color and position light signals though perhaps of an independent development.

A second major development in the early twentieth century was centered on color and meanings. Already in the nineteenth century UK, as well as other European systems, were employing red for halt/danger and green for proceed/line clear (see previous segment). The very large US railway industry was slow to make the change from white to green for

proceed and to add yellow. However, the change, though slow, was firmly based on scientific and technological research and the resulting colors, meanings, glass standards and consistency, were to have any impact throughout the century (AAR, HDRS 1953, Section 11, 75-76 and primary source for following paragraph; Brigano serves as supplementary source). And the conversion to green was made quickly after the decision was made (McKnight 1990, 7-15).

Much of the work on the development of color was undertaken in the years 1904-1906. This included setting of limits for colors and deciding the contents as well. As a result the (US) Railway Signal Association (RSA) adopted green for proceed and yellow for caution in 1906. During 1905 the Corning Glass Works and RSA worked out specifications for colors and these took the place of individual road standards. 1910 marked the general usage of red/yellow/green and the fading out of white as a principal color (white is found with dwarf position-light signals, and lunar-white (a blue-white was added some years later). The color specifications not only provided consistency and reliability but the scientific study created a yellow that could not be confused with any other other color hue, and thereby created a cautionary color that permitted green to become the proceed color. The US was more inclined toward three-positions than many other systems; at least in the development stage.

Note

Early in the twentieth century (EB 1910, Vol. 22, 823-824) noted that the US. had just short of 40% of the world's trackage. Six additional systems had from 3-6% of the track-aage, and four other systems had 1-2.5% each. These 13

railway systems had 85% of all of the operational tracks. UK/ Ireland (#7), British India (#4), Australia (#9) and South Africa (#13) constituted a second very large inter-related signal pattern. Other British dependencies, Canada, and some major South American railways were also heavily influenced by UK. Germany (#3) also had influence well beyond its boundaries as can be seen even today in many signal indicator types.

An examination of statistics for Europe (1840-1870) underlines the premier role of UK during much of the first development stage. In 1840 UK had nearly three times the trackage of Germany and France combined; by 1850 UK maintained its lead though more narrowly. Even with major German and French expansion, UK maintained its first place position though only by a thin margin in 1870. Colors, blind-edge signals, semaphores were all areas where UK created and where others frequently adopted or at most adapted (Mitchell, B.R.[EHS] 1975, 581-583).

1B2 Further Developments, 1920-1980

1920-1980 is a time of great changes for railway signals and signaling. It was a time, especially after World War II, of major switching from semaphore to color-light signals. New forms and variations of color-light signals were developed especially in Europe. Cab signals and many electronic mechanisms also came into service. Yet much of the ground work for these changes already had taken place: much of the glass technology, color standards, basic forms of all-lighted signals were in position for broad use by about 1920. One important area for signals in this period were attempts at international cooperation. Regional and more than regional efforts

would also fashion new signal codes with new ideas.

Belgium, because of widespread destruction in World War I, created a new system of signals that incorporated new ideas (Nock 1962, 79-83, and source for this coverage). However, this system remained tied to the prevalent semaphore dominance of that era in contrast to conditions after the next war. A notable event with far-reaching implications was the work toward a new concept of signals in UK. Even though much of UK modernization did not take place until the 1950s; the ground work came three decades earlier. High points of the work, involving IRSE and the Board of Trade, included the advocacy of three-position signalling over the main form of two-position. Yet the recommendation was for color-light rather than three-position semaphores. And a fourth aspect, a double yellow, was also called for. This new signal was needed to cope with special situations that a single cautionary indication could not respond to. The notion of a double yellow was to be emulated by many systems in coming decades though in some instances a green over yellow was in use rather than two yellows (G/Y was under consideration in UK at one point).

Semaphores in their various forms and signal boards may have dominated Europe in the inter-war period but some systems were moving toward general usage of color and all-lighted signals. The US was the outstanding force in this direction. But Australia and New Zealand provide examples of movement toward all-lighted signals as well. New Zealand exemplifies the pinnacle and rapid decline of the semaphore (as was seen earlier in the US). In 1922 New Zealand introduced the three-position UQ automatic semaphore but in less

than two years all-lighted color signals were also introduced (“A Century ...”, 1964, 1-3). Limited adjustment of the old collided with a much more advanced signal. But in these systems as in others, semaphores were still growing in at least some areas for several more decades even though a general decline was increasingly evident.

Even in present times the old continues to exist though it may be largely confined to less important tracks and slower train movements. Signals, from somersault semaphores to the most advanced forms of semaphores, continue to be found all over the world. Signal boards are still found in Europe, portions of Asia and Africa.

World War II wrecked havoc upon all aspects of life both individual and social. Railways and their signals fell as well. The largely intact system of semaphores and boards declined sharply in a few years. Many systems created new ideas in signal practice. Some correlation can be observed among signals though notable variations exist. For example, the French have introduced a complex system based on almost curvaceous signals while the German have a less-complex system housed in sharp and angular signals. The Italians and Dutch made use of substantial numbers of search-light signals. Unfortunately guidelines for signal indications took place after much of the changeover in signals had occurred. The sense of an integrating Europe came too late to prevent a variegated signal apparatus. As signals produced in various nations are transplanted to non-European nations the curved signals and angular signals crop up in far-removed locales; for example, RAN followed SNCF practice, and Siemens influenced SAR. UK, US and Japanese upright rectangles and searchlight signals (through Westinghouse companies, GRS,

USS, Nippon and others) have also moved beyond the original borders as an overlapping mosaic of various shaped signals. Agreed-upon forms are often conservative and long-lasting as can be seen in century old semaphores.

Three events, too new to be regarded as historical, unless one perhaps subscribes to “instant history,” are the signal codes or guidelines of IUR, OSShD and UAR. IUR, during the 1950s and 1960s worked to create a system for its members especially in Europe. But existing signals were too entrenched for success of the new ideas (Though work on signals for high-speed trains was more possible). But IUR did produce guidelines based on common practices and these may shape future signal developments (see Chapter 3A). OSShD, the former Communist Block system, produced a full system in the early 1960s and one that is operational and highly integrated. It is a system that is complex upon first examination but has a simple and highly rational message system upon more study. Variants of this are found in Poland, DB and other member-states. The system also includes some older systems especially those associated with Germanic formsignals. UAR, in the past ten years, has also created a system of signals. This code incorporates British and French approaches as well as a contemporary color-light system. UAR eliminated the long-enduring blind-edge for signal board clear messages though at least RAN (in the French tradition) holds to the blind-edge rather than the UAR form (see codes of IUR, OSShD, UAR, PKP, DB etc. for references to this part).

Even though great diversity continues to be found among signals there are some points of commonality even if not full-scale convergence. The forms of signals and color message bear some similarity though a convergence akin to

road, marine or aero markings may not achieve coherence.

1C Methodology of the Monograph

The 1st edition began with limited sources of T-M information and that was especially the case with international signal materials. An effort was made to canvassing national sources for signal information. At that time information was obtained through postal mail. As a result 40-some railway systems provided data. This method provided a framework for the necessary classification of railway signals and other safety aids.

That older work retained in this 2nd edition may be possibly dated though signal systems do not change often. Newer sources of a different nature have augmented the older sources including newer books are available from IRSE: 1) The 1995 *European Railway Signalling* include coverage of 12 European rail systems (Bailey); 2) A more recent book, *North American Railways* (Bisset, 2008) includes United States primarily and some materials from UK. IRSE had provided earlier sources including Nock 1962. Existing international sources continue to provide substantial information.

The Note on Sources is also retained. Though it is augmented by newer and often different sources. For the most part the statistics are not significantly different.

A major problem in a study of railway signals stems from the lack of a central railway organization (beyond the regional level). This lack of an organization affects not only the information available for this study but it also means a lack of an established international structure and organization

of railway signals. As a result, much of this study is based on national and regional signal codes. It is possible that in bringing together different materials lacking a central structure it may generate misinterpretations. However, the goal of the project is to produce a coherent body of information that brings together railway signal systems that respect the specific and special character of the individual systems. This task can build up a single cohesive system while providing a classification that produces a classification and narrative description. If a single cohesive system has achieved a third component of the monograph series in T-M it has been accomplished.

What sources and method have been used in the monograph in order to achieve the study? There are several transnational organizations that have produced signal codes or at the least general guidelines for signals. There are also the individual railway codes. A primary organization is that of the International Union of Railways (Paris) whose members are found not only in Europe but in many systems throughout the globe. That organization, which is nearly 90 years old, attempted too late to build a signal code (Smith 7-10-1987). However, they were able to establish general principles which have shaped newer developments.

The Organisation for Co-operation Between Railways (OSJD (Warsaw) [Or OSShD, or OSZhD], a compact of Communist and formerly Communist states, has produced a full-scale signal code. While not fully implemented it provides a structure and direction for this study [Organisation ...]. The Union of African Railways (Kinshasa) has also composed a signal code for its members. That code includes both traditional and modern signals and acts a guideline for a wide gamut of signals. The Association of American Railroads

(now termed AREMA [“About AREMA”]) offers a wide spectrum of signal information and has had influence beyond North America. One national system, that of the UK, has had world-wide influence on railway signals: southern and eastern Africa, the sub-continent of India, Australia, portions of South America as well as the British Isles all bear the imprint of British principles and practices. The UK system is no longer among the largest signal systems but its historical impact continues on to the present.

It is not possible to include all of the railways of the world in this study in order to decide which railways are to be included. Track length has been employed as a criteria to determine railways. This may not be a precise standard since a short railway may have more signals than a long one. However, it is more likely that a longer railway would use more signals and exhibit more complex signal messages than a shorter system with a more intense safety aids system. 2500 kilometers [1554 miles] in length was decided upon as a minimum figure for inclusion in the study. There are four classes of railways for the study: “A” systems with a minimum of 20,000 (c. 1.5% km of track (and two sub-divisions within “A; those with at least 50,000 km and those with less than that); “B” systems have at least 10,000 (.75%) km but less than 20,000; “C” 5000 (.4%) to 9,999 km; and “D” 2,500 (0.2%) to 4,999 km of track.

A1 systems include the US (with over 20% of the world’s track), The former USSR (with just under 12% of the tracks), Canada and India (the former with slightly under 5%, the latter with 4.75%), and China with slightly more than 4% of the track total. A2 systems include Australia with its several systems, and just under 3% of the total; France and

Argentina (each has about 2.50% of track total; Mexico has slightly over 1.5%). The “A” systems have about 2/3 of the world’s track. A concerted effort was made to obtain materials from all of these systems and all sent information though it varied greatly. The newer Russia is under 8% and China slightly over 8% (List-of-Countries ...).

“B” nations have from .75% to 1.49% of the world’s trackage. These include the UK and Italy with 1.25% of the trackage each. East Germany, Spain, and the Czechoslovakia have slightly over 1% each; Sweden and Rumania slightly over 1% and Yugoslavia and Turkey have near .8%. The nine nations have slightly about 1/12th of the total.

“C” nations have .4 to .75% each of the trackage. They include Pakistan, Chile, Hungary, Indonesia, Austria, Zaire and Cuba. They provide something over 3% of the total. Information has been received from all of them except for Zaire and Cuba (and Zaire is represented by UAR system).

“D” nations include those with at least .2% of the total trackage. They include Egypt, Sudan, Bulgaria, North Korea, Iran, Norway, New Zealand, Vietnam, Mozambique, Thailand, Portugal, Belgium, Nigeria, Burma, South Korea, Uruguay, Ireland, Switzerland, Bangladesh, Netherlands, Zimbabwe, Algeria, Greece, Kenya, Colombia, Bolivia, Tanzania and Denmark. Together they make up about 8% of the trackage total. About 80% of these states are represented in this study though the amount of information was sometimes brief at times and received through an indirect source. All of the nations (A through D) represent slightly about 90% of the total world rail trackage.

Two other information sources can be mentioned for this study. One source is a small number of manufacturing companies that are active producers of signals. Documents from a variety of these concerns have been obtained and incorporated into the study. A final source of information comes from an examination of individual railway systems. That examination has uncovered shared characteristics and overlapping signal types and messages. Those shared features have been brought together through historical foundations, common manufacture of signals and various cross-fertilizations. Together they constitute an additional source since understandings of the working of signals has resulted from the shared features that the separate features do not reveal to the observer.

Despite the problems encountered in obtaining materials the end result of interweaving many fragments has made it possible to build up an image of signals in use and the kinds of messages produced. This process adds to the structure of this study.

Note on Sources

One problem for this study has been the unevenness of statistics for railway route-kilometers. While figures for some systems are similar in a variety of reference works, the figures for other systems can vary greatly from one source to another. There are probably several reasons for this problem. Sometimes (though not often) mistakes are made in the statistics. For example, one source added an extra number to the 2400 km of Kenya's tracks and produced 24,000 km of track. Another source added 100,000 km to the 140,000 km of the former USSR creating a total of 240,000 km. More

often the differences stem from definitions: one source lists the state system but not small private lines. Sugar and mine lines are included/excluded. Seemingly, reputable reference works give accurate figures yet at the same time they may clash with one another.

For the first edition of this study there were two primary sources of statistics: *Jane's World Railways* (1988-1989) edition with recent consultation of the 1989-1990 edition; Allen 1988, 1989), and the membership list of the International Railway Congress Association, 1989. The membership list in the possession of this compiler includes inked-in membership railway trackage. Since the IRCA includes just over 75% of the railways of this study (though some of those systems have not submitted data) it represents an important source of immediate data; 70% of the systems if the several systems of Australia are counted separately. *Jane's* is the primary source for non-member IRCA systems. A variety of other sources supplement IRCA and *Jane's*. These include: *Europa Year Book*, *International Marketing Data and Statistics*, *The World in Figures*, and the *Statesman Year-Book*.

Statistics need review for some nations. Iraq has 2,800 km in *Jane's* but 1113 in IRCA; it is not necessary to include Iraq. Peru, Syria, and Taiwan have under 2,500 km in primary sources though have 2,500 km in secondary sources; it may not be necessary to include those systems. RAN (apparently disbanded though possibly functioning again), Taiwan and the Philippines are included because of available materials.

What is the world's trackage? That too can prove to be an elusive matter. The journal, *Rail International*, estimated trackage as slightly under 1.25 million km in 1981. The

second figure forms the basic calculations for this study. The actual ranking of systems may not be precise; however, the figures even if approximations, are adequate for this study.

Additional notes can be here included on specific situations. Australia and Canada each show an increase of about 2,000 km in the 1989-1990 edition of *Jane's* over the previous edition. Necessary adjustments in the statistics for the monograph have accordingly been made. IRCA figures for Germany appear to include DB but not only lines; these additional lines include some 2,800 km of track. The DB system is the concern of this study.

IRCA shows nearly 3,000 km for Ireland yet other sources indicate less than 2,000 km. The discrepancy may be caused by many closed lines in Ireland. Japan National Railways has been replaced by the Japan Rail Group. According to *Jane's* the rail lines that include the words Japan Rail (JR-West, etc), plus Shinkansen Property Corp, and other lines (private rail lines and "Third Sector Railways" include about 6,000 more km of track than does IRCA. If the other lines category is excluded then IRCA and *Jane's* have approximately the same mileage. And that figure is used in this study.

Jane's includes 5,000 more km for Poland than does IRCA. IRCA figures have been used for this study. IRCA is also employed for SBB trackage figure for Switzerland. However, there are some 1,300 km of other lines. Those lines may be tramways and other operations. IRCA, however, has the higher figures for Turkey and Yugoslavia.

The US provides a complex situation. Figures for the US in various sources are widely divergent. Jane's approach is to list Class I railways then selected other lines (some Class I, others Class II). The total of both groups reveals a figure of about 274,000 km. This figure is very close to the figure in *Jane's* for a mid-1980s edition.

Tremendous social and political turmoil has occurred for many peoples and nations in the last few years. DDR is now gone, USSR has less territory, Yugoslavia is fragmented. And the railway systems of Sweden and of Japan have undergone major changes in structure and administration. For these and probably other reasons as well, the figures and organization presented in this study may not always be as accurate as one would want. But presumably signals and signal codes are slow to change and perhaps the reduction in accuracy is minimal.

Note: Addendum for 2nd Edition

The information of the 1st edition is retained. That older data is adequate for this edition though qualifying remarks needs be added. The primary sources for new statistics come from UIC, CIA World Factbook and World By Map that appears in Wikipedia (List of Countries... 2014). Some figures are similar to those of older sources. Seven of the largest rail systems have increased while twelve have declined and one is unchanged. The demise of the Soviet Union has caused a significant decline in the Russian Federation rail system. China railways display a significant increase in trackage. Germany is now a unified nation and the rail system reflects growth. Some figures may manifest a lack of reliability. Ukraine and Kazkhastan are now listed in the

first twenty nations for trackage. Five more former Soviet holdings have more than 1,000 km and are listed in the source. Numerous nations have a decline in trackage though many changes are notable. Only limited nations have increased, and others have stationary systems. (List of Countries ... 2014).

CHAPTER TWO

CLASSIFICATION

2A The Main Classification

2A1 Introduction

i T-M Background

Classification has been the foundation of T-M since the beginnings of this study. In fact it was the study. That early work dates back to 1969-70 and consisted of a chart of U.S. Transportation-Marking forms. The original idea was accompanied by basic rules for its working. A larger study in the 1970s included not only the basic classification but also added variant classifications. It also included information on semiotics and communication, and coverage of marine, rail, aero, road Transportation-Markings.

A third monograph of a larger scope was undertaken in 1981. The classification was augmented by a nomenclature that explained and guided the classification. It also included the first of the modal studies, marine aids to navigation. That marine study included an international classification in addition to the original U.S. version. The 1981 edition included segments for semiotics, taxonomy, nomenclature. That partial work became an independent work under the heading of Foundations (Part A) with a broader scope of information. The original marine information monograph also became an independent monograph (Parts C and D with floating and fixed aids as segments). The early U.S. work became a

separate and expanded monograph (Part B). Further work resulted in road (Part E), aero (Part G) T-M works.

The original edition of the railway study (Part F) was finished in 1991-92. It was influenced by the series of earlier Transportation-Markings (Only Part G came after Part F). Notes on entries in the classification were included though the nomenclature was not included. Beginning in 1994 a series of classification monographs (Part H) has been added including an extensive nomenclature. Those specialized works have reviewed and altered existing classification forms including that of railway aids.

ii Railway Signals & Classification

Railway signals and relate safety devices are a complex subject. This is especially true when compared with other mode devices. That is notably true when classifying signals and other forms. Railway systems, including safety devices, became constructed without substantial international assistance. By contrast marine, aero and road forms had been influenced by international systems in many nations. Marine safety efforts on an international scope go back to the 19th century. And international road groups began in the earlier 20th century. Aero international efforts began in the 1940s which is relatively earlier for that mode.

The International Union of Railways (IUR) in the 1920s began a process of shared safety systems. However, many systems and signals were already established. The IUR can only offer general guidelines for the most part. As a result there are a plethora of types of safety devices and meanings in use. While there are regional efforts to create a agreed upon

systems they are only partial in creating a common pattern of signals. As a result the building of a classification has many changes and alterations to consider a system. The diverse needs for a system required not only a main classification but also a broad range of variant classifications in order to cover the complexity. All modes now have some degree of variant classification but rail studies began that practice and is more heavily employed used variants because of that unique requirements.

Chapters Two, “Visual Aids I, 1750-1920” and Three, “Visual Aids II, 1920-2000” of *Transportation-Markings: A Historical Survey, 1750-2000* provide information on development of systems for various kinds of safety aids. “Radio Aids” and “Sound Signals” augments system development to a degree.

iii Forms of Safety Aids in Classification

The first edition of this study was entirely visual and a visual form that was fixed (one form was included in the study but outside the classification). Classification studies have added several devices including Electronic devices (Radio Token); Sound devices (Audible cab signal and Crossing Bells); Multi-message aids (including Cab signals and Grade/level crossings with sound and visual forms). A special category are Movable Signals. They are in main and variant classifications but not in the first railway study classificaton. However, those forms were in an Appendix that included: Staff, Ticket, Tablet and and Token; the second type consists of Train Order and Time Interval forms.

One notable change in classification categories is the use

of employing the third digit of “0” for a single device. Devices for more than one device are designated by a number from 1 to 9 as required. The 1991 study employed “0” in the same manner as 1-9. However, that practice has ceased in the classification studies and the second edition of the railway study as well.

2A2 Classification of Railway Signalling

51 All-lighted Railway Signals

511 Trackside Signals [Signals Governing Train Movements on One Track (SGTMOOT)]

- 5110 Color-light: Multiple-lens Signals
- 5111 Color-light: Searchlight-lens Signals
- 5112 Color-position Signals
- 5113 Position-light Signals
- 5114 Symbol Signals

512 Cab Signals

- 5120 Color-light Signals
- 5121 Position-light Signals
- 5122 Numeric Signals

513 Dwarf [Signals Governing Train Movements From One Track to Another Track (SGTMFOTTAT)]

- 5130 Color-light: Multiple-lens Signals
- 5131 Color-light: Search-lens Signals
- 5132 Color-position Signals
- 5133 Position-light Signals
- 5134 Symbol Signals

52 Partially-lighted Railway Signals

521 Trackside Signals -- Semaphore (SGTMOOT)

- 5210 Blade-spectacle Fully-integrated
 - 5211 Blade-spectacle Integrated Through Linkage
 - 5212 Blade/Lens Partially Integrated
 - 5213 Blade/Lens Separate
 - 5214 Composite: Blade/Lens Integrated
 - 5215 Double: Blade/Lens Integrated
 - 522 Signal Boards/Board Signals (SGTMOOT)
 - 5220 Single-unit Signals
 - 5221 Double-unit Signals
 - 5222 Composite: Semaphore-signal Boards
 - 523 Dwarf Semaphore & Rotating Signals (SGTMFOTTAT)
 - 5230 Dwarf Semaphores
 - 5231 Disc Signal with Signal Lamps
 - 5232 Disc Signal, Indirectly-lighted
 - 5233 Disc-Semaphore
 - 5234 Pillar-Disc
 - 5235 Miniature Graphic Symbol Indicators
 - 524 Dwarf Revolving Signals (SGTMOFFAT)
 - 5240 Disc Signals
 - 5241 Panels
 - 5242 Graphic & Geometric Symbols
 - 5243 Alphanumerics
 - 525 Railway Signals
 - 5250 Single Forms, Lighted Signs
- 53 Unlighted Signals, Signs & Markings
- 531 Targets & Track Indicators
 - 5310 Color
 - 5311 Shape
 - 5312 Color-Shape
 - 5313 Miniature Graphic Symbol Indicators

532 Signs

- 5320 Advance Locations Signs
- 5321 Limit & Location Signs
- 5322 Territory Limits Signs
- 5323 Safety Signs
- 5324 Maintenance of Way Signs
- 5325 Speed Control Signs

533 Markings

- 5330 Plates & Flags
- 5331 Boards & Posts
- 5322 Markers & Marks

534 Fixed Unlighted Signals

54 Railway Sound Signals

540 Signals with Single Forms

- 5400 Detonators

541 Signals with Variant Forms

- 5401 LC/GC Bells

56 Multi-message Railway Aids

561 Lighted/Sound Signals

- 5610 Cab Signals [Audible Cab Signals]
- 5611 LC/GC Signals [Crossing Bells]

55 Railway Electronic Aids

550 Radio Aids - Single Forms

- 5500 Radio Token

51. All-lighted railway signals are divided into 511, Trackside Signals [Signals Governing Train Movements on One Track (SGTMOOT), 512, Cab Signals, and 513, Dwarf [Signals Governing Train Movements From One Track to Another Track (SGTMFOTTAT). Dwarf form follow the same range of components of Trackside Signals. The category of Cab Signals was a single entry in the former Trackside Signals unit. The terms may suggest more precision than is actually the case. Nonetheless, the terms provide a workable division between signals that function as mainline trackside signals, and other signals that provide guidance for trains moving from mainline track to another mainline track, siding, yard or other ancillary track (as well as shunting services on mainline tracks). Signal categories can overlap. This is likely the case with all-lighted dwarf signals that carry out a variety of related functions.

5110, Color-light: Multiple-lens signals have one lamp and lens unit for each aspect; 3- and 4-aspect color-light versions are probably the most common forms; 2-, 4-, and 5-lamp versions are also in use. Within 5100 there are a variety of design configurations which are described in Chapter 29B and 29C (this is true for railway signals, signs and marking throughout the classification).

5111, Color-light: Searchlight-lens. The signal unit contains three interconnected lenses sharing a single lamp; each is brought into position as required.

5112, Color-Position-light Signal. This signal, an all-lighted to be form of the semaphore signal, produces

messages through rows of uni-colored lenses according to semaphore patterns. Position lighted signal, 5113, combines a color message with positions of the lamps. The colors and messages arrangements based on color-lighted signals and positions are from the semaphore (and also position-light) signals. Signals designated as position-light in other systems that contain color are included with color-position signals in this study.

5114, Symbol Signals. This form includes graphics, geometrics and alphanumerics. This edition includes three forms in the classification. Current practice assigns separate forms to variant classification with a general term for variant versions.

513, Dwarf Signals category of signals includes a broad array of all-lighted units that serve as switch/point, siding, rail yard, shunting, route and junction indicators. Many are dwarf signals though some full-sized models are included. The size or shape is less significant in this category than is the function. These functions are non-mainline functions which are found on secondary lines, on mainlines, or to and from mainlines, or involve low-speed movements on mainlines. In biological terms they are identified by morphology more than by physiology.

5130, Color-light: Multiple-lens Signals. These often parallel full-sized models though often they are only two-position signals; searchlight models are also in use. Color-light: Searchlights-lens signals, 5131, though dwarf, are identical to full-sized units and are common in North America and selected other systems including SAR, FNM, FS, some Australian and other systems.

5132, Color-position signals include all signals of a dwarf nature that emit messages by color and position without regard to the official name of the signal.

5133, Position-light signals include only true position-light signals. The 5133 type of position-light signals are often of a different design than full-sized versions. Though in Mexico the dwarf versions are identical to full-sized types save for the mast (FNM, 265). The position-light signal may have fewer message possibilities than 5113.

5134, Symbol Signals are an amalgam of very diverse signals. Some include graphic designs -- often arrows -- while others include letters and/or numbers. Geometric shapes are employed in some. Many serve as either switch signals or route and junction indicators. There are partially-lighted counterparts to many of these signals.

52, Partially-lighted signals include 521, Trackside Semaphores; 522, Signal Boards/Board Signals; 523, Semaphore and Rotating Signals, and 524, Revolving Signals, and 5250, Lighted Signs (within 525 Railway Signals).

521, Trackside Signals: Semaphore signals are divided into six segments for this study. The first segment, 5210, contains two groups in the older version which were fully-integrated but some were upper-quadrant (UQ) while others were lower-quadrant (LQ). In both categories the blade and lens apparatus is a single integrated unit with the lamp positioned behind the spectacle/lens assembly. There are nuanced differences within the categories; these are taken up in Chapter 2B and 2C.

5211. This form is Blade-spectacle Integrated Through Linkage. It requires separate listing because the blade has a distinct means of connections.

The remaining forms of the semaphore are at variance with the first three categories. Blade and lens units are at least partially separated and lack integration or linkage of the other forms. Partially-integrated forms, 5212, separate the blade and lamp unit but the blade has an opening in it so that in some positions the lamp shines through the opening. The Blade/lens separate type of semaphore, 5213, has a completely separate lamp assembly and blade and lacks integration. A combined UQ and LQ form, 5214, is available only in the Netherlands (Op de Rails, 12-1985, 58-59). A double form in FS, 5215, displays two blade spectacles operate from a single mechanism (FS, RSS 1947, 74-75).

522, Signal Boards. The term is discussed in Ch 5C1. They are a signal rather than a sign because of the changing character of the messages; in some systems offer a full-line alternative to the semaphore. The older classification divided into three forms of single-units, one double-unit and one composite. The single-unit is labeled 5220. It includes stationary, hinged and revolving forms. The double unit, 5221, revolves.

5222, Composite: semaphore/signal board. This form could be located either under semaphore or signal board. It includes the singular Spanish signal that attaches a signal board and a semaphore to the same mast; messages require both elements. Two other forms include a semaphore arm below the signal board which qualifies the signal board message, and a final form that superimposes a center-attached arm on a signal board.

523, Dwarf Semaphore and Rotating Signals, and 524, Revolving Signals (both SGTMFOTTAT) contain the many forms of other-than-mainline signals (dwarf, ground, miniature switch/points indicators). They promote a taxonomical problem: what are the significant points of differentiation among these signals? Are these disparate and numerous signals to be considered as a single category or are they to be divided into sub-categories? And if they are to be divided into smaller groups what are the characteristics of those categories?

There are many limited differences that might be considered as important but many of these are “red herrings” rather than primary differences. One possible distinction is the difference between full-rotary and partial-rotary models (full rotary: entire apparatus revolves while partial includes those in which only the signal assembly revolves). This difference can be important to the railway crews but has limited importance for signal users. The more significant difference would be the number of faces that a signal exhibits: a single-sided signal has one face though multiple messages within that context while a double-sided signal has two faces of which only one is present at a time. This distinction fragments disc signals into single-sided and double-sided signal. Nonetheless, the distinction based on the number of faces is an essential one: those signals having two message possibilities which can only be exhibited by a basic physical change, and those with the capability of changing messages without creating physical change.

523, Single-sided models. These include semaphores, 5230, which are dwarf versions of BSFI full-sized models; seemingly only BSFI includes dwarf semaphore types. Disc signals include models with signal lamps in the face of the signal, 5231 and those flood-lighted forms, 5232, that exhibit the same message aspect day and night. The disc-semaphore, 5233, is an integral unit of SAR and not a composite signal. The pillar-disc, 5234, is a rare signal that may be defunct. Track indicators, 5235, are partially-lighted devices with miniature graphic symbols.

524, Double-sided models. A further point of confusion with some railway signals has been the historical practice of giving names to some signals (for example, disc signals) while other signals lack any name (for example various US, and European switch/point indicators have no name except for a general one denoting function). This study will use existing specific names, and append general descriptive terms to those lacking names (for example, this study will refer to targets bearing resemblance to a costume mask as a mask-type).

5240 and 5241, Disc signals. The secondary distinction is included in the classification and of a disc form and common to UK among other nations (K & W [UK] 1963, 22, 51). A second term called “panel signals,” coined by the compiler, has the essence of disc characteristic but of a square housing without day targets. This signal is designated as 5232. (New South Wales, Signal Indications 1952, and termed as Point Indicators; Queensland's Fixed Signal is similar in design and term).

5242 and 5243 Graphic and Geometric symbol signals enclosed and open serve as “umbrella” terms for signals

serving primarily at switches and points. The enclosed version is confined largely to Europe while the open version (known as targets) is common to North America and selected other systems. The enclosed form often exhibit a translucent symbol (circle, arrow, etc) behind which a lamp illuminates the symbol for night usage. The open form displays an unlighted symbol (target). This is mounted on a mast that is shared with a signal lamp (there are signal lamps that include a small day target affixed to the lamp body). The two forms of graphic signals, despite notable differences, are allied markings and belong logically in adjoining categories.

525, Railway Signals includes Single forms, Lighted Signs. This single unit may be an adequate for this form though an older version included several forms.

53, Unlighted signals, signs and markings, consists of two categories: 533, Signs and 534, Markings..

Signs consist of .1, Speed Signs, and 2. Other Signs. Some thought had been given to a tri-part classification based on traffic control device (TCD) practice. But an examination of railway sign forms indicates a two-part classification is satisfactory. The individual character of sign speeds and related information only categories of an over-reaching nature are included here. Chapter 2B offers details on the component of 532. AREA classification of signs provides pointers for the complex and uncertain topics of signs (American Railway Engineering Association).

533. Markings or non-sign markings are a difficult object to clearly define and distinguish from signs. Chapter 5G discusses the problem at some length. Chapters 2B and 2C

also consider these markings. They are a smaller category of railway safety devices and are not well known. A general classification of the markings within .3. uncovers four principal groups. Pillars, Petites, Boards, Sign-like Objects. Posts are relatively tall and slender objects with distinct colors and patterns. Petite-markings are short objects and again marked by special coloring and patterns. Marking Boards, are literally that: they are frequently tall, wide and thin. The final is a confusing group of objects quite similar to signs but without the symbols associated with signs.

Classification ends with three small units: 540 Signals includes 5400 Detonators and LC/GC Bells. 561 includes Lighted/Sound Signals: Cab Signals and LC/GC Lighted Signals. 562 includes Lighted/Unlighted Devices. 55 Railway Electronic Aids including a 5550 Radio Token.

2B Variant Classification

2B1 Introduction

The principal classification for railway Transportation-Markings may adequately cover the various kinds of signals, signs and other markings. However, there are many modes that a specific signal may take. For example, a color light signal has two basic forms: search-light or multiple-lens. But within the multiple lens forms the lamps can be arranged in a vertical pattern, a horizontal pattern or one of several other possibilities. It is important to include the various specific modes. But the broad range of diverse signals can hardly be encompassed within the existing classification system since the classification would become unwieldy and the numbers would be inadequate for the material to be classified. Hence, the creation of a sub-system of classification attached to the principal system was needed.

A first form of the variant classification system employed conventional outline designations (Roman numerals, capital letters, Arabic numbers, and small case letters) but that created an incongruous situation in relation to the numbers-only system of the main classification. A second form employing numbers-only was adopted. This is separated from the adjoining main classification through the use of decimal points. This eliminated the contradiction of using two forms of designating symbols for the markings and at the same time allowed a conjoining of the numerals with the decimal points as both a connecting link and a demarcation point.

Nomenclature of the variant classification is three-fold:

one digit, two digit and three-digit each preceded by a decimal point.

.1 (and succeeding numbers) refers to a basic sub-division which can be:

a) coterminous with a three-digit division of the main classification; for example, 510 Signals Governing Train Movement on One Track.

b) or a special sub-division within a three-digit grouping; for example, a large number of variant forms may be divided into basic shapes and special shapes.

c) or two or more three-digit groupings if shape configurations are limited; for example, 532 and 533.

.10 (and other two-digit designations) refer to primary segments within the basic sub-divisions. These segments may be based on shapes (rectangles, squares, circles, etc.), on the means of joining day and night portions of signals (fully-integrated semaphores, partially-integrated semaphores), or graphic symbols (arrows, masks, etc).

.100 (and other three-digit assemblages) designate individual forms of a marking. These include secondary design features (for example, a rectangle with curved corners, the number of lamps or arrangement of lamps, or the shape of semaphore blades).

2B2 Variant Classification

51 All-lighted Signals

511 Signals Governing Train Movements on One Track
(SGTMOOT)

.1 Basic Shapes

- .10 Rectangle/Rectangular Backplate: Vertical
- .11 Rectangle/Rectangular Backplate: Horizontal
- .12 Rectangular Backplate: Slanted
[Lamps Configurations: Single Row (SR), Double Row (DR), Irregular (IR), Random]
- .13 Circles [Lamp Configurations: Triangular Arrangement (3 Lamps), Single Lamp (Multiple Lenses), Circular Arrangement (8, 9 Lamps), Cluster Arrangement (4 Lamps)]
- .14 Triangulares [Lamp Configurations: Triangular Arrangements (3 Lamps)]
- .15 Octagons [Lamp Configurations: Multi-row Arrangements]
- .16 Square Backplates [Lamp Configurations: SR, DR, IR]
- .17 Diamond Backplate [Lamp Configuration: Single Lamp (Multiple Lenses)]

.2 Special Shapes: France and Algeria

- .20 Inverted "L" (two rectangles fused together; one on a horizontal plane, one on a vertical plane).
- .21 Rectangles (Vertical dimension more prominent; joined together in non-synchronic manner)
- .22 Rectangle/Circle Fused Together

.2 Special Shapes: Other Nations

- .23 Rectangular Backplates [Lamp Configuration: Double Row (2, 4 Lamps)]
 - .230 Rectangular with Triangular-shaped Lower Edge, DR
 - .231 Rectangles Fused Together (Off-centered “V”, rounded ends), DSB[Lamp Configuration: V”-shaped Pattern (5 Lamps)]
 - .232 Rectangle with Triangular Extension, Rounded Ends to the right, SNCB [Lamp Configuration: SR/DR (5 Lamps)]
 - .233 Rectangle with Rectangular Extension, Cropped Corners, to right, PKP, [Lamp Configuration: Assymetrical DR (2, 4 Lamps)]
- .24 Truncated Parallelograms
 - .240 Single Basic Form, DR, PKP [Lamp Configuration: Assymetrical Dr (2, 4 Lamps)]

512 Dwarf Signals (Signals Governing Train Movement From One Track to Another Track (SGTMFOTTAT))

- .3 Basic and Special Shapes [Lamp Configurations: Generally SR; Some Irregular; also Graphic, Alphanumeric, Geometric, Composite (1-3 Lamps and/or one or more other symbols)]
 - .31 Square-shaped Signals [Lamp Configurations: Double Row, Assymetrical, Circular, Graphic, Alphanumeric Symbols (3-7 Lamps, and/ or one more other symbols)]
 - .32 Triangle/Triangular Shaped Signals [Lamp Configurations: Triangular-shaped frequently; some arrangements are assymetrical (1-3 Lamps)]

.33 Other Shapes

.330 Circles

.331 Octagon

.332 Arms

.333 Obrounds [Lamp Configurations: Diverse (1 to nearly 20)]

52 Partially-lighted Signals

521 Semaphore and 522 Signal Boards

.4 Basic and Special Shapes

.40 Blade-Spectacle Fully Integrated (BSFI): Rectangle I,
Slightly tapered

.41 Blade-Spectacle Fully Integrated (BSFI): Rectangular
II, Broader, Less elongated

.42 Blade-Spectacle Fully Integrated (BSFI)

.43 Blade-Spectacle Fully Integrated (BSFI)

.44 Blade-Spectacle Integrated Through Linkage (BSITL)

.45 Blade-Lamp Partially Integrated (BLP)

.46 Blade-Lamp Separate (BLS)

.47 Special Shapes

.470 Propeller Arm

.471 Double Arm

.472 Lattice-work with Opening in Blade (Circular)

.48 Signal Boards: Rotary Form

.49 Signal Boards: Hinged and Stationary

523 Partially-lighted Signals: Dwarf Semaphore, Rotating
Discs & Composite Discs

.5 Dwarf Semaphores, Rotating Discs & Composite Discs

.50 Semaphore, Dwarf (see details)

.51 Rotating Discs

.52 Composite Discs

524 Partially-lighted Signals: Revolving Signals

.6 Revolving Discs and Enclosed Graphic Signals

.64 Revolving Discs

.65 Enclosed Graphic Signals

.7 Open Graphic Symbols (& 530)

.70 Mask-shaped Vanes

.71 Arrow-shaped Vanes

.72 Oval-shaped Vanes

.73 Rectangle-shaped Vanes

.74 Obround Vane

.75 Miscellaneous Shapes of Vanes

.750 Circle & Square

.751 Circle & Chevron

.752 Diamond/Single Vane

.753 Triangle (Truncated) & Oval

.754 Octagon/Single Vane

.755 Square & Square

.756 Square & Square (With graphics)

533 Signs

.1 Speed Signs

.10 Announcing of Restrictions

.11 Ending of Restrictions

.12 Within Categories of Restrictions: Nuanced Variant
Forms

.120 Temporary/Permanent Differentiations

.121 Special Designation of Trackage: Branch Line

- .122 Special Designation of Trackage: Main Line
- .123 Designation of Train Speed Categories: Express
- .124 Designation of Train Speed Categories: Passenger
- .125 Designation of Train Speed Categories: Freight
- .126 Lighted Dimensions to Signs
- .127 Distance Dimension to Restrictions Signs

.2 Other Signs

534 Markings

.3 Pillars, Petites, Boards and Sign-like Objects

.30 Pillars

- .300 Straight-line/Flat-top Forms
- .301 Pointed-top Forms
- .302 Tapered Forms
- .303 Forms with Visible Undergirding
- .304 Lighted Forms

.31 Petites

- .310 Cylinders
- .311 Square Post - Flat-top
- .312 Square Post - Pointed-top
- .313 Rectangular Post
- .314 Horizontal Slab

.32 Boards

- .320 Tall with Visible Undergirding
- .321 Tall without Visible Supports
- .322 Intermediate with Visible Undergirding
- .323 Symbols for Boards: (Stripes [Two Forms],
Zig-zags, Chevron, Checks)

.33 Sign-like Objects

- .330 Forms with Primary Horizontal Dimension
- .331 Forms with Primary Vertical Dimension

- .332 Square Forms with Single Support
- .333 Special Forms with Single Support

535 Movable Signals

.4 Movable Signals

- .40 Staff, Ticket, Tablet & Token Forms
 - .400 Manual Staffs
 - .401 Staff & Tickets
 - .402 Electric Staff
 - .403 Electric Token
 - .404 Key Token
 - .405 Electric Tablet
 - .406 Tokenless System (Paper Ticket)
- .41 Train Order & Time Interval
 - .410 Telegraph Train Order System
 - .411 Train Order System
 - .412 Time-Interval System
 - .413 Telegraph Block System

56 Multi-message Railway Aids

- 562 Lighted/Unlighted Devices [Sound may be present]
 - 5621 Barriers & Gates
- .1 Lighted Forms
 - .10 Lighted LC/GC Signals
 - .100 Free-Standard
 - .101 Attached to Other Devices
 - .11 Barriers & Gates
 - .110 Full Barriers & Gates
 - .111 Manually Operated Barriers
 - .112 Half-Barriers & Gates

2B3 Variant Classification: Explanatory Notes

511

511 notes are divided into .1 Basic Shapes, and .2 Special Shapes. Explanatory notes for SGTMOOT and SGTMFOTTAT will necessarily overlap since they frequently share similar forms. Variant classifications and notes are provided for both since the functions and shape configurations often are different. Mainline signals are more important though greater coverage of the more diverse secondary signals may suggest the opposite situation.

Vertical rectangles (.10) are the most common in many systems and somewhat common in others. Cropped-corner (s) frequently denote signals in Europe especially those of German provenance, and in systems influenced by Germany or supplied manufacturers from there. Rounded-end signals are found in many systems in the Americas and in the English-speaking world. Rounded-corners are common place in the French sphere of signalling. Signals in the .10 segment are mostly single-row though other forms are in use.

Rectangles with a horizontal emphasis (.11) are less common than vertical. They are, however, frequently used in France and systems so influenced. The rounded-end signal is American though not commonly employed. The slanted rectangle (.12) is in use by DB as a distinct signal. Quite possibly the slanted rectangular signal should be with the special shapes. However, this compiler has reserved the special shape category for signals of very singular shapes. Lamp configurations include single row (SR), double row (DR), Irregular (IR) and Random (RM).

Circles (.13) are commonplace in some systems though unknown in others. Circle containing a triangular arrangement of lamps are infrequently employed. Lamp configurations include the searchlight signal. Color-position, position-light, and cluster arrangements.

Triangular, Octagon, and Diamond-shaped backplates (.14, .15, and .17 respectively) are not commonly employed. Square backplates (.16) are much more in use. The variant square shapes clearly suggest their origins: the rounded corners form is of French provenance while the cropped corner version is of Swiss usage. Lamp configurations include SR, DR, and IR.

The second portion of 511 shape configurations, .2, refers to special shape. These include unusual shapes confined to a single rail system or at most a few railways. There are two segments under .2: France and Algeria, and Other Nations.

Special shapes for other nations include four forms under .23. Many of these are at least partially rectangular in shapes: .230 is from DR, (while it is possible to subdivide .240 into variant forms, one designation should suffice); .231 belongs to DSB, .232 to SNCB and .233 to PKP. The single unit, .240, in .24 are from two members, DR and PKP, and display truncated parallelograms.

512

SGTMOOT Signals (510 .1 and .2) contain diversity

and downplays predictability. Shapes of signals, the range of symbols, the meanings of messages can vary greatly even within systems. This part of the 512.3 segment can only suggest the complexities of these signals.

“True” rectangles are an exception; all have some rectangular properties but these are frequently mixed in with curves, partial spheres or other dimensions. Some include extensions onto the basic rectangular portion whether back-plates or signal housing. Nonetheless, an image of rectangular design is more prominent than any other shape. These signals are often elongated in appearance though some more squat models are in use. Vertical signals are more common than horizontal forms.

The shape of a signal and its relationship to the message capabilities of the same signal may not appear to be of great consequence but there is a substantial correlation between the shape of the housing and the working out of the message. Most rectangular shaped signal displays color-light messages (though the color pattern may be different from mainline signals). Some arrow and alphanumeric signals are among the .30 category. Lamp configurations include SR, IR, graphic, alphanumeric and composite forms.

Square-shaped signals (.31) are important on the continent of Europe and in systems supplied by manufacturers in that region; they are uncommon elsewhere. This shape contains position-light, and color-light signals and also alphanumeric signals. Lamp configurations include DR, asymmetrical, circular, graphic and alphanumeric.

Triangle and triangular-shaped signals encompass a wide

variety of forms; possibly the term triangular is used in an overly elastic manner with some of the .32 entries. These forms include rounded points. Other triangles are of a right-angle form. These include an UK model which displays a relatively strong triangular shape, a more angular and truncated version (SBB). Some route and junction indicators are triangular in shape. A triangle fused with rectangle (FS) is possibly an Other Shapes type (326) though included here.

Other Shapes (.33) include less common standard forms as well as special shapes. Circles (.330) are common only to a limited number of systems. They are employed for shunting and for simplified position-light signals. Dwarf search-light signals are also circular in shape. Color-position signals are of circular design though mounted on a square or rectangular-shaped base. It is possible that circles - because of the diverse forms that they exhibit - ought to be sub-divided but hopefully one heading will suffice for this first classification. Octagons are in use in some European systems (.331). They are frequently a position-light signal. A variant form of the octagon is fitted with arms for use in route and junction indicators. These are frequently a position-light signal. A variant form of the octagon is fitted with arms for use in route and junction indicators. These are common in UK and derivative systems. Arms (.332) are more precisely a composite signal with an octagon base. The obround-shaped signal (.343) is found only in Japan.

It can be noted that Graphic and Geometric Signals constitutes a special area in an earlier draft since it is the form of the symbol rather than the shape of the housing that takes precedence. However, they have been placed with the shape of the housing (either rectangles, .30, or squares, .31). The

graphic dimension is mentioned under lamp configurations of those segments.

530 and 531

This segment includes both full-sized semaphores and signal boards under the heading of .4. Variant classification, notes and illustrations may not exhaustively cover these signals and all their nuances. All-lighted signals, though diverse, share many forms and message patterns but partially-lighted signals are more open to local interpretations in design. Hence, this material may do little more than suggest the outline and content of these signal forms.

Semaphores within .40 refer to UK and UK-influenced systems (empire/commonwealth but also EFEA and others) in which semaphore blades are clearly rectangles. This version comes in a full range of designs and in both UQ and LQ. The semaphore designated by .41 share key characteristics with .40 except for a degree of tapering of the blades. This form is found in the US and areas affected by the US including ANR, VR (A), and FNM. .41 displays a substantial tapered appearance. Semaphores assigned to .42 refer to semaphores similar to .41 save for a more muted tapering of the blades. While this is a narrow difference it is one that is easily discernible. The Dutch version of the semaphore (.43) is fully integrated yet distinctive as a separate form. It is broader and less elongated in design.

The semaphore under the acronym, .44, BSITL, is a special form of the semaphore originating in UK designed to prevent signal failure in snowy and other conditions. The

shape is somewhat different from that of the standard semaphore with its rounded inner end yet it is clearly a UK design. The spectacle, though separate, is linked with the blade and they function together. Though a traditional signal it is still in use in UK, WA, VR (A), and NZR.

Partially-integrated semaphores, are designated by .46. The lamp unit is separate from the blade but because of an opening in the blade the halt indication is visible through that opening. This signal, in several variations, is found in SJ, VR, JZ, and MAV.

The blade/lamp separate type of semaphore, .46, is the most common form on the continent of Europe. The Germanic form is the most significant of the BLS. Other forms include semaphores with ends similar to those of the Anglo-American model. RENFE and SNCF, in fact, employ-ed signals very similar to US-UK models except for separ-ating lamps and blades. The final models are of Belgium provenance.

The .47 designation includes several miscellaneous types of limited circulation semaphore signals. A special type, termed the “propeller arm” (.470) by this compiler, is attached to the signal mast at the midpoint of the blade. It is associated with German usage and can modify another signal such as a signal board. It is smaller than the regular form and is pointed at one end. The .471 refers to the FS “Accoppiati” or double semaphore which contains two blades and lamp units in tandem; the older US train order signal was a double signal though of different design and significance. CZD maintains a signal (.472) which is a rectangle signal in lattice work design with an opening in the blade for the lamp unit.

The shapes (.48) are common and in use by a variety of systems but the color patterns are quite diverse and shape alone ignores a vital dimension. They include disc, diamond and square forms.

The .49 designation for Signal Boards includes hinged and stationary forms. They include hinged forms and a single stationary type in a diamond-shape.

523 and 524

This segment, .5, includes the three sections of 523. All of these signals incorporate a principle of motion either of moving arms or rotating discs and all of the signals are revolving.

Dwarf semaphores, .50 seem to be found only among Anglo-American systems. They resemble full forms in color and blade shapes though physically they are frequently very different in appearance. The illustrations in 2B2 offer three forms of this signal. The variant classification is very brief with only two signals listed; both are full-integrated, one UQ and one LQ. The previous segment on full-sized semaphores can supply details for those signals.

Rotating discs (.51) are in three forms; the first (.520) consists of one to three openings in the face of the signal lamps (a variations of this has a partial disc). There is a single lamp mechanism for the signal. The second is indirectly lighted: a light unit shines onto the face of the signal and acts as substitute daylight. The final form is a disc-shaped signal encompassing a movable arm within a glass case. Composite discs (.52) includes two rare signals. One form is a disc-

semaphore that consists of a short arm attached to a disc and the pillar-disc. The disc-semaphore acts much as any standard disc signal. The pillar-disc may be extinct though possibly there is a current use.

Partially-Lighted Signals: Revolving Signals, 524, contains two segments: .6 Revolving Disc & Enclosed Graphic Symbols and .7 Open Graphic Symbols (Targets). There are two-digit forms but no three-digit forms in this edition. Revolving Discs (.64) and Enclosed Graphic symbols (.65) are the only components of .6. Rotating discs are U.K. derivative signals. Other forms are fully-revolving, panel signals, and a final version that combines rectangles and discs.

Enclosed graphic and geometric signals (.65) are generally found on the European continent (with the previously described exception), and, to a reduced degree, systems influenced by European ideas. These signals are largely found at switches though these signals may carry out other functions. They are divided into rectangles, circles and arrows. These signals can be seen (judging by various signal codes) in daylight without lighted lamps.

Open graphic/geometric signals (.7) also includes unlighted targets. This portion of the classification presents a complex situation. Instead of a few models, a veritable forest of symbols has sprung up. Several systems employ these signals (including JNR, ANR, FNC) but the bulk of these designs are US (and North America in general). In all likelihood few American railways utilized more than a few models. This active phenomena is created through historical developments and many different railways in operations.

Many of these signals have numbers not names for identification. An attempt was made by this compiler to apply appropriate terms to the signals in order to identify and distinguish among them.

“Mask” forms are the most common form (.70). Some masks have distinctive shapes while others vary only modestly from adjoining models. But all extant versions were included. Arrows (.71), display considerable diversity and probably only a sampling of possible design is here included. Oval, rectangle and obround shapes are more limited in design variations but display enough diversity to warrant their own segments (.72, .73, .74). Miscellaneous shapes (.75) brings together at least a sampling of more unusual and less-used forms.

53 Unlighted Signs, Markings, Signals

This coverage is diverse and complex. Basic forms are in the general classification for more elementary levels. 533 Signs include a .1 Speed Signs because of diversity while .2 includes a single category without subdivisions. .10 indicates restriction announcement while .12. includes ending of those messages. .12 includes diverse categories of restrictions through a battery of forms.

534 Markings include .3 Pillars, Petites, Board & Sign-like Objects. Three-digit forms are attached to each of the two-digit terms.

535 Movable Signals category was not in the first edition. The segment of .4 Movable Signals includes .40 Staff, Ticket,

Tablet & Token Forms, and .41 Train Order & Time Interval. Each include three-digit terms.

56 Multi-message Railway Aids.

This category was also absent from the older edition. The devices include 562 Lighted/Unlighted Devices under the heading of Barriers and Gates, 5621. Under .1 are two segments: .10 Lighted LC/GC Signals and .11 Barriers & Gates. Acoustic signals may be included.

Notes

The original classification system of the 1991 study has been altered in the three editions of a separate classification system for all T-M study. Two changes are described in the following notes.

The original classification for the railway study (1991) included one, two, three digits throughout the structure. The three editions of the classification system have included three digits when required. The universal use of three digits were only in the 1991 study.

The original study included a single numerical structure beginning with .1. That numerical structure was altered for the classification monographs. Fully-lighted and partially-lighted forms continued a single format but unlighted signs, markings, signals (and also movable forms and multi-message aids) initiated a separate single digit format.

CHAPTER THREE

COLORS AND MEANINGS

3A Toward Basic Principles in Signalling

A1 Meaning of Colors in Railway Signalling

There are seven principal railway signal colors. This number was determined with the aid of NBS incorporating the work of CIE (Breckenridge 1964, 1967), the practices of numerous railways, and the publications of railways and other groups. Signal colors include the universally recognized ones of green, yellow, and red. They also include the less frequently utilized ones of white, and lunar white, and the infrequently used colors of purple and blue. The “colors” of orange, amber and violet are not actual color hues; this matter is discussed in Chapter 3B3.

Colors and meanings are examined from three perspectives for this study: a) whether or not the meaning ascribed to a color is intrinsic to that color; b) the use of colors in various railways; and c) color usage in partially light and unlighted signals, signs and markings. Some overlap may occur in this tri-part approach.

Each of the colors is visually different from all other colors. However, color meanings are not distributed solely by the meanings ascribed to the color hues; other factors can determine meanings. It is possible to speak of two levels for types of meanings in signal color usage. Type I refers to color hues that have intrinsic meaning while Type II includes those colors generally receiving meaning from external factors.

Green, yellow, and red are among those hues with specific meanings intrinsic to them, and which are employed on a universal basis. Green, whether in railway usage or in other transportation modes, indicates proceed (or go or line clear); red indicates stop or halt; yellow supplies a meaning of caution. Various terms, such as proceed and halt, can be replaced by other terms but the significance of the message remains constant. Yellow has a more complex meaning structures within railway usage.

A report of the “Three-Position Signal Committee” to the IRSE in 1924 provides a workable summary, despite the intervention of 65 years, of the various meanings of caution:

- a) “proceed cautiously.”
- b) “next signal is at ‘danger’.”
- c) “be prepared to stop at next signal.”
- d) “line clear’ for braking distance ahead.”

(Nock 1962, 63ff; 1971).

The committee favored (c) though all of these meanings of caution, and other nuanced versions, are in use; a complex system such as that of AAR provides variant forms of most of them. Ultimately yellow, no matter how the message significance is formulated, means a readily understood message of caution or of restriction. It is true that meanings attached to green offer some variant meanings but the range of possible meanings is narrow and green presents a substantially straightforward message.

The uses of blue and purple represent a complex matter. Those colors may have intrinsic meanings but only in a few systems and those few systems may not be in agreement. A possible degree of intrinsic meaning and one that is sometimes shared may exist but the evidence is too scanty to say more

than that. Purple has been used as a substitute for green in situations where green on a secondary line is near a mainline signal displaying green; that is a role also performed by white.

In meaning structure Type II, the meaning of the color is not found in the color itself but is imparted to the color by an outside factor; this does not preclude color from having both intrinsic and extrinsic meaning formulations. In many instances a signal manifesting a Type II function is some form of position-light signal; some color-position signals may also be represented.

In some instances (Type IIa) the color serves as a substitute for semaphore arms; for example, in the US position-light signals display amber (yellow) indications but in this instance the yellow does not represent a caution message but rather the “arms” of a semaphore signal (General Railway Signal 1925; also Kopp 1987, L. A. Provenzano, 8-14).

In a second form (Type IIb) the color - often times white or lunar white - serves to illuminate graphic or geometric-shaped symbols at points/switches or at route/junction indicators. At many of these signals black serves as a boundary or background color for the white symbols.

In a third situation white or lunar white is combined with a standard color. These indications are frequently for shunting signals. This creates a color-position signal and may suggest a Type I signal since the white acts as a substitute for green (and eliminates confusion with a mainline signal) and the standard color indicates halt. But the signal is also a position type of indication and thereby suggests a semaphore

arms as well as intrinsic messages. Type IIc can be viewed as a composite signal.

The following six segments of Ch 3A may appear uneven. This unevenness is caused by the nature of signaling systems and their degree of complexity. Those signals that are simple are explained here in their entirety. But only the salient features of more complex systems are reviewed here; details of those systems are included in Appendix (Appendix includes a more detailed summary of all “A” and “B” class systems).

3A2 IUR Principles

The International Union of Railways (IUR) in the 1950s and 1960s attempted a union-wide system of signals. But because the existing signal systems “were too well established” the attempted overarching system was not successful (Smith 1986, 2-25). The IUR was able to introduce basic principles or guidelines. These were based on past efforts as well as a response to newer needs. The IUR signal principles suggest a body of common understanding even if an actual system was not possible. But they provide guidelines for expanding or making changes in existing systems and as a foundation for new systems. The research arm of IUR notes that it is more possible and necessary to create international signaling for new high speed trains (Smith 1986, 2-25).

The principles include these points: the color green indicates that the track section beyond the signal is open; a train can travel at the highest approved speed for that section (IUR/UIC 732R 1-1-1961) and following material unless otherwise noted). Yellow “indicates a warning to stop;”

presumably this can be equated with a caution signal. IUR recommends a preliminary warning signal for “the future system of signalling.” (Preliminary caution/warning signals exist and date back to UK in 1922-24 (K&W 1963, 12; also Nock 1962, 70-1). This second yellow is in operation in several systems including that of Portugal (CP 1981, 19). Red, of course, means to stop. IUR also includes a “permissive stop” which indicates a “permissive stop” which indicates the train crew is to “stop then proceed with caution.” This can be noted by a sign or by a marker lamp (some systems, including France and Canada, may confuse the issue by requiring two red lamps absolute stop and one for permissive; the reverse procedures might be closer to UIC/IUR guideline) (BOTC 1961, 115 [Canada]; SNCF 1981). An earlier IUR publication regarded red as either permissive or absolute; the current practice is that of the more recent guidelines (UIC/IUR 733-R 1951 (1)).

Some systems, including those of Canada and the US, describe speeds in word values with an accompanying color indication. But if speeds are expressed according to mile/kilometer values there is less confusion and an increase in natural qualities and some reduction in arbitrariness (see semiotic coverage in Ch 2A (BOTC 1961[Canada], AAR 1965). The second approach is described by Mashour (1974, 34) and is reflected in a further principle of UIC/IUR: Speed-1 (30/40 km/h); Speed-2 (60/70km/h); Speed-3 (90/100km/h); Speed-4 (120km/h). Speed indications in practice can be indicated by lights or other symbols. A green/yellow light combination is frequently used for a lower speed and a double green for a high rate of speed UIC/IUR 732 R, 1-1-61).

A third IUR publication (IUR 735-1, 1951 (2))

describes two forms of signalling: speed and directional. IUR expressed a preference for speed signalling over directional though directional would be employed at the juncture of two principal lines. UK is an example of heavy usage of route and junction signals while the US and Canada are advocates of speed signaling even in complex situations of heavily-used tracks (Armstrong 1957, 19-20).

3A3 The OSShD System

A first examination of the Organization for Cooperation of Railways (OSShD 1962 and paragraph) suggests complexity. While there are a variety of stages in that system it does follow a logical pattern based on incremental development that manifests some simplicity upon further examination. The system remains abstract concept until implementation which some member-states (including DR, CSD, MAV, CFR and PKP) have done though with modifications. The system has the potential to respond to more situations than probably any rail system would encounter. It provides for a range of speeds from 40km/h to 160km/h (and possibly beyond that), as well as halt.

The system is predicated on green and yellow lights; red is found only with halt indications in contrast to the North American system. Green and yellow signals can be either flashing or steady (fixed); flashing signals can be either rapid flashing or slower flashing. Green and yellow are separated for some indications though much of the time they are combined in varying configurations. Light strips (Streifen-Indikatoren), comprised of small signal lamps in a horizontal row, frequently accompany the main signal lamps and thereby increases the range of possible messages.

The system employs speed values not word values. OSShd follows or parallels IUR in speed designations by designating speeds of 120, 90, 60, and 40 km/h. "Vmax" or maximum velocity is sometimes specified as 160km/h. (OSShD 1962). PKP and DR have a modified version of this: speeds of 100, 60, and 40 km/ with a Vmax which may be 160km/h. A possible added speed of 30km/h appears to be a speed for some situations for PKP and DR.

The Appendix provides details on the workings of OSShD and variations of it. There are also elements in OSShD of pre-existing signals. These appear to follow older German practices (Smith 1987, 7-10). Diverse names and acronyms for this organisation are also reviewed in the OSShD coverage in the Appendix.

3A4 British Signals Practice

British signal practice has influenced rail signal systems - empire, commonwealth and others - throughout the world. Modern and complex systems have been substantially affected by long-established UK principles and practices. This segment on UK practices is brief which may belie the importance of UK contributions; brevity is engendered by the succinctness of these seminal concepts not by any marginality of import. Modern UK practice is summed up in Appendix and only partially reflects the formative period (see Nock 1962, K&W 1963 [UK], and Chapter 2B).

British signals in the later nineteenth century are quite simple. Only two colors were in use (at least for mainline functions): red and green (K&W 1963 [UK], and other sources survey UK history). Two-position semaphores signals include the somersault, an upper quadrant signal, and the more common lower quadrant. Home (later termed stop) signals had square-ended arms and the distant (caution) signal was fish-tailed (or dovetailed). Red served as a caution indication for the distant signal, and as a stop signal for the home signal. After 1919 yellow replaced red in distant signal lamps and, at some point, arms for these signals became yellow with a black chevron (K&W 1963, 12).

Some present day systems (to judge by signal codes) continue the older UK practice of red for the arms of distant signals: Argentina, New South Wales and possibly South Africa; however, they all employ yellow signal lamps (EFEA 1958, 106-107; NSW, S.I 1969; SAR 1936). Other UK-influenced systems changed the color of the arms from red to yellow:

(Western Australia, Queensland, and Victoria (WA 1974, 470; QR, F.S., V.R.(A).

3A5 Signal System of Canada and the US

The US and Canada can be said to possess one signal system because of the many points of commonality in their signal codes. Portions of the signal code aspects and indications are also found in several systems in the Americas and in Australia. Because of the many common features it may seem a simple matter to review these signals; however, the substantial similarity is occasionally skewed by differences, and a review of Canadian and US signals can be a complicated matter.

The Canadian Uniform Code of Operating Rules (UCOR) (BOTC 1961 except other sources in paragraph), and the Association of American Railroad Standard Code of Operating Rules (SCOR) (AAR 1965 excepted where noted for joint BOTC and AAR). The numbering and content of rules is similar: both codes begin with Rule #281 (for clear signals) and end with #293 (stop signals). But the US pattern has several rules or sub-rules lacking in Canada, and Canada has some that are not found in the US; one shared rule number contains divergent contents.

Despite differences an overview of the two systems in tandem is possible. However, if such a review follows the rule in sequence an anomaly becomes evident: the color pattern breaks down and contradictory groups of color indications are placed together. The Canadian National Railway (CNR) [Canada] offers an alternative pattern that ignores numbers but preserves color patterns and categories of

indications (CNR 1975 [Canada]). CNR has arranged signal indications into categories of clear signals, approach signals in which the speed indication comes before the word approach, and stop signals.

This method creates a coordinated color pattern: the left-hand side - or clear segment - contains signals with green and green/red signal lights; the second segment contains signals with yellow and yellow/red lights; the third with yellow/green and some yellow/green/red and the fourth, those containing red-only messages (though plates with qualifying messages may be present in some situations).

In essence, UCOR and SCOR display simple messages; green indicates clear, yellow indicates approach (caution) and red means halt (with qualifications in Canada). But many signals are multi-position and this creates more complex messages; for example, a red lamp may be found with a clear indication: the top signal lamp will be green but a second and third lamp will be green but a second and third lamp can be red without altering the clear meaning. A red/green indication is in the clear category but has a more restrictive character. A “medium clear signal” (RGR) requires a train crew to proceed at the medium speed while traversing turnouts or while within an interlocking arrangement; RRG is yet more restrictive.

Approach signals are Y or YR. Y before R is less restrictive while R before Y indicates greater restriction. Nearly all are prefixed with a “be prepared to xxxx at the next signal.” Approach/speed signals are YG and sometimes YGR and lack the “be prepared” preface. Stop signals exhibit more complexity than the simple word may indicate.

In the US the stop signal has one, two, or three lights for an absolute stop. The Canadian absolute stop requires two lamps; Canada single aspect red lights and staggered two-aspect lamps are permissive stop or stop and proceed signal. There are also grade, and station protection variant forms of the stop signal. Appendix II provides further details and a chart for Canada and the US.

3A6 Continental European Signal Practices

An examination of European signal codes reveals some commonality among older signals. Yet there is no European signal system nor has there been one. According to W.R. Smith of IUR-ORE in Utrecht (Smith 1987, 7-10), and after consultation with other experts, the older signals are from the early of the century during which time Germany occupied a very strong position in signal design and manufacture. Despite new models, a considerable portion of the older signals remain in service.

The types of signals that share a common origin include formsignals (central European type of semaphore), switch/point indicators (weichensignals), shunting signals and signal boards. There are several models of the formsignal in service; the German form consists of an arm with a circular end; the arm and disc are white in color with a red border (see OBB, DR, DB, PKP and other codes). The lamp units, as is true of many European signals, are separate from the arm. Many signals, are separate from the arm. Many signals have one of these characteristics but seemingly only the Germanic form has both.

All systems have switch/point indicators but the German form is distinctive in housing shape, and in the use of arrows and other symbols. They are found in the Germanies, adjoining nations, possibly Spain and Portugal, and some non-European states (DB, RENFE, CP). A final area of German influence is that of the signal board. This signal is hinged in the middle so that when not upright the board lies flat and is therefore not visible to the train crew. There is a second form of the signal board which is found in some systems. The second form is of one board on a pivot so that when it is in a parallel position to the track it denotes the proceed indication (or "blind edge"). This form is shared among several western and south-western European systems including France, Portugal and Spain, and some common origins may be present (SNCF, RENFE, CP). The Dutch Klapbord (Op de Rails 1985, 68) though bearing some resemblance to the Germanic form, can be seen as a separate marking (NS 1978, 46, 58).

Despite the lack of an agreed upon system of signals, there are considerable similarities among some older forms of signals in Europe and especially so in central and eastern Europe. The newer IUR principles for signal indications probably foster at least partial adherence in European systems.

There are also some forms of signs that are common throughout Europe. The most notable form is that of electric traction signs. These signs denote various operations of such trains and share common graphic symbols. The signs vary in colors but are strikingly similar in most respects. Approach boards, a non-sign marking, are also a common feature of various systems. These boards, subject to national variations, are often multiple in number, stripe and denote a specified

number of meters to an approach signal. Speed restriction station signs may bear some similarity to one another though there is not enough to suggest a common origin; the nature of sign functions can dictate similar signs without common origins.

3A7 The Union of African Railways Signal System

The Union of African Railways (UAR) has substantially completed a signal system for its member states (UAR 1981 and paragraphs). The system is operational and constitutes a code rather than general guidelines. This code is on two-levels: traditional practices -- based on French and UK practices -- and an all-lighted signal system. The UAR code incorporates existing practices, and thereby makes official and orderly notions of a more limited provenance available to a larger realm.

The mechanical signals of UAR may seem out of place in a new code but as long as such signals are in use they form part of any signal code. The UAR semaphores and signal boards include African systems with a French heritage or British heritage. The coverage of these signals provides a comparative summary of two major approaches to signalling that transcend the specifically African milieu.

A UAR working group was established in 1980 to prepare the signal code and "preliminary UAR draft document" and was completed in the following year. By 1983 a final draft document based on the first draft was completed. This draft was adopted by the UAR Signalling and Telecommunications Committee and was to be submitted to the membership of the Union. (Note: This compiler received a copy of

that 1983 draft in 1987 but it contained no mention of approval by the member-states). The purpose of the code is to harmonize present signal systems “in anticipation of the interconnection of the railways.” The code was also intended to improve safety, increase freight capacity and save on labor costs.

The system includes fixed signals, grade (level) crossings, hand signals, acoustical signals, and temporary warning boards. The study does not consider grade and hand signals. Fixed signals include mechanical, and color-light signals, and also permanent warning boards. The last category includes speed restrictions, whistle and some miscellaneous signs.

The French railways in Europe have historically placed importance on signals at stations and limited significance for signals away from stations (Allen 1982, 146-147). English signals, though found at stations, are more abundant away from stations. However, an emphasis on signals at stations is found in UAR for both English and French approaches. It may be noted that early signalling in English-speaking areas of East Africa also placed importance on signals at stations (Hammond 1964, 74). It should be noted that older signals are often near stations because of the manual nature of earlier signals (McLean 1990, 7-03).

There are two main mechanical forms for UAR: the station protection signal (comparable to a home signal), and the warning signal. The French form for station protection station form for station protection consists of two-sided signal boards with a red/white check pattern on a square board (perpendicular to the track) for the warning indication, and a solid green pattern (parallel to the tracks) for the

proceed at reduced speeds indication (SNCF). In Europe proceed indications in signal boards manifest a blind edge but UAR provides a positive proceed marking (though RAN follows the French practice of a blind edge) (RAN 1984). The English style signal is an upper quadrant semaphore (red arm with white stripe and three roundels). The horizontal position indicates stop, the 45 degree position, caution, and the vertical denotes proceed.

The warning signal for the French signal is a yellow diamond in a fixed position and located 1000m from the station protection signal. The English signal is a semaphore with yellow arm, dovetail-end and black stripe. It too is 1000m from the station. This signal has two roundels indicating either a message of caution or proceed. (SNCF).

Color-light signals for UAR are unified. The messages are the commonly accepted ones of green for line clear, yellow for caution and red for stop. A flashing red light indicates that a train is on a siding and should stop at the station according to standard procedures. A white lighted, fixed or flashing indicates caution. Any flashing light, yellow or green, denotes a less restrictive pattern. (UAR 1983).

3B Color Usage in Signals, Signs and Markings

3B1 Basic Colors

Green can be regarded as an ubiquitous signal color though of more recent vintage than red. White, rather than green, served as a proceed color for much of the nineteenth century and for some rail systems into the twentieth century (AAR 1953, 73). The French firm of Chappe Brothers established green as a caution signal in 1841; English railways selected green as the official proceed color in 1893 (AAR 1953, 73; K&W 1963, 10 [UK]). US railways did not follow until 1906 (AAR 1953, 73). Despite divergent meanings in the nineteenth century, green now has a clear and universal meaning for railways and other transportation modes.

Secondary colors have a limited or specialized range of uses. This is not the case with green which can be found with mainline signals, on sidings, in train yards, controlling shunting and other functions (secondary color usage reduces the frequency of green for specialized functions but does not eliminate it). For many systems, including those of the Americas and UK-influenced systems, green is frequently a fixed and single-lamp signal. But in Europe much more diversity is found: doubles, triples, flashing green (both slower and faster versions) signals are relatively common. While no one system has all varieties, the full company of forms will be found within Europe. Double greens are found in systems from Canada to Pakistan (BOTC 1961[Canada]; PR T-A S and M-A C-LS). Multiple greens are found in more complex configurations rather than basic message forms. Fixed multiple greens

are not confined to the OSShD system; for example, Sweden is a frequent user of those forms of green (OSShD 1962; SJ 1979, 19, 22). Some use of flashing signals is found in the Americas; for example, they are in use in the Conrail system (McKnight 1990, July 15).

The color green in essence means proceed. The various nuances and qualifications indicate differences in degree of maximum speeds; the essential message remains constants.

Red has a longer history in its essential message of halt/danger than the messages associated with any other color. Volume I, Part A of this series provides information on the background of red. Early railway usage of red closely follows present day usage. It is a general purpose color fulfilling many functions (red, like green, is sometimes reduced - if not eliminated - for specialized roles). Red is less often affected by variant indications than green or yellow. Halt is most often signified by a signal and fixed red lamp. France and Canada use a double red for an absolute stop with single red for permissive stop or other variation. Flashing red can convey several meanings including that of deferred stop (BOTC 1961, 115 [Canada]; SNCF 1981). Some Australian systems also employ a form of double red for stop indications (McLean 1990, 7-03). Brazil has “stop and proceed at restricted speed prepared to stop” (RFFSA 1965).

Yellow with its ascribed meaning of caution is a more recent signal indication than green with its assigned meaning of proceed. Earlier uses of yellow for caution appear to be in the US (AAR 1953, 73), and South Africa (Starkey 1944, 49).

The word “caution” encapsulates the meaning of yellow though frequently some other word is employed to convey that meaning. France speaks of “avertissement” (warning) (SNCF 1981); Spain of “anuncio de parada” (announcement of stop) and Portugal, “precaucao” (precaution) (RENFE 1978, 1-9; CP 1981, 19). Brazil, a second Portuguese-language system employs “limitado” (limited) (RFFSA 1960), and an American Spanish-language system, Argentina, has “precaucion” (precaution) which is employed by other systems in the same language (EFFA 1958, 110). German-language usage includes “Langsamfahrt” (slow) (DB 1981, 19). UK simply calls it a caution signal, and South Africa offers the variant, “proceed with caution” (K&W 1963, 52; SAR 1964, 16). The US and Canada operate a variety of cautionary signals and all contain the word “approach” (BOTC 1961; AAR 1965). IUR describes yellow as indicating “a warning to stop” (at the next halt signal presumably) (IUR 1951-2). Frequently the caution message indicates “proceed but be prepared to stop at the next signal” though variant wording may be employed. Flashing yellow uses include proceed-limited in Brazil (RFFSA 1960), and “decelerated advance in hump signals for China (CR 1989). Despite uncertainty about terminology the meaning of yellow, in operational usage, is relatively uniform though less so than that of red or green.

The common form of yellow signal is that of single and steady (one lamp unit in a fixed pattern). Double yellow for a preliminary caution is recommended by IUR and presumably this has influenced the increased usage of it (IUR 1961). Double yellow can have variant meanings include upcoming divergent route in Taiwan; (TRA 1989)), and in Bangladesh (BR 1989). China has a similar use of yellow (CR 1989). European systems, UK-influenced systems and a variety

of Third World nations have double yellows for preliminary caution. Some flashing yellows are in use; OSShD is a notable user of such signals (OSShD 1962; see Appendix II). DB employs a triple yellow but only in a very specialized role (DB 1981, 32a). Double yellow in India indicates “proceed, pass the next signal at restricted speed.” (IR, 7).

3B2 Signal Colors: Combinations

Combinations of colors and their meanings in railways is problematical. It is difficult to write succinctly about the meaning of signal colors for the various systems, and combinations are much more of a problem. A comprehensive coverage of the subject would require examination of individual codes; hopefully a brief treatment will provide some notion of combination signals. Appendix provides details on signals for larger systems.

While there is a broad range of color combinations only a few forms are recurring: GY, YR and GR being the most important. Less frequent combinations include GW, RW, and YW; white provides a common denominator. The complexity of combinations is increased by a dual character: GR can also be RG, and GY can be YG. The order of signal colors can increase or decrease the restrictive (or non-restrictive) degree of signal indications, as in the US and in Canada.

A general “rule” about color combinations might take this form: the upper color of such a combination is the dominant or at least more important of the colors that are present. The lower color, though secondary, is a modifying agent of the upper hue. For example, a YR (yellow over red) combination is cautionary with a tendency toward some restriction.

A RY (red over yellow) tends towards restriction though somewhat reduced because of the cautionary modifier; R over G would decrease the proceed character of the indication, Y over G increases the cautionary status of a proceed indication.

GY (and YG) represent the most common color combinations with nearly one-half of the systems containing a form of G and Y. The restrictive character of GY/YG is less than Y or YR. It is the only combination common in Europe: both OSShD and Western European systems frequently employ GY. It is present in African, Asian and American systems (including those of Canada and the US). A typical GY pattern is that of Austria where it signifies a maximum speed of 40km/h (single G indicates simply “Frei” or proceed; two greens permit 60km/h (ÖBB 1979, 15). There are many forms of GY in OSShD including GY (40km/h), GFF/Y (40km/h to 120km/h) and GFF/Y and one Y strip (60km/h to 120km/h) (OSShD 1962).

GR (and RG) are employed by less than one in four systems. Only a small number of European systems display this aspect. A variety of English-speaking nations use these aspects (KR, PR, NSW among others). It also is found with several larger Western Hemisphere nations. GR indicates clear in a complex system, with multiple signals, while RG denotes a clear signal with a degree of restriction. Brazil, for example, employs both G and GR for maximum speed while RG indicates limited speed (RFFSA).

YR (and RY) are found with a similar range of nations, and more European systems than was the case with GR. Australian National Railways (employing the former South

Australian code) mirrors a common usage for YR/RY aspects: YR calls for a cautionary response by the train crew and at normal speed; RY is a cautionary message at the medium speed; and the more restrictive RRY requires the train crew to proceed at low speed (shunting) ANR 1947, 109-110, 112). RY indicates proceed at slow speed at selected divergent routes for Taiwan (TRA 1989). A more singular variant is the Y/FLR indication of Denmark that denotes stop and then go slowly (DSB 1985, 34-3).

Canada and US signals are complex because of many aspects and indications. Some of these indications are also found in Asia, Australia, and other parts of the Americas. Appendix II provides a review of these signals. In brief, clear has four levels: basic clear, limited-, medium- and slow-clear. In nearly all instances, G precedes R for basic level, and R precedes G for qualified forms. Three-aspect signals add an additional G or R (BOTC 1961, AAR 1965 and paragraph). The second category includes approach-limited, -medium, and -slow signals. These are marked by YG or GY indications; three-aspect approach signals include R. Limited-, medium-, and slow-approach signals manifest some form of YR or RY; restricting signals also follow this pattern. Two US advance-approach signals also are YR/RY.

Some systems combine a regular signal color with a special color (blue, purple, white, lunar white). Many examples are found in Europe; for example Portugal employs blue and red for one form of permissive stop, and Poland uses white and red for shunting (CP 1981, 19; PKP 1975, 197-198). Frequently these combinations are for specialized purposes. For example, UK and Australian systems

frequently combine white and red in shunting signals (K&W 1963 [UK]; see also various Australian signal codes). Zimbabwe combines white and yellow as well as red for shunting work (AJCR Thompson 1987, NRZ). The use of white reduces the possibility of confusing a shunting signal with a mainline one. There are other instances when a special color and a regular color have mainline significance; for example, Portugal employs lunar white and red to indicate a permissive stop as well as for shunt signals (CP 1981, 19). At times blue is combined with red for shunting (RENFE 1-10). White is found with red in Belgium for various authorized movements (SNCB 1967, 37). China employs lunar white with blue for shunting, and red and lunar white for call-on signal indication (CR, Hu Tang Guang, Xian 4-4-1989).

The use of special colors for non-mainline roles (and the use of special colors as qualifiers of mainline signal indications) are sometimes joined by full participation of special colors in mainline signals in some systems. This is very much in evidence in the Netherlands where white constitutes a fourth regular color (contrary to other systems) for color-light signals. White is utilized as much as green, and is found in combination with both yellow and green. Examples of such messages include WWY indicating the next signal will be red, and GWW indicating maximum speed on main line. GWG indicates next signal at WWG and divergent line open at 45 km/h. (NS 1975-83, 22, 23; also Signal Patterns 1952).

3B3 Less-Used Colors

G, Y, and R, though the most prominent railway signal colors are not the only colors as has been noted. The secondary colors include blue, purple, lunar white and white.

Some systems employ all of them, others employ none. It may appear that at least three other colors exist but they can be regarded as chimeras: violet, amber and orange.

In US railway literature there are references to both yellow and amber. One signal manufacturer, for example, states that position-light signals use amber glass (General Railway Signal 1925, 57). But color documents do not include any amber hue. According to Kopp Glass, the color amber is actually the term in use for the yellow hue employed by railways. It is a “less saturated yellow” than that found with other transportation markings (Kopp 1987, 8-14). It appears to correspond to the “restricted signal yellow” of the US Bureau of Standards and allied agencies (Breckinridge 1964, 27). Robert McKnight (McKnight 1990, 7-15) notes that amber is the hue employed for position-light signals and yellow for caution indications and this conforms which assign yellow to color-light signals and amber to position-light signals. Though Conrail (former Pennsylvania Railroad) gives the same hue for both color-light and position-light (Conrail 1985). Brigano refers to the invention of the position-light signal and its “lightly-tinted” character (Brigano 1981, 141). Vietnam has employed a yellow-orange hue which may be within the yellow spectrum (UN-TAAEC 1954, 23).

Violet also represents an area of possible confusion. Several Western Hemisphere and Australian systems include purple in their signal codes while some European systems include a color often mention both purple and violet but more technical works focus on purple. Spanish and Portuguese signal codes include violet though both languages include words for purple and for violet (RENFE 1978, 1-10; CP 1981, 19). The two colors - if they represent two colors - are similar in

appearance. Purple (and/or violet) are restricted to specialized functions which often include derail and shunt/switch functions; Spain, however, makes more extensive use of the color as a stop signal in various situations. (RENFE 1978, 1-10). Several European systems use it to designate permissive stops (ETR 1952). New Zealand, however, employs it in lieu of green at points to designate proceed for the principal line (NZR 1989, 118-119). The US marks derails with that color (Hayes, 1971, 854-855); however the latest publications of color standards omits purple as an official color (AAR 1974, 3).

Orange in SBB is within the yellow spectrum according to that railway system. However, SBB also employ yellow under the name of yellow (SBB). Blue is an infrequently employed color. Several European systems use it to designate permissive stops (ETR 1952). The US uses blue flags and lights to denote rail workers in close proximity to rolling stock (McKnight 1990). Spain employs it extensively for directional signals, both lighted and semaphore versions, and blue accompanies many red stop indications (RENFE 1978, 1-10, 1-19). Portugal employs both blue and flashing blue for specialized uses; fixed is employed for permissive stops and directional indications (CP 1981, 19, 44, 50).

White is a relatively common color with at least 15 rail systems using it. In Europe it often is used for points/switch indications (see Ch 4B5 for the role of white in alpha-numeric signals). US, Argentina and Mexico employ white for position-light signals (EFEA 1958, 113; FNM, 263; GRS 1925, 60). Japan applies white to a variety of signal functions (JNR 2-5, 2-6). Finland employs flashing white for distant signals (VR 1976, 1984). White is also used for backlight in

various systems including Pakistan and New Zealand (NZR 1989, 108).

Lunar white (or blue-white) is relatively common in UK and UK-derived/influenced systems; it is also found in some American railways (Breckinridge 1967, 35). It is used with point indicators and route/junction signals. In the US it is employed with color-position signals (US B&O 1953). The Netherlands uses a “melkwit” or milk-white color which appears to be lunar white (NS 1978, 60). In China lunar white is used for shunting (CR, Guang 1989). This color is also discussed in Chapter 31B5.

3B4 Color Usage in Combination with Non-Color Symbols

This segment includes fully-lighted, partially-lighted signals, signs and markings. Some discussion of color is also found with treatments of messages. Color in these situations can have one of two forms: color as a message indication in its own right, and color primarily as an instrument of contrast with an essentially non-color message. For example, a white arrow on a black background provides contrast instead of white having intrinsic value in its own right. Of course color can have value in itself as well as provide contrast.

All railway colors are in use for markings displaying geometric and graphic symbols. White and lunar white are probably the most important colors for fully- and partially-lighted signals that include such symbols. UK and UK-influenced systems, the US and the Netherlands all employ lunar white; those systems using regular white are more common.

Railway signs do not follow a color code as is the case with road signs. However, some patterns of usage exist. White is the most common sign color. In some instances it serves as the specific symbol while in other cases as a background color. Few signs altogether lack white. Black is also a commonly used color. Black is sometimes a background color (RENFE and SNCF-influenced systems frequently have black backgrounds for signs) but it is more often use for specific symbols. Blue is a frequent color for electric traction signs though accompanied by other colors. The color practices of lighted signals can dictate the colors for signs. For example, some speed signs employ yellow as the main color for preliminary announcement of restrictions, and green for ending of restrictions which permit full resumption of the former speed. The color red finds limited employment for signs.

Some of the comments about color for signs can also be applied to non-sign markings. Stripes and bands are common with such devices where there is a need for a sharp contrast; such symbols are frequently white and black. White is found in combination with other colors; red is a frequent companion for white. Contrast is often a more vital goal than intrinsic meaning.

Targets of various types, both unlighted and partially-lighted often follow lighted signal practice and therefore target colors often display more intrinsic value than contrast meaning. For example, red and green are more often in use than the premier contrast hues of white and black. It would appear that the use of white on US targets is a remnant of an earlier era where white was the proceed color in place of green; in these instances white has intrinsic meaning (see Ch 1B).

Fully-lighted graphic, geometric, and alphanumeric color usage is very much one of contrast with white symbols and black backgrounds a common motif. There is some use of red and yellow for these forms for Western Australia but that application is very much an exception to the common practice (WA 498-9).

While there is only limited information on ancillary uses of color (color for signal housings, masts and so forth) it can be said that black is a common hue for these purposes and also for baffles and hoods as well. Black serves well for contrast and for reducing glare thereby increases visibility of the signal. White and “aluminum” or silver are commonplace for signal masts, bridges and ladders. It is not clear whether some systems are employing black or whether railway structures have turned black from pollution. An unusual use of color for ancillary purposes is found in Chile where spiral bands of red and black are in use on signal posts and flat bands on signal backdrops. (EFEC, 96, 106-107). This is also true in Austria where spirals of black/white/red, and gray/white/red stripes are in use on signal masts (ÖBB 1977).

CHAPTER FOUR

ALL-LIGHTED SIGNALS & MESSAGES

4A Types of Signals

4A1 Color-light Signals: Forms & Configurations

The Color-light signals have been the most common railway signal in use today. They are the only visual signals that are experiencing growth in numbers. This is in contrast with the historic semaphore and other forms. Color-light signal consists of a signal head, baffle and supporting mast or bridge; the head contains lamp units, lenses, and electronic or electro-magnetic mechanism. The basic signal form exhibits primarily green, red, and yellow lamps, and a range of messages. However, the color light signal and messages is simple only in the abstract, and basic forms. Over many years, and through the mediation of many rail systems the color-light signal has evolved and expanded into many forms and configurations. The variant classifications in Ch 4B undergirds segment of the study. Brian Solomon in his *Railroad Signaling* (2003) provides a summary of reduction of forms of signals and increase in color-light for US and probably Canada. Changes elsewhere mirror that change though with altered signal forms. Todd Sestero in his web site also describes and illustrates many signal forms that are now fading. For example, traditional semaphores remained active up to the 1970s but then declined sharply. Maintenance cost was a factor for many changes because of cost and deterioration for railway signals (Sestero 2013).

References to the beginnings of color-light signals indicates activity in the US. An AAR publication (LS & LSL 1949) suggests a shift to all-lighted forms. In all likelihood all-lighted signals became dominant and color-lights were favored through a range of designs. Short-range all-lighted color signals date back to early 21st century. Early lighted signals of that era included long-range types (1914). Searchlight signals followed in 1915, and the Color-position signals followed year (AAR 1953, 69-70).

The searchlight is a precisely aimed signal; in fact, sights are included on the signal head for that purpose. Signals are designed for left and right-hand curves as well. The signal is a more expensive unit than the standard color-light signal (Armstrong 1957, 12). The multi-lamp type may have a preference to the searchlight in some territories where special problems occur including that of track curvature (Armstrong 1957, 12). The precision of the search-light signal can be illustrated by the former usage of it by the US Coast Guard in marine ranges (General Railway Signal, 1960). Searchlight declined in the 1980s. The moving element of the device generated greater maintenance and possible failure of more expense. And color-lights mechanisms were improved. (Brian Solomon 2003, 55).

The color-light signal can be divided into two basic forms: the multi-lamp/multi-lens forms, and the single lamp/multi-lens forms. The second form is frequently termed the "Searchlight" type. In one nation (and others as well) is also known as the "single-lens" in South Africa (SAR refers to the multiple-lamp as "Multi-lens"; SAR 1964, 13). For some

sources searchlight is separated from color-light (Brian Solomon 2003, 55). The color-light has from two to five aspects or positions, though more than five are possible in some configurations. Two signal heads become necessary especially in systems where installations require more than three aspects. This is also true of the search-light signal since it is incapable of more than three aspects per unit. The searchlight has one configuration and no variants. But the multi-lamp type explodes into a verdant jungle of configurations which forms must be reviewed.

Configurations in this study do not refer to the number of lamps to be found with a given signal. Instead they refer to the arrangement of lens and lamps within a signal unit. Readers familiar with railway signals of a simple form may find this puzzling if accustomed to a signal housing that consists of a single-row pattern of perhaps three lamps; and assume that there are no other patterns. Simplicity is not always a hallmark of all railway systems. OSShD and North American are examples of complex systems. French forms of signals among European signals also display diverse and seemingly irregular colorlight forms (Les Principaux 1981; OSShD 1962).

Configurations can be divided into three principal categories: basic, modified-basic, and complex. The complex can be further divided into a standard-shaped signal head with irregular lamp arrangements, non-standard-shaped-head deploying multi-symbol patterns either within a standard configuration or a non-standard configuration. "Standard" in this study - and this may be somewhat arbitrary - refers to basic geometric shapes which are favored in most systems; patterns that are symmetrical and balanced. Special shapes are

those shapes at variance with common design forms. Standard arrangement of lamps refers to an arrangement in which the lamp follows the contour of the signal head, and most often this is a straight-line, vertical-orientated pattern. Patterns that are arranged in a seemingly random arrangement is not standard. The classification, especially variant forms, presents the range of signals both basic and special shapes. (Chapter 2B).

The basic configuration is a vertical unit with two or more lamps. The most common version has three lamps though one or two additional lamps are less commonplace. The basic model has one row of lamps which are spaced equally apart. The modified-basic configuration has undergone some change from the basic form but not a change that is a drastic reordering of design. The basic modified models include a horizontal version of the basic vertical form, and a triangular form. A somewhat more altered version contains two rows of lamps but within the basic form.

Complex configurations include more substantial changes. These can be sub-divided into three major categories. Type I contains those signals with a standard shaped head but with an irregular lamp arrangement. Lamps may be located in some areas of the signal head surface but not in other areas depending on specific needs. Lamps may have an apparent random appearance depending on the needs of the signal operation. The shape of the signal head has a simple geometric form despite the arrangement of lamps.

Type II configuration consists of those signals comprising both non-standard heads and lamp patterns. There are several forms within Type II. These include the triangular-

rectangular form which consists of five lamps in the triangular portion. A second form is the “V” pattern consisting of two rectangles positioned diagonally and joined at the base.

Type III configurations include those complex situations in which more than one kind of symbol is employed. This does not refer to marker lamps, and other adjunct lamps which are part of a given signal installation but separate from the principal head though frequently attached to the same signal mast. The diverse symbols possible with Type III include the standard circular lamp, alphanumeric signal, groupings of small lamps that can be loosely summed up as graphic symbols. All of these diverse offerings, for example, can be found in the OSShD system. Type III configurations are single signal heads rather than multiple heads. Type III may need to be further divided into IIIa and IIIb; the former contains standard signal heads and the latter, non-standard.

The previously described configurations, whether basic, or complex, refer to the essential form and not to nuanced differences. The true square, rectangle, or triangle is almost a rarity in railway signalling. Frequently one, or both ends of a rectangle have rounded ends, or at least rounded corners; squares may not have rounded sides but may have rounded corners. Other signals have the corners of the signal head or baffle “cropped” off. In yet other instances one side or end will be altered but not both. Ch 2C provides illustrations of these various features. The configurations classified in this study do not consider the size of the signals as a basic concern. But there are differences in signals and this is only partly due to the number of signal lamps. And the size of the

lamps is not a factor unless there is a very noticeable difference in lamp size. For example, signals that contain lamps that are only 12 inches in diameter (30m) are noted but those from five to eight inches or more in diameter are not separately noted as significant for the study.

4A2 Semaphoric Signals in All-Lighted Forms: Position and Color-Position Light Signals

Many or most all-lighted railway signals have been influenced by the semaphore signal. The semaphore, since it was the predecessor of the lighted signal, established the basic position for signals: horizontal for halt, vertical for proceed, diagonal for caution, and this pattern has been carried over into lighted signals. The influence of the semaphore is more evident with the position and the color-position signals. This is more true of the wayside position and color-position signals though it can have significance for specialized forms of these signals.

Confusion over matters of terminology is especially rampant with these signals. The signals are somewhat more rarified than standard color-light and semaphore signals and the definition of terms is frequently contradictory. "Position-light" and "Color-position-light" have clear meanings in the US, Argentina, and Mexico signal practice among other nations. The basic signal, that of the color-light, projects a message by color only. This means one lamp of one color or of two colors. The lamps are in set positions but the color is primary and the signal is known by color only. The true position-light signal displays messages through a single color emitted by at least two lamps. These messages follow easily perceived semaphore-derived patterns. Color-position signals

utilize both color and pattern position with two signal lamps of one color for each basic indication.

But in a number of systems a different form of position-light signal is in use. These signals contain signal lamps that are placed in an irregular pattern. This is in contrast to the US form in which precisely and easily determined patterns are to be found. Yet the variant signal is in some sense a position-light signal. This variant signal has been described by O. Lavellee who notes that the US style of color-position and position-light signals are “illuminated in horizontal, diagonal, or vertical planes” while the European models have the signal lamps arranged an irregular patter over the signal face (Lavellee 1953 (1), 9). The distant planes of the US form follow the semaphore signal pattern while the European form does not do so. In this study, the position-light signal will refer to those signals set accordingly to clearly defined planes. Other “position” light signals will be included with color-position signals. A special form of the position-light is that of the pedestal signal. This is an intermediate model employed by Conrail in place of the full-size signal in areas of limited space. The configuration of lamps is at variance with both full-size and dwarf but it does display a full-range of indications (A.C. Fisher 1990, 7-27, and Conrail 1985).

Some nations in Europe employ a true position-light signal but these are for shunting purposes, marshalling and humpyard work. This signal displays a limited number of indications and is not a mainline or primary signal. Finland is one example of this (VR, 54-56). Japan employs a variety of types of position-light signals (repeating, shunting, route indications) (JNR 2-5, 2-6, 2-7).

One other area of confusion is the use of the term “position-light” signals for what are in reality color-position lights. This is especially true in UK and UK-derived systems. These signals, frequently used for shunting purposes, often employ more than one color. Since they have contain position they are a bonfide position-type signal but to be more accurate, a color-position not position-only in form (Westinghouse Signals, Series 2000 Signals).

The complexities of all-light signals would be largely absent if the spectrum of railroad systems maintained one, or at most, a few forms of signals. Because of diverse systems a differentiation of terminology accompanied by an involved classification and nomenclature is required. The world of signaling, when seen through such a classification may project a rational and logical. However, beneath the image of a signaling system though the diversity remains and may take on an unkempt disarray. This is perhaps no more than an indication that signals stem from and are a part of human society and communication. That appearance may also indicate nothing more than these signals are discrete monads and it is only the bringing together of diverse elements which creates an image of unkemptness.

The position-light signal for mainline use, which corresponds to color-light and other trackside signal messages, uses yellow (or amber), lunar white or white lights (See AAR, FNM, and EFEA code materials). The basic signal indication closely follows the indications of the semaphore signal. Though the message indications are expressed only through lights not lights and arms. An “arm” of three lights serves the position-light signal day and night while the semaphore has separate mediums for day, and for night. A final form of the

position-light signal is found in systems employing route signalling. This form serves as an indication of route and junctions. These signals frequently use lunar white lights and may have from one to four or even five arms with the lamp units set within the arms; SAR is one example of a system employing these lights (SAR 1964, 20); many other UK-influenced systems also operate them). Pseudo-position-light signals are discussed with color-position-light signals. Position-light declined because rulebooks became standardized and the range of aspects were reduced. (Brian Solomon, 2003, 58).

The color-position signal combines color and position. There are two rows of two lamps each for the individual aspects in the mainline version. Marker lamps augment the range of possible messages. The full-size and aspect color-position signal appears to be the monopoly of the Baltimore and Ohio Railroad and affiliated lines (B & O 1953, 105ff [US]). What this compiler refers to as pseudo-position signals employ colors as well and these include red, yellow, white and lunar white (K&W, 1963, 53 [UK]).

4A3 Cab Signals: Introduction and Type

Perhaps cab signals ought to be placed with special signal forms (staff, tickets, tokens and other forms in Ch 6) rather than with regular signals because carried aboard the train. However, the message systems are often patterned after those of wayside signals and in some cases the signals are miniature versions of wayside signals, and even numerical forms which produce conventional messages though without color intermediaries and are therefore placed with the regular signals.

Information on cab signals can be limited. Some full-scale codes may not mention cab signals. Journal and trade literature may provide better information source than in signal codes. Available information is sufficient, though limited, to explain cab signal forms. Cab signal include three general forms: a) color-light signals, b) position-light signals, and c) numerical signals (which in turn includes some color indication forms).

Cab signals are frequently not “stand-alone systems.” Some are used in conjunction with wayside signals; others with some form of automatic train control or train warning systems. Since this study concentrates on signals and messages it will not focus on the subject of ATC and other related systems of train control, nor signal control impulses. There are three systems for delivering operational impulses to the signals: the continuous, the intermittent and a composite version (Frattassi 1977, 193; see also Union Switch and Signal 1984).

Major users of cab signals include the US, USSR, Japan, Germany, Italy and France. OSShD has also studied this form of signalling. With the increase of high-speed trains, especially in Europe, expansion of cab signalling may increase in significance.

4A4 Graphic, Geometric & Alphanumeric Signals

A special category of all-lighted signals are those that replace or supplement color and/or position signals with symbols: a graphic design, a geometric form, or letter/number representations. There are more individual and local practice with these signals than conventional all-color forms. Some

systems may not have any of these forms of signals while other systems have only limited numbers. Nonetheless, there is great diversity, in the uses that these signals carry out. This segment will have, if not marked brevity, at least a very provisional character.

Alphanumeric signals are of three basic forms: mechanical, the multi-lamp, and the stencil (see K&W [UK], NSW, QR, Westinghouse Brake & Signal (Aus.)). The mechanical (also known as the moving slide indicator) is an older form and associated with the semaphore signal. The letter or number to be displayed is moved into position by a moving slide, hence its name. The signal is of large proportions in comparison with other signals. It is employed as a route indicator.

The multi-lamp (or theater-type) consists of a large square signal housing containing the letters of the alphabet and many numbers (Westinghouse Brake & Signal, Aus). It provides a great measure of flexibility for preparing messages. The signal is so designed that a surface sheet of obscure glass prevents viewing of letters or numbers when a message is not intended to light up. The stencil has two forms. The larger consists of a rectangular shaped case with up to three symbols. The surface of the case is covered with obscure glass so the letter and/or numbers can not be seen unless the lamps behind the symbols are on. In a variety of cases there are two lamps for each case. There can be a series of cases in a horizontal bank or cases can be attached in a vertical manner. This form of the stencil is for route indications. A second form of stencil is frequently based on standard signal lamps and housing; this form usually has one symbol. It is used for various functions and is often found with a mainline signal. A variety of systems, often outside of Europe, use this form to denote

signals that are automatic. A variety of forms is included in DB-RR 2009, 119 ff).

Graphic and geometric signals are usually found together in codes even if some are fully-lighted and others are only partially so. This is reasonable because of the common functions they perform. But in this study fully and partially-lighted signals are divided into different groups even though this results in separated treatment. The arrangement of signals has not lost the commonality.

Dividing signals according to nature of message is an uncertain matter since all dimensions of graphic and geometric signals are virtually fused together. Limited remarks are included. Of those that are single-sided a limited number are fully-lighted. Most all-lighted are graphic rather than geometric.

Fully-lighted graphic signals are found in several Australian systems (e.g., NSW). The signal known as a double-crossing indicator is found in a variety of European systems (DB, RENFE) and is fully-lighted. All of these involve arrows and some are related to color-light signals.

4B Messages For All-lighted Signals

4B1 Introduction and Basic Messages

Various segments of this study deal with color - in both general and specific ways - and with the types of signals. Discussion of these types does not eliminate the need to review signal messages in themselves. It is also necessary to consider other topics that have direct bearing on messages.

The basic color messages are proceed (green), caution (yellow), and halt (red). Double yellow is becoming more common for a fourth message of preliminary caution. Position messages (all-lighted forms) follow those of the semaphore: horizontal for halt, 45 degrees for caution and vertical for proceed. Speed signalling as well as other factors create more complex message situations (involving additional colors, combinations of basic colors, and altered positions).

These messages are projected through signals that can be divided into searchlight or multi-lens (straight-line and vertical). There are other forms in use that display messages through variant forms; for example, the square shape of South Africa (SA 1964, 17) and the rectangular of France (Les Principaux 1981). Triangular and an elongated rectangular form are other possibilities though seemingly less often used. Ch 4B2 reviews speed signalling's impact on message configurations, the OSShD system, as well as systems with more complex configurations for essentially basic message patterns (for example, DB, DSB, and SBB). Signal systems in 4B4 are of simple patterns: a) signal housing (and layout of lamp units) is either a straight line vertical unit or a square unit that is not greatly at variance with a vertical housing, or b) a three-color

pattern (or a four-color unit with the fourth color a second yellow, and combinations made up of the basic colors such as G/Y). Searchlight signals emit all messages through one lamp unit which contains multiple-lenses. These units contain one lamp unit which can handle up to three colors. Multiple units can have from two to five lamps in a straight-line apparatus.

Traffic control signals have standardized the arrangement of the lenses: red on top then yellow then green. The arrangement of railway signals is both more complex and more uncertain. It would appear that the Anglo-American systems have standardized the order of light units and that standard is the semaphore signal; for UQ signals green is at the top then yellow then red (LQ would of course have the reverse order). Color-light, color-position and position-light signals have the same pattern. A review of signal codes from UK to South Africa to Australia to the Americas bears out this order. More complex light patterns may suggest contradictory arrangements but the basic pattern will hold up.

Variant forms of this include the SAR square-shaped signal (green in the upper left-hand corner, yellow in the upper right-hand corner and red in the lower left-hand corner), the US triangular-shaped signal (G in the upper left-hand point, Y the upper right-hand point and R in the bottom point), the US horizontal version (G on the left, Y in the middle and R on the right), and the UK cluster signal (Nock 1962, Plate 9).

The continent of Europe offers a broad range of color arrangements; these comments refer to basic three-color arrangements. If one examines formsignals - especially those of the Germanic type - it would appear that the GYR color

pattern is in use, and that may be the case during the day. But the lighted aspect of these signals presents a different image: not infrequently the lamp unit moves so the red may be above the green lamp; though of course this is only one possible version of the form signal. Color light patterns are more at variance with the Anglo-American style. FS has RYG, CP has GRY, SNCF has the same though in a square signal (G upper-right corner, R in the lower left-hand corner, Y in the lower right-hand corner), RENFE has GYR. Other systems have more singular forms of signals and it is more difficult to describe their patterns (DB 1981, 17, 19; FS 1981; SNCF, 1981; CP 1981, 22, 28; RENFE 1978, 1-13).

Other features that can alter the message projections are marker lamps. These can alter a basic message, provide the second yellow aspect, or even rank as an integral part of mainline messages (see position-light and color-position signals). Even the manner of attaching the signal unit to the mast can be part of the message system. For example, Canadian National Railway places one signal unit to the left in order to denote automatic signalling (CNR 1975 [Canada]). Flashing lights are found in some systems and these carry out a range of functions; for example, flashing red can denote a deferred stop in some systems. Denmark employs a broad range of graphic symbols that qualify all-lighted and semaphore signals; the symbols are white on black backgrounds (DSB 1984, 34ff).

4B2 Complex Message Configurations

Complex message configurations for this study are of two types. The first includes (OSShD) and speed signalling. Both approaches contain a variety of aspects which are

integrated into a single system. Such a system is well beyond a few simple signals denoting proceed, caution, and halt. The second variety includes individual railway signal systems which are complex either by the number of aspects they display or by the arrangement of signal lamps in the housing apparatus or some combination thereof. The systems include SBB, DSB, SNCB, SJ, SNCF, KR, and PNKA. Some systems are notably complex, others marginally so; DB, for example, is included in Ch 4B1 though a case for its inclusion here could be made.

OSShD (OSShD 1962) system employs three colors with red serving exclusively as a halt indication. The system in its full panopoly consists of several dozen indications employing fixed and flashing green and yellow signal lamps as well as strip lights of yellow and green. A review of this is found in Appendix. Put simply, the greater the predominance of green the more velocity is permitted while the greater the role of yellow the more restrictive is the signal aspect. The system is based entirely on speed indications of kilometer route length with a single fixed green for maximum velocity and a double fixed yellow for indication of zero velocity.

The actual working out of OSShD by member-states creates differences from the theoretical system. Poland, for example, employs moderate-sized units with searchlight signals (PKP 1975). While DR utilizes signal units of large dimensions with a variety of lamps “scattered” over the surface (DR 1971). Czechoslovakia employs a variant form akin to that of DR (CZD Ludmila 1986). The actual systems using OSShD do not make use of the full range of possible message indications.

Speed signalling (as found in North America, parts of South America, and of Australia) offers a broad spectrum of indications. Not all indications are in use by any one railway. A review of these systems is found in Appendix. Three basic colors are in use and usually these are fixed aspects. Combinations of two, or even three, basic colors, is commonplace. A simple speed system may include only one signal head but more complex versions require two. In perhaps overly simple terms, the greater the prominence of green the greater the allowed speed; while yellow - when central to an indication - calls for some measure of caution, of a slower speed requirement, and quite likely, an upcoming halt signal. Red is often combined with green and yellow and indicates a varying degree of restriction; less so with green, more with yellow.

A variety of individual systems, especially in Europe, require individual reviews. SBB (SBB 1982 and paragraph) has a two-tier system: home and distant signals. Distant signals are square in shape with five positions. Two yellow signals indicate halt for a distant signal; two green indicate proceed. Y/G allows for a maximum of 40 km/h; GG/Y allow 65 km/h in some circumstances and 60 km/h in others. Two green and one yellow (with yellow in the lower right-hand corner) permits 95 km/h in some circumstances. High home (signals range from one row of three lamps to as many as seven positions in two rows. Red of course indicates halt; one green indicates proceed. G/Y indicates a maximum speed of 40 km/h and GG allows 65 km/h in some circumstances and 60 km/h in others. A speed of 95 km/h is permitted by triple greens (and 95 km/h in other situations). YY allows a maximum of 40 km/h and denotes that the next signal is at halt.

Belgium's basic categories partially suggest those of U.K.: home signals are termed stop signals which includes halt, caution and proceed indications. Distant signals are termed warning signals. For stop indications there are two basic forms of signals: a three-position straight line unit, and an upright rectangle with a rightward triangular extension. The second unit contains lamp units for both stop and warning messages. (SNCB 1980)

Stop signal messages include one fixed red light for halt, one fixed green for proceed and two diagonal yellows for cautionary messages of an involved nature. For warning indications two diagonal yellows indicate stop. Horizontal GY indicate proceed but at a reduced speed. Vertical GY permit passage of the train within specified conditions. A single green indicates proceed without qualifications (SNCB 1980).

An interesting feature of Belgium is a group of signals intended for reverse movements. These signals are identical in message but all are flashing. In the case of the signal with the triangular rightward extrusion the signal is reversed so the extrusion is to the left.

Sweden utilizes two colors for home signals: red for halt and one/two/three greens for proceed indications: one for simple proceed, two for a maximum speed of 70 km/h, and three for a maximum speed of 40 km/h (SJ 1979). Distant signals are flashing: one for stop at next signal, two for next signal at 40 km/h, and one flashing white to indicate next signal is at proceed.

France employs a straight-line rectangle (with rounded-ends) and this signal displays the basic message aspects of

RYG; the red is singular and for SNCF that is a permissive stop signal (SNCF Principaux Signaux, and paragraph). The French system employs a variety of other signals. These include a more elongated rectangle containing red lamps for absolute stop, and a small, less elongated rectangle (longer axis horizontal plane) with two signal lamps in red. A disc shaped signal is employed to indicate a deferred stop with R and Y messages. A signal in the shape of an inverted “L” displays two yellow lights which serve as the distant signal of the speed restriction signal. Two rectangles with rounded ends and partially joined display two vertical yellow lights authorizing a maximum speed of 18.6 mph (30 km/h).

The signal system of Denmark, though of a complex nature, projects its messages through a relatively simple pattern (DSB 1986). R or YR indicate stop, a single Y denotes stop on condition, YG indicates slow, two green for go through, one green for proceed, a flashing red - or flashing red and fixed yellow - for stop and go slowly.

Indonesia’s system can be seen as an intermediate one with limited complexity (PNKA 1971). Mainline signals have a maximum of four positions and some mainline have just two. The four-positioned signals display R, G, Y and a second G. Red and green indicate stop and proceed respectively. The second G is used in conjunction with Y; in some instances the colors are YG while in others GY. It would appear that YG is slightly more restrictive and indicates movement to a second track. Y is cautionary.

South Korea has three-position signals with five aspects: RYG. There is a combination YG and a variant R aspect; one R is absolute stop while the other is a “slow

pass" indicating stop and then proceed (maximum speed of 15 km/h. Y allows for a maximum speed of 45 km/h and YG permits a speed of 60 km/h. G, of course, indicates proceed (KR 1985, 19).

4B3 Messages for Position-light and Color-position Light Signals

These signals and their messages may not appear to be very significant within the total range and numbers of all-lighted signals. But they require attention because of the special features and message systems. They are a mainline signal for only a few systems but they serve a variety of ancillary functions in a substantial number of systems. They can be considered under three headings: mainline usage, route and junction roles, and shunting and miscellaneous roles.

Position-light signals for the US, Mexico and Argentina are mainline signals and follow that pattern of messages (see codes for AAR, FNM, and EFEA). The most extensive system in message forms is that of the US. Position-light signals have four basic positions; marker lamps are employed but to a less extensive degree than with color-position signals. Position-light signals imitate semaphore arms through the use of single-color lights. White is a basic color for these lights but yellow is in use for full-size US forms. Japan has a somewhat extensive system of position-light signals but they are for more specialized functions (JNR 2-5, 2-6).

Proceed is marked by three vertical lamps. Approach-medium indicates the message by the semaphore caution position (URH/LHH axis); a three-lamp marker unit is situated below the main signal. Medium-clear partially follows

the horizontal stop position; however, this is qualified by a three-unit marker assembly below the main signal. Approach signal has the same format as that of the approach medium but without the marker lamps. Caution is marked by three lamps on an URH/LLH axis). Permissive indications follows that of the caution signal except that the marker assembly is on the reverse axis. Stop and proceed is a vertical indication accompanied by a one-marker lamp. A stop signal consists of three vertical lamps without marker lamps. Stop can also be indicated by a two-position dwarf signal in a vertical pattern.

Mexican and Argentinian position-light signals focus on basic messages (FNM, 263, 265; EFEA 1958, 113-114). EFEA offers the basic messages of proceed, precaution and stop. Precaution can be either URH/LLH or ULH/LRH in axis orientation. FNM has three basic messages of stop, precaution and proceed, and these are available in absolute and in permissive forms. Absolute form is marked by an arrow-shaped top for the signal mast. A fourth indication is offered by a two-position light signal for divergent routes; this signal is accompanied by a single marker lamp. Japan includes both basic and complex message patterns (JNR 2-5, 2-6).

Color-position signals, under that name, are in use by the US both for mainline and for ancillary uses (see B & O code book as well as AAR materials). These signals display indications by position-lights that are also in colors: two horizontal red for stop, two vertical green for proceed, two lunar white (URH/LLH) for permissive indication and two yellow (URH/LLH) for approach. These aspects match the positions of semaphore arms and the fourth indication, that of LW, is from LQ semaphore practice. Color-position, as is

the case with position-light, displays four aspects from one signal head. Conrail has added red stop aspects to its Position-light signals thereby creating a kind of Position-color signal (A.C. Fisher 1990, 7-27).

In addition, color-position is divided into three levels of speed routes: normal, medium and slow routes. Normal or higher speed route, is indicated by a white marker lamp above the regular signal head except for the red aspect which has no marker lamp. Two red lamps if a stop and proceed indication are marked by a white lamp. A green light denoting approach-slow is shown by a displaced marker lamp to the right of the signal mast though attached to it; approach-medium has a marker lamp to the left of the signal mast. Medium routes have a similar pattern but all marker lamps are below the signal heads. Slow-route indications are three in number: restricting, slow-approach and slow-clear; there are no marker lamps (AAR 1956, 57, and B & O 1953 [US], 101-121).

“True” position-light signals for route and junction purposes are represented by UK and derivative systems (see QR, et al.). These signals are attached to a regular mainline signal and display three or five lunar white lamps. There may be one to six arms per installation.

Route indicators, by that name, are frequently dwarf signals for shunting and other operations. While termed position-light they are in reality color-position-light signals (Westinghouse Signals, Series 2000, QR and other codes). In one version of three lamps there are two white lamps and one red. The lamps are arranged in a triangular manner with one white and the red at the bottom and the second white at the point. If the bottom white and red are lit then the message

indicates proceed; if the two whites are together then the indication is stop. One variation of this signal replaces the red aspect with yellow. A second version contains two white lights only; if both are lit then the message is one of proceed; if both are unlit then the indication is stop. A third version, in NSW, has two red lamps on the bottom with one yellow at the point (NSW SI, 5). The yellow indicates caution while the two red denote stop. This is more in accord with the standard color meanings and reduces confusion that may result from the version that calls for proceed with horizontal lamps, and stop for lamps arranged at a 45 degree angle.

Finland employs a dwarf signal that includes two vertical lights indicating stop and two vertical lights that indicates proceed. A third configuration displays two lights at 45 degrees (ULH/LRH) indicating proceed with caution, and two lights at 45 degrees (URH/LLH) indicating a non-signalling condition (VR Signals); Sweden employs a similar signal (SJ 1979, 23). German systems include a full size shunt signal that is a position-light form. These signals include two to four indications (DB 1981, 50-51). The indications include halt (horizontal lamps), a cautionary indication at 45 degrees, a proceed (moderately fast speed), and in some systems an inverted "L" which calls for a reverse movement. (K&W 1963, 53 [UK]) has a similar signal. Germany and Austria employ position signals with small lamps of a numerous nature (DB 1981, 31-32; ÖBB 1979, 25-26). In Austria these signals serve a repeating function and in Germany they provide indicators of acceleration, delay and track variation.

4B4 Messages for Cab Signals

There are two forms of speed indications: speed

categories and speed values (see Mashour, see also Chapter 4A). Cab signalling is also affected by those two forms. Color-light and position-light follow the traditional pattern of color representing a word formula which, in turn, represents a numerical speed. Other cab signals employ numbers. But unlike wayside counterparts they employ numbers directly and without color (though color is an adjunct with some numerical cab signals). US and USSR employ the more traditional form while other systems mentioned here and in Ch 4A3 utilize numerical types. (USSR has been dismantled but information is probably in use. OSShD information and of former USSR may be in use in new nations). Cab signals also include some acoustical signals; these constitute the bulk of sound signals for railway signalling. It would appear that bells and whistles denote the need for changing of speed and may indicate a warning that a signal has been overlooked. It does not appear that a multi-level signal system is in use; that is, there are no sound signals for proceed, caution, and stop; just one indication of a general nature.

The US uses brief signal aspects for cab signals in contrast to that of wayside signals. Color-light aspects include: green for clear, yellow over green for approach-medium, yellow for approach, and red for restrictive. This pattern is for a four-indication system; three aspects eliminate approach medium and a two-position eliminates approach medium as well. Position-light signals in the U.S. include three vertical lamps for clear, three lamps at 45 degrees diagonal (to the right) over three vertical lamps for approach medium, three lamps to the right (45 degrees) for approach, and three lamps at 45 degrees (to the left) for restrictive. Audible whistles indicate changes in signal indications (Armstrong 1957, 15; General Railway Signal, 1954, 605).

The former USSR system maintained a vast system of cab signals, often parallels wayside signals with cab signals. The system has four levels of aspects: green for clear indicating two blocks are clear, yellow indicating one block clear, red over yellow indicating approach of a stop signal, and red alone indicating the train has run past a wayside signal at red. A white lamp indicates a non-cab signal territory. Audible signals alerts the train crew of the need to reduce speed (AAR 1960, 200-203).

The Japanese system, as developed on a principal line (Akawaga 1975, 16 and paragraph), consists of four main speed indications: 210 km/h, 160 km/h, 30 km/h and stop. There are other speeds including 110 km/h (sharp curve), and 70 km/h (“turnout and slow down”). There are several versions of the stop including and absolute stop and two variants forms which are activated by the ATC system. Cab signals and ATC are an integral unit in Japan. Audible signals in the form of bells denote a change in speed. Signals are of a speedometer model which includes the signal aspects.

The French system, in the form found on the Paris-Sud-Est line, uses a number-color pattern (Savrzeiz 1981, 734-735 and paragraph). The system uses three-part in that a speedometer gives the speed of the train in digital numbers, a separate speedometer employs fixed speed numbers and a line indicator, and a third indicator presents the numbers marked in categories and in colors. These categories include:

- a) “authorized line speed”
- b) maximum speed of 260 km/h (both are marked by green squares and together they have a controlled speed of 285 km/h. The second category includes:
 - a) maximum speed of 220 km/h

b) “ “ “ 160 km/h

c) “ “ “ 80 km/h (numbers are set in white

octagons; all categories have meaning of “driver warned not to exceed speed indicated entering next section.” Controlled speeds are 285, 235, and 170 km/h respectively). The third category includes three units with the speeds of the second category but with a different message: “driver instructed (rather than warned) not to exceed speed indicated.” And the controlled speeds are 235, 170, and 90 km/h respectively. This segment has black squares with white numbers.

It is not known why yellow is not employed for at least one of the two intermediate segments. White and black are not standard colors (though SNCF employs white symbols on black grounds at demarcations for cab signal usage and that color matrix is common with French railway signs). The final two segments are in red (octagons and square). In the first of these the driver “must stop at next section marker.” Maximum speed is 80 km/h unless preceding indication was an instruction to exceed 160 km/h; controlled speeds are 170 and 90 km/h. The last segment indicates that the “driver to run on sight without exceeding 30 km/h and to stop at next section marker.” Controlled speed is 35 km/h. Unlighted signs as noted above are an integral part of this cab signaling system. (Savarzeiz 734-735, 9-1981).

4B5 Message for Graphic, Geometric and Alphanumeric Signals

Because of the close connection between signal equipment and message some overlap in these topics is difficult to avoid. Multi-lamp signals can be found in theater-type forms and also in a direct multi-lamp form (Alkmaar, RSI). These

aspects can provide for as many as 12 routes and they are frequently found in conjunction with low speed situations such as train yards and terminals. The glass plate over the lamps can be lunar white, white or yellow. The housings are frequently flat black. These are associated with UK and UK-influenced systems. The Dutch form is a rectangle with half-sphere bottom edge and denotes routes or speeds. The signal employs white lamps on a black ground.

The stencil form can project up to three letters and/or numbers at a time. The units are frequently rectangles with a horizontal emphasis. Depending on need up to seven units can be formed into one assembly. A vertical orientation is possible though rare. The letters are white on a black background and the housing is black as well. A second form consisting of a single letter denotes a message such as automatic signals ("A"). Though this form may be partially-lighted if the letter is painted on the glass and illuminated by a light behind the letter.

Graphic models are more diverse form and found in a greater diversity and number of systems. The German double-crossing consists of white arrows on a black ground. Other systems utilize forms of arrows that are internally lighted. One example are the single and double arrows of NZ (NZR 1989, 118-119); a second example would be that of QR. NZR also employs unusual purple arrows with some points. QR also employs arrows (QR 1965 [Australia]).

CHAPTER FIVE

PARTIALLY-LIGHTED & UNLIGHTED SIGNALS, SIGNS, MARKINGS & MESSAGES

5A Introduction to the Semaphore

5A1 Background, Terminology & Characteristics

The semaphore signal, the nearly ubiquitous signal of a former era, is no longer expanding and is, in fact, very much obsolescent. But it continues to be important due to the numbers in operation, and because the semaphore has shaped the message systems of most other signals; this is true not only of position-light and color-position light signals but of all fully-lighted signals.

There is no one term that describes all of those signals which display day messages by means of an arm and night messages by colored lights. The term “semaphore” is in use for English speaking nations and many Romance-language nations; it is also employed by other systems including Sweden. But the term is not employed in German-speaking nations. Those systems, as well as German-influenced systems such as that of Poland, use the “formsignal” (DB 1981). For this study the term “semaphore” will be employed as a general term but keeping in mind that differences between Germanic form-signals and those of other nations exist.

A connecting link in terminology and in signals is found in Sweden where a signal akin in design to the Germanic is in use but under the title of “semaphor” (SJ 1979, 21). A further connecting link is the French edition of SBB’s signal code (SBB Les Principaux Signaux 1981) which employs semaphore not form.

It may be further noted that the term form signal encompasses all less than fully-lighted signals for those systems using that term while semaphore encompasses only specifically semaphore signals and not other partially-lighted signals. In one “school” of signals there is no single term for all less than fully-lighted signals while in a second “school” there is no separate term for semaphore-type signals. A literal term for arm signals is that of armsein in the Netherlands; arm has the meaning it has in English, and sein represents sign (Op de Rails, 1985, 142 ff, December).

Characteristics of the semaphore (beyond the core elements of arm and lamps) includes the relationship of arm to lamp, whether upper quadrant (UQ) or lower quadrant (LQ), and whether left-handed or right-handed. In much of continental Europe signals are mounted on the right side of the signal mast (though in Spain and portions of Scandinavia they are mounted on the left). US practice places the arm generally on the right side. UK and derivative/influenced systems position place the arm on the left side of the mast. Asian systems, including those of Japan and Indonesia are on the left (see respective codes: DB, RENFE, AAR, SJ, JNR, PNKA). Quadrant refers to the direction of the signal arm. If the arm moves from the mid-point upwards it is an upper quadrant

signal; if it moves downward then lower quadrant. A three-position upper-quadrant then lower quadrant. A three-position upper-quadrant has three movements: horizontal (halt), three-quadrants upward (caution), and vertical (proceed). Two-position signals contain halt and proceed indications only. Three-position LQ signals are rare (Adams, *Signals & Signs Symbols* 1972 [1911], 15).

Locations of LQ and UQ signals display diverse patterns. UQ are quite common on the continent of Europe; the Netherlands by contrast includes notable numbers of both UQ and LQ forms. In areas influenced by UK and US there are often both forms; ratio of UQ to LQ is probably greater in US than in UK. LQ have been declining probably since the early twentieth century; UQ was expanding in usage for a portion of the century but they too are becoming a less common signal. UK began a limited usage of UQ after World War I; the LQ form finds a measure of usage even now (K&W 1963, 12 [UK]). The most mixed picture is probably in Australia: Western Australia includes somersault LQ as well as US-style UQ. SA employs mostly three-position UQ though some LQ remain; New South Wales and Victoria include both forms; Queensland is a LQ strong-hold (see respective signal codes: AAR, UK, WA, ANR, NSW, VR-A, QR; see also SAR, various South American codes).

South Africa follows a UQ pattern of two-position signals (SAR 1936, also newer publications). Indonesia utilizes both LQ and UQ though the latter predominates (PNKA 1971). Turkey emulates German practice for older signals (TCDD 1987); this is also true of Thailand. The Indian -

sub-continent, New Zealand, Ireland, various South Americans systems are influenced by UK. The Philippines also employs UK style patterns (UN TAAAEC: ROSTEJU 1954, 21-22. Japan, despite sophisticated systems, retains some LQ signals (see respective signal codes).

5A2 Models of the Semaphore: National, Regional, and Technical Considerations

For much of the English-speaking world -- as well as portions of the Third World -- the semaphore conjures up a distinctive-shaped end and fastened to a spectacle of red, green and possibly yellow. Despite this image, the semaphore is not a monolithic object. The model so described is only one of several semaphores in use. This particular form, what may be termed the Anglo-American, exhibits message capabilities determined not only by the position of the arm, but by the color of the blade as well, and by the shape of the end of the blade. The day portion of the signal (blade) and the night portion of the signal (blade) and the night portion of the signal (the spectacle) are an integral unit (the tumble-arm or balanced-arm model) is not fully integrated but the parts are integrated through linkage (K & W 1963, 8-9 [UK]).

Color is an important “ingredient” for the Anglo-American semaphore. This includes the blades of semaphores. Many railways paint all blades (UK:arms) with a single color for shape of the blade according to usage. For example, UK distant signals display a swallow-tail (US: fish-tail) and painted yellow with black trim while home signals (with blunt ends) are red with white trim. The blades would be n

This “double- identification system” aids quick recognition of a signal. However, in New South Wales all semaphore blades are painted red even though different shapes are in use (NSW 1952). NSW practice may support the notion that color patterns are a useful dimension though not essential.

UK semaphores (and these are also found in EFEA, ENF, IR, PR, UN ROSTEJU (for Burma), SAR, etc.) have a “true” rectangle shape while the US form is slightly tapered (AAR 1948, 46). The source of a system’s semaphores can be frequently determined by the shape of the semaphore blade. In Australia -- where both UK and US forms are in use -- the source of a semaphore’s origin can be determined by visual appearance. Whether a signal is left-hand or right-hand it is a second mark of origins since UK has left-hand models and the US has right-hand versions. UK seemingly lacks a term to describe the assembled semaphore mechanism since it simply refers to arm and spectacle while the US terminology reserves arm for the assembly which is made up of blade and spectacle (AAR 1948, 38, 42; K&W 1963, 14 [UK]).

The previously mentioned tumble-arm (or balanced-arm) signal is a UK product. It was developed in response to an older form of semaphore that, on occasion, gave an erroneous clear indication during times of snow or other problems. The somersault was so designed that its normal position was one of halt even in times of snow or broken control wires (Blythe 1951, 55). The blade and spectacle are not separate units, as is so often the case on the continent of Europe. The two components are linked by a rod so that movement of

one requires movement of the other. Shape, color and position characteristics are those of UK practice. The signal, though minor now in UK, remained a major signal for Western Australia and New Zealand (WA 1974; VR-A; NZR).

A modified version of the integrated semaphore is found in Argentina and in Uruguay. The arm is standard but the spectacle component is of a variant design. The lenses for this unit may be smaller than with standard forms (EFEA 1958, 110ff; FE 77-78).

Dutch semaphores (seinpaals or armseins) bears a partial resemblance to Anglo-American and European models. All of the Dutch semaphores have the arm and spectacle joined together which parallels UK and US practice (Op de Rails 1985a and paragraph). However, these signals have the rounded ends associated with German or Central European semaphores. Other Dutch semaphores have square ends, and arrow-shaft shaped ends. Both UQ and LQ signals are in use and in some instances they form a single installation.

The type of formsignal associated with German practice is an important form but it is only one of several forms in use. There are differences not only between nations but also between regions. For example, some southern European nations employ semaphores bearing some resemblance to US and UK models. West-central Europe is populated with a variegated pattern; the Netherlands, France, and Belgium each have developed singular forms. Finland and Sweden have also produced variations reflecting their railways and societies.

Much of central and eastern Europe conforms to the Germanic pattern. A key characteristic of many of these signals is the separation of arms and lens; this is true even of some signals that bear a visual resemblance to the UK and US models (see RENFE 1978 for an example of this phenomenon).

The Germanic form frequently is found only in one pattern: an elongated rectangular arm ending in a disc. The signal is often painted white with a red border. The signals may be either UQ or LQ and may have one or two arms. This signal as found in DB, DR, OBB, PKP and other systems separate arm and lamp units. The Finnish and Swedish form have an opening in the arm since the signal, in the halt position, is centered over the red portion of the lamp. This practice is also followed in Yugoslavia and Hungary though in those cases the form has a squared-off end and a half-spherical inner end (where the arm is attached to Germanic form where a single stripe follows the outline of the arm (see signal codes of the systems included in this paragraph).

The form signal of Switzerland is of a slightly different shape and color pattern though it remains within the European form signal tradition (SBB 10ff). Turkey and Indonesia employ form signals that stem from German and Netherlands practice respectively (TCDD among other sources; PNKA).

Belgium has a variety of semaphore forms of which most are of distinctive design. The foundations of Belgium practice are based on destruction of older signals in World War I (see Nock 1962, 79ff). Many other European nations

continued older patterns of signals until the destruction of World War II led to contemporary color-light signals. But Belgium's changes occurred when semaphore forms were still very significant and their first new system continued the semaphore pattern. Patterns include standard rectangular forms with square-end and disc-end forms (SNCB 1980, 88, 96-122). They also include two forms with an arrow shaft end; one of rectangular form and one with oval shape mid-length along the arm of the semaphore. The final form is rectangular with square-end but with a partially oval longer edge for the inner part of the arm.

Other distinctive forms include the lattice-work semaphore (CZD) and the double-arm lattice-work semaphore (SBB). What might be termed a "propeller arm" semaphore is employed in DB and DR for specialized purposes (DB 1981, 50-51; DR 1971, 109-111).

5B Messages for Semaphore Signals

5B1 Fully-Integrated Semaphore Signals

Semaphore messages are not independent of the technology of the signal: fully-integrated semaphore messages differ from those of less integrated forms. It is appropriate therefore to examine the message configurations separately.

There are variant forms of the fully integrated signal but the Anglo-American pattern predominates (NS constitutes a major variant). UK-US semaphore though not identical share many similarities differences will be noted. Perhaps

one-fourth of railway systems in this study use this model of the semaphore.

An examination of the Anglo-American signal can be a dialectic process of thesis and antithesis: signal are upper-quadrant (UQ) or lower quadrant (LQ); signals are left-handed or right-handed (for this study these characteristics can be abbreviated as UQRH or UQLH and LQRH); Message positions are horizontal and 45 degrees for both UQ and LQ; UQ has also vertical position. Signals are square-ended, pointed, fish tail (or swallow-tail, UK), round-end. Signals are true rectangles or tapered; signals are red or yellow (chevrons and other secondary symbols and colors are subsumed within the dominant shape and color). Signals may be home or distant, manual, semi-automatic or automatic (there are also nuanced distinctions: outer home, intermediate home, etc); there are also specialized functions: shunting signals; calling-on signals, repeating signals, etc.

The quadrants define the core messages. A halt message is horizontal whether UQ or LQ; a horizontal indication denotes cease movement without regard to the type of signaling. This indication occupies the mid-point of the signal apparatus (see Ch 2B for illustrations). Caution indications are at a 45 degree angle whether UQ or LQ. Proceed indications are not the same for UQ and LQ. UQ proceed is a vertical indication while for LQ the indication is about 45 degrees (LQ usually requires two arms so angle of blades is not contradictory, (GRS 1913, Southern Pacific Rule Book [US])).

For most systems there is agreement on the significance

of blade shapes. Square-end blades designate a home signal while fish-tail (or swallow-tail) indicates a distant signal. Pointed blades announce automatic signals. In some systems (e.g., ANR 1947, 112, 118) square-end signals indicate absolute signals and pointed-end blades indicate permissive signals. NSW offers a variation that is apparently contrary to other usages: square-end blades designate three-position UQLH signals but fish-tailed blades are used with two-position (UQLH (NSW 1952). Color patterns for semaphores are uniform: red blades with white stripes or bands for home signals, and yellow blades with black chevrons or red blades with white chevrons for distant signals.

Night messages for home signals are red and green for two-position, and red, green, yellow for three-positions. Variations based on nineteenth century practice, can be found with distant signals: red and green instead of yellow and green; in these instances red has a cautionary meaning. The message of caution is simple and easily understood for many systems but becomes complex in some OSShD users and North American systems.

The Anglo-American pattern may dominate integrated semaphores but other models exist including those of Italy (FS 1983), and the Netherlands (NS 1975-83, 30, 34, 40). Spain bears a partial resemblance to the Anglo-American form (RENFE 1978, 1-10). Italy employs a double semaphore (“Accoppiati”) unique to that system. Two blades are mounted in tandem though each is capable of free movement. The signal produces messages of caution and of proceed

though with qualifications. The Spanish semaphore has the shape, color and markings of US and UK practices but the lamp and lens unit is separate from the blade. Blades are red with white secondary markings with some pointed and others square-ended; pointed-ends have chevrons while the square ended models have bands.

The semaphores or seinpaals of the Netherlands are visually at variance with the Anglo-American model but are nonetheless an integrated signal (Armseinen ...). Home signals are marked by a round oval (similar to the Germanic model), distant signals have a square end; junction signals have an arrow-shaft end (Alkmaar); shunting signals are also marked by an arrow-shaft end with a secondary marking of a white stripe near the outer end. Dutch influence was at work in pre-UK, South Africa, and also in Indonesia; that influence is clearly present in the latter system (PKNA 1971).

5B2 Partially and Non-Integrated Semaphore Signals

Integrated semaphores have much in common even though they are found in many widely-separated systems. European semaphores (formsignals) are marked by more diversity than Anglo-American versions though Europe is a much more restricted area. Similarities as well as dissimilarities can, however, be summarized. Points of commonality include a signal form in many systems (home and distant distinctions are frequently not present or if present then created through a joint usage of semaphores and signal boards), heavy presence of German-originated signals, and an overlap of signal shapes within sub-regions.

Sweden and Finland employ a single form of semaphore signals which are UQLH; three-positions require two arms (SJ 1979, 21; VR 1984). Both systems employ a hollowed out blade for the viewing of the halt aspect and this can be regarded as a partially integrated signal. Signal aspects are different for the two systems; for example, Sweden employs two green G for 40 km/h aspects and Finland G/Y for 35 km/h messages. The blades have red and yellow horizontal stripes for Sweden and red and white stripes in Finland; both include an oval at the end of the blade (SJ 1979, 21; VR 1984).

The Germanic form is UQRH and is used for home or main indications (for this paragraph see DB 1981, 18; see also DR, PKP, CFR, etc). The signal is rectangular with an oval end; arms are white and bordered in red. Two arms are required for three positions. Vertical and red marks halt, 45 degrees with two arms and G/Y lamps denotes caution, and one vertical arm with G indicates proceed. Lamp and blades are fully separated.

The code book of the USSR does not include semaphores (SZD 1979), but the 1984 German Railway yearbook (Kuhlmann 1983-5) lists semaphores for the former USSR including an unusual three-arm signal. It denotes entrance to a station and indicates that the train crew is to be prepared to stop.

Czechoslovakian semaphores resemble those of Hungary and Yugoslavia except that both ends of the blade are squared-off. The color pattern is red and white. The

signals of all three nations have separate lamps and blades but without the disc end common to many central European systems. Hungary and Yugoslavia both have a half-sphere end to the blade. JZ and CSD blades are red with a center white stripe; this is also true of MAV. CSD also includes some blades with a yellow center stripe (see signal codes of JZ, MAV and signal information of AZDP; see also Signal Pattern, 1984). (Note: CSD are now two nations; AZDF is a signal marker that followed OSShD instructions.

CSD indicates halt with horizontal indication and red light; 45 degree position and green light of course denote proceed. "Proceed with caution" marked by a double arm of which one is red and white and the other yellow and white, and a yellow lamp. An additional speed, "caution, allowed speed 40 km/h" requires both arm and two yellow lamps. A lattice work semaphore is also included in CSD (see AZDF and Kuhlmann), and a double-arm lattice work semaphore is employed by SBB (SBB 1982, 65). The propeller arm has simple messages of proceed, stop and qualified proceed (DB 1981, 50-51).

Yugoslavia has three formsignal aspects which include the basic proceed and halt indications and a modified proceed signal marked by G/Y lamps (JZ, 27). Hungary has green and red aspects but no yellow. A double green aspects denotes messages (MAV, 264). OSShD formsignals are in the Germanic tradition and have standard aspects. Two arms at 45 degrees and lamps indicate a proceed to branch line message; the same indication with G/Y lamps is a variant of that (OSShD 1962). Belgium semaphores combine European and UK-

US schools of signalling. Home signals consist of rectangular red blades with white stripes and square end; the distant signal is yellow with arrow-shaft shaped-end with black chevron. These signals emit standard messages (SNCB 1980).

5C Signal Boards

5C1 Terminology, Types and Locations

The reader may recall from *International Marine Aids to Navigation* (Volume I, Parts C & D, 2nd edition) that some forms of daybeacons are only found in a few places and are important for only a few nations. Yet that study could not leave out an important marking even if few systems included it: a Transportation-Marking can be important even if far from global in scope. Railway signal boards represent an analogy to those daybeacons: they are not global and they are important to only selected systems. Yet a study purporting to be international can not exclude them.

Signal boards are found mostly in Europe and date back to the nineteenth century. They are a separate form of signal that stands apart from semaphore as well as from all-lighted signals. There may be a muted resonance with unlighted targets of North America and several other systems. Signal boards are varied in appearance and follow mostly geometric shapes: triangles, discs, squares and diamonds. Signal boards are rarely fixed (that is, the signal apparatus), a somewhat substantial number are hinged, and more are revolving in nature. There is no extant term to describe these signals; “signal board” is described below and offered as a possible

appellation for these safety aids.

In Germanic nations, and nations influenced by German practice, the term “Formsignal” is applied to all less-than-fully-lighted signals. But that fails to differentiate between signal boards, semaphores, points/switch indicators, and so forth. The situation, in varying degrees, is true in other European nations as well. In English-speaking nations it is frequently the practice to have a specific name for each signal but there are no over-arching titles (unless one can include words such as unlighted or partially-lighted as titles).

The term “Signal Board” has potential for describing these signals. Signal board is found in various dictionaries though with a different meaning. The *Oxford English Dictionary* while not including signal board does include sign board which is a board for mounting a sign or is a sign in itself (OED 1933, Vol IX, 36). Both *Random House* and *Webster’s Third International* dictionaries include signal board but not in the sense proposed here (RH 1966, 1326; WTID 1961, 2115). Signal board in this sense may refer to a board in an elevator containing a list of signal indications, or it may refer to a list of electronic impulses for some purpose or other. Neither RH or WTID include signal board as a signal in itself.

Since the term signal board is accepted as either as a sign or a foundation for a sign it seems plausible that signal board represents an analogous situation for signals consisting of a board or mounted on a board. What alternative terms to signal boards are there? Other possibilities are seemingly too broad, or include signals not made up of boards or that use

boards as an foundation. O.S. Nock has referred to the older non-semaphore signals of Europe as “discs, diamonds and boards” (Nock 1978, 780). His usage of several terms indicate the lack of a general term; his use of board as a type of these signals suggests that as a possible general term.

There are two types of signal boards: one revolve on an axis with one position parallel with the track; the second form is hinged so that one position of the board is horizontal and one position is vertical. This form can be termed the Klappbord (Netherlands, see page 90. An alternate is the German word of Klappbarr.. Both forms often employ a “blind edge” as a proceed indication. A third type, with a single fixed message, is rare and seemingly found only in the UAR system.

Most signal boards are free-standing units. And usually they are single units though in some systems (France for example), at least two signal boards are employed at one location in order to provide a full complement of indications (Allen 1982, 146-7). Signal boards are sometimes combined with semaphores; for example, Spain uses a composite form of semaphore and signal board on one signal mast (RENFE 1978, 1-13). A type of semaphore arm is found with some of the hinged signal boards (termed propeller arm in this study) that augments the message capability of that signal. These are found with German systems (DB 1981, 50-51), and also in the Indonesian system (PNKA 1971, fold-out chart).

While the several types of signal boards each have individual characteristics there are no general characteristics

other than the board and the mast and some kind of activating mechanism (and that is true of all signals). Signal boards are usually two-position signals and often one position is a “blind edge” indication. Chapter 5C2 reviews possibilities of the board.

The hinged or klappbarr variety of signal boards are in use in DB, DR, OBB, PKP, TCDD, OSShD and possibly in the former USSR. In most instances these exist only in limited numbers. This variety is more common in Yugoslavia and in Hungary; there is some usage in Rumania. Belgium and the Netherlands in western Europe make very restricted use of similar forms of boards. The area of extensive form -- is in south-eastern Europe: France, Spain, and Portugal (SNCF 1981; CP 1981; RENFE 1978). These nations maintain a full complement of signal boards; this is especially true of France and Portugal. In fact, the boards of France and Portugal are very similar in design and function.

Outside of Europe there are signal boards in the UAR system (UAR 1983), Vietnam (UN-TAAEC, 22-23) and Algeria (SNCA 1968, RGS). These are all largely of French vintage. Indonesia (PKNA 1971), employs a variety of signal boards. It may overstate it to see any relationship between the signal boards and the nineteenth century disc signal of the US.

5C2 Signal Board Messages

The three systems with a wide range of signals boards --as well as sharing many points of commonality -- will be

considered as a group. The UAR, with resemblance to SNCF, will be an adjunct of the group. The Germanic sphere of influence is to be seen in signal boards in central and eastern Europe and provides an exemplar for the klappbarr form and a second group. A final group consists remaining systems.

The “Big Three” of signal boards: France (and French-influenced systems), Portugal and Spain display similarities though national characteristics are also present. Historical exigencies, and possibly additional geographical ones, may explain the three overlapping sub-systems of this signal. It may also be true that any railway designing a particular form of signal may parallel similar signals in other systems since railways draw from a common store of shape and meaning.

There are parallels between the above rail systems and North America: both groups project a common core of messages through multi-form means: messages for proceed, caution and halt. No one kind of signal has a monopoly on indications. The multi-form modes include both fully-lighted and partially-lighted signals.

The three principal signal board system may be termed General Systems of Signal Boards (References for this segment include: SNCF 1981; CP 1980, RENFE 1978; see also RAN 1973, SNCA 1968, UAR 1987 and UN TAAEC 1954 for Vietnam). The coverage includes a review of each shape and color under the headings of stop, cautionary and proceed categories. Dissimilarities among the systems will also be noted.

Stop indications are denoted by a square signal board. This is solid red in Portugal and by red/white checks in France, Spain and Vietnam. UAR employs a red board indication is stop (or absolute stop). Portugal also includes a permissive stop signal: a square board accompanied by an upright rectangle (with the top edge cut off at a 45 degree angle).

A modified stop indication is provided by the deferred (“diferida”) signal of Spain and Portugal, and the disc signal of France. It is a solid red disc (CP 1981, 18; SNCF 1981; RENFE 1978, 1-11; UN TAAEC1954, 22).

A diamond shaped board in solid yellow denotes a precautionary signal in Portugal and Spain, and a warning signal in France. A yellow disc with diagonal black bar is found in Spain and Portugal. It is a precautionary signal in Portugal which, in some circumstances, permits a maximum speed of 45 km/h instead of the usual 30 km/h. In Spain the signal announces or advises of an upcoming stop signal. Triangle (point downward) is also within the caution category. This signal is solid yellow in Spain.

An additional cautionary board is the triangle with point downward. It is solid yellow in Spain, yellow with vertical black bar in France, and with yellow and white segments in Portugal. It advises precaution in Portugal, announces or advises precaution in Spain, and serves as a speed restriction signal in France. Triangle with point upwards is found only in France. It is employed as a distant signal of the previously described speed restriction signal.

A solid green square is provided by UAR for the clear indication. Portugal displays an upright rectangle with a triangular top edge and green and white segments for the clear indication. France and Spain use the more common “blind edge” for providing the clear indication. (CP, SNCF, RENFE).

A violet or purple square indicates prohibition of shunting in France, Portugal, Spain, Vietnam. A semaphore indicates shunting permitted rather than the blind edge of the aforementioned square. (UN TAAEC).

Spain provides an interesting two-part composite group of signals: one part combines signal boards and semaphores, and the second brings together different kinds of signal boards (RENFE 1981, 1-13, and paragraph). There are four elements within the composite signals. The first consists of the semaphore and the signal board (blind-edge) for proceed; semaphore and downward pointing triangle for advising/ announcing of precaution (semaphore upright); semaphore at 45 degree position and downward pointing triangle for announcing/advising of upcoming stop signal, and semaphore in horizontal position with the same triangle for stop. The second element is a more nuanced one: semaphore arms sometime display pointed-ends and at other times, blunt-ends; the signal board triangles are the same in both cases.

The third element is comprised only of signal boards. The proceed indication consists of two blind edges, for advising precaution it is one blind edge and the inevitable triangle, and for announcing stop, one disc in yellow with diagonal black bar above the triangle. There is no stop indication in

this variation of the composite signals. The final element displays the indications for proceed and for announcing precautions; there are no messages of announcing of stop or a stop indication. However, there is a deferred stop message marked by a red disc and accompanied by a triangle.

The second category of signal board users is that of limited usage. Many of these are in the Germanic mode and they represent functions of distant signals indications or shunting instructions. Three other board users will be attached to this category.

DB, DR, OBB and PKP and the OSShD sources provide a very similar form of klappbarr distant signal. In the stop position the signal displays a yellow disc while in the proceed indication a blind edge is displayed. Yellow or green lights are displayed at night. Turkey has this signal as well as rectangles with red center and white border (TCDD, 2-3). These signals also include a “propeller” arm semaphore mounted on the signal mast below the board. This supplemental arm remains vertical unless the distant signal denotes a divergent line. In that circumstance the disc is present to the viewer and the lighted message is G/Y. The DR has a somewhat more complex klappbarr system though in essentials it is the same. In Austria the blind edge is accompanied by a rectangle with rounded corners and displaying a white and green color pattern (for references see signal codes of listed systems).

The distant signals of Yugoslavia and Hungary bear a resemblance to the German mode but notable differences are

also present. The distant signal for Yugoslavia consists of a rectangle (horizontal dimension is emphasized) or a disc. Both designs have yellow and white vertical stripes (JZ #12; MAV, 264). These represent the day indications for stop. The proceed indication is a blind edge for day usage and green light at night. The proceed indication is a blind edge for day and a green light at night. The proceed indication is a blind edge for day and a green light at night. Rumania has a very similar signal (CFR, 1).

Shunting signals for the eastern and central European systems display diversity though points in common are also present. The OSShD system offers a square divided into small blue and white checks (OSShD 1962, 20). This is the day message for shunting prohibition. At night blue signals give the same message. Shunting permitted is marked by a blind edge in the daytime and white lights at night. This shunting signal is not found in the codes viewed by this compiler other than in OSShD.

Yugoslavia employs a blue diamond with vertical blue and white stripes for no shunting message in the day and a blue light -- set within the diamond -- indicates the same message at night. Blind edge indicates shunting approved during the day and by a white light at night. Another variant form is found in Hungary and Poland where a solid blue light at night. Blind edge and white light are the messages for shunting approval (JZ Signal #4; MAV 264; PKP 1976, 58).

Two other nations employing signal boards are those of

the Netherlands and of Indonesia (NS 1978, 46; PKNA 1971). Indonesia has a variety of signal boards. A major form has three messages: red discs with red lamp (stop), and blind edge (proceed), with a green lamp, and a semaphore arm attached to the blind edge that indicates caution, when at a 45 degree angle, with yellow light at night (PNKA 1971, fold-out); another form has green and red discs with accompanying lights for night use. The Netherlands employs a signal board for the platform signal. For day usage this is comprised of an upright rectangle in red for stop and a blind edge for proceed. At night a red lamp indicates halt and a white one indicates proceed. The signal board has side hinges as in the case of southwestern European signal boards (NS 1975-83, 58).

5D Graphic and Geometric Signals

5D1 Terminology, Types of Signals and Signal Functions

This segment encompasses a broad spectrum of signals less than wholly-lighted and neither semaphore nor signal board. They produce messages by geometric or by graphic means. Since so many of these signals deal with switch/point functions and/or with shunting functions it would have been reasonable to term this segment Switch and Shunting Signals but in keeping with the perspective of the Transportation-Marking monographs, the first concern is the signal then the message and its context.

Each of these signals bear two of four basic characteristics (and the characteristics can be paired); the signals either rotate or they revolve, and the night/day portion is

either an integral unit or a separate unit. If a signal revolves then all, or a significant portion of the signal unit, turns on an axis. If it rotates then actual signal-producing component turns (similar to the motion of a clock). If the day/night aspects are an integral unit (as in a disc signal) then both portions are always present. US targets, however, share a common base or signal mast but the signal lamp may be absent from the day targets.

The major functions of graphic and geometric signals are as shunting and switch point indicators. In many systems there are specific shunt signals covering low-speed movements on mainlines and to and from mainlines; it is possible that train movements in marshalling yards and other special situations can be encompassed within the shunting function. Shunting signals by that name may not be known in North America but the shunting function is carried out by dwarf signals or by the low-speed indications within regular signaling. Of course many of these signals are fully-lighted and not covered in this segment.

The second major function is that of switch/points indications. This function is virtually universal. Indicators are found at junction of tracks; intersections of main tracks, main-secondary tracks, marshalling yards and other situations. In some instances they are termed signals while in other situations. In some instances these are termed signals while in others they are indicators (McLean notes that signals give messages of proceed, etc. while indicators denote direction to go; this is the case for some systems it is not for others; McLean 7-03-1990). Signals in a given system may or

may not include these markings as an integral component.

Terms for shunting signals in a variety of languages bears a striking resonance: Romance language terms include *Manoeuvre* (French), *Maniobra* (Spanish), *Manouva* (Italian), and *Manobras* (Portugal). Even several languages removed from the Romance tongues employ similar terms: *Manowrowa* in Poland, *Manevrisanje* in Yugoslavia, and *Mahebopobon* in the USSR code. German language codes employ *Rangiersignal*, and the Netherlands, a similar *Rangeersein*. Belgium speaks literally of “*petit mouvements*.” The English language has settled on shunting.

There are two terms for the juncture of tracks: switch, and points though they refer to the same function. This divergence in terminology is reflected in the variety of terms in other languages: France has *Signal de position* while Spain uses “*Indicador de posicion*” (SNCF 1981, RENFE 1978). Italy uses *Segnale indicatore* and this is echoed by Portugal with “*Indicador de posicao de agulha*” (indicator of the position of switches) (FS 1983; CP 1981).

German language codes use “*weichensignale*” and the Netherlands, “*wisselsein*” (UIC/IUR Gen. Dict. 1975, 914). North America uses switch stands and switch signals. More often, other English-speaking nations employ points indicators. There is a marked degree of uniformity of function if not terminology for these markings. Switch indicators can also refer to track indicators and their relationships to switches.

5D2 Geometric Signals

Geometric signals are within the categories of the classification. All of the geometric signals will be encompassed in this segment. In the classification revolving or two-sided signals are separate from rotating or single-faced signals. In this coverage they will be conjoined since they share notable similarities. Other rotating and revolving signals will also be included. The other remaining portion of geometric markings are the targets found in North America, parts of South America, Australia and Asia. The rotating discs offer four forms. The most common is a disc signal with face and a simulated semaphore bar mounted on the disc. The signal lamps are behind the face and shine through an opening in the face: the color appearing depends on the position of the disc. A second form employs indirectly light by a flood lamp attached to the signal which acts as a substitute for daylight. This indicates that day and night messages are one and the same. This form lacks an internal signal lamp. A third form, though not termed a disc signal, is a glass-enclosed arm or bar within a circular housing. This is termed a banner repeater in the UK (K&W 1963, 22 [UK]). The partial disc constitutes the fourth form. Despite its truncated disc it closely resembles the message capabilities of the full model.

Revolving discs are marked by greater diversity. This signal form has at least five versions. One version has discs of equal size for both stop and proceed sides; another has discs of unequal size for the faces; a third displays a disc on the stop side and a horizontal band on the proceed side. Yet another has a non-message or "blind-side" for the proceed (a similar situation is found with some signal boards that have

a non-message side for proceed messages). Finally, one form has a disc for stop and an upright rectangular bar for the proceed side. Discs in Victoria are on signal masts and therefore not dwarfs though they are for shunting purposes (VR-A Wooley 1958-1).

The functions for these signals are primarily shunting, and points indication. But it is not easy to divide the signals into a single function. The message segment of this chapter provides some information on signal function.

There are two geometric signals affiliated with the disc signal for QR that perform much like a disc signal. These signal display arrows on both faces in one model and solid on one face and arrows on the other face in the second model (NSW 52).

The UK and derivative systems also include two geometric signals without a special day target. In both cases the signal housing, or the metal framework, affixed to the housing serves as the indication. In one form the housing (termed panel by this compiler) is of a single color with one signal lamp for each indication; the second form is divided into two color panels with accompanying signal lamps. Each panel represents one track. The color patterns are applied to the housing (red and white; QR 1965).

The disc signals so far considered follow a largely unvarying pattern dating back in some instances to Victorian and Edwardian eras. Even though on the wane it continues to find considerable use (see for example the 1900 catalogue of

McKensie and Holland). Another form of geometric signal also has Victorian antecedents but with more variations and thereby more difficult to briefly sum up. This signal is the open target previously mentioned and which is most commonly found in the US. The day and night portions, though sharing a single mast, can easily be separated and thereby exist independently of one another. Since this is a simple marking to manufacture this adds to the difficulties of comprehensively reviewing it. Patterns in Transportation-Markings often maintain certain forms over many years which suggests there is a limited range of design in use. This signal is definitely and visually different from switch and points indicator of US and UK-influenced systems, and indicators in Europe.

The free-standing target is not covered by a central code. A US railway engineering group provides a listing and illustrating of design shapes and at least one manufacturer provides a pictorial catalogue of shapes (Bethlehem Steel 1981). This is the case in the US but it is less true for other systems such as ANR and JNR (ANR 1947; JNR, 2-8) where a more restricted range of shapes are approved and in these instances a certain standard is followed.

5D3 Graphic Signals

There is uncertainty, at least for this compiler, about the placement of graphic signals: are they to be considered partially-lighted or fully-lighted? This question does not arise with most other railway signals. Fully-lighted signals, for example, are all-lighted, and most partly-lighted signals are

clearly partly lighted and unlighted. There is no problem in determining the character of those markings or distinguishing between lighted and unlighted dimensions.

However, graphic signals have an uncertain character since the two separate signal message properties of graphics and lighting are nearly fused together (there is no day part separated from a lighted part). In a geometric disc signal the disc is one element, and the signal lamp is another, while in an all-lighted signal the signal lamp constitutes the entire message apparatus. But the graphic signal has one shape whether unlighted or lighted.

Nonetheless, despite their uncertain character, an examination of pertinent signal codes can suggest an approach to graphic signals for this study: it is possible to subdivide these signals into two forms: one fully-lighted, and one partly-lighted based in a logical pattern. In the first form, internal lighting is required for both day and night indications. In this form the graphic representation (usually an arrow though of a variety of design patterns) can not be seen when unlighted unless the viewer is quite close to the signal. In the second form it is possible to see the graphics in daylight without internal lighting and at some distance from the signal. Many examples of the first form are found among double-crossing switches (Doppelte Kreuzungsweichen, DB 1981, 55; DR 1971, 119), and are considered in Chapter 4.

This bifurcated view of graphic signal is undergirded by the character of the signal itself: all-lighted graphic signals are stationary signals: all possible signal combinations are present

on a single face. By contrast the partially-lighted graphics are revolving signals. The revolving character eliminates the need to obscure some dimensions of the message indication cycle since only one signal face is present at a time.

Possible shapes for graphic (partially-lighted) include rectangles, circles, parts of circles and a plethora of arrows. Arrows can range from representational forms to decidedly abstract varieties. Circles are both full and partial; the partial forms bear a resemblance to slivers of the moon. Another version of this signal (though for non-switching functions) consists of a circle with a movable bar that resembles the positions of a semaphore signal. The housing for a graphic indicator is frequently square in shape for the circle or arrow messages; the other face of the signal is an upright rectangle. The graphic follows the rectangular shape. Chapter 5E2 describes the message significance of the graphic forms.

What has been said of graphic signals can be said of alphanumeric signals though more hesitantly. Day messages are possible but it would appear that these messages are normally of a lighted character. Therefore, they will be considered under that heading. This view can be contested: many systems employ route and junction indicators and some unlighted versions can not be altogether ruled out.

A final form of the graphic and geometric area of signals is that of the track indicator (also known by several other names; see Glossary). This signal is largely obsolescent (possibly only the Southern Pacific in the US, and the SA to any extent; NZR has a variant form: see below).

Even though it may be part of the past it is important to include it in the study because of the range of symbols and messages that it contributes to Transportation-Markings (Sources are an amalgamation of information from multiple references including Hall Signal 1913, 60-F-a and 60-H-a; US&S 1911 and 1929; Southern Pacific, 141, 142 [US]; Sante Fe 1909; Union Pacific [CCOR 1967, 130, 131]; Rock Island [“Electric Lights”, 1936, 627, 628, 629]; and SA 1947, 139).

It may be debated whether it is a graphic-shaped or a geometric-shaped signal. Since many of its form displays graphic designs it seem more reasonable to place it with graphic signals. Many of the track indicators are unlighted though some partially-lighted forms (and possibly full-lighted though of a marginal nature) are extant.

The several major forms center on the word miniature: whether semaphores, pointers, positions, discs or lights. Some forms emulate a full-size form: other forms are exclusive track indicators; all are small. The semaphore types can be either UQ and LQ and are two-position; pointers are three position. The position form, formed by rows of dots, exhibits one or two messages contrary to position-light signals. The disc indicator is perhaps the only remaining version of the formerly important disc signal in the US. The pointer does not have a full-sized version.

The different names may be “only semantics” though the names may indicate differences of substance. The switch lock indicator, for example, may constitute a variant form

though symbols and operations closely resemble some members of the track indicator group (SA 1947, 139; NZR 1979, 115).

5E Messages for Geometric and Graphic Signals

Messages for graphic and geometric signals constitute a varied and complex situation. There is more diversity and less centralized regulations than for many other signals. This segment can only offer a general survey of these messages though an attempt has been made to offer some specifics within a context of synthesis; reference to individual signal codes is necessary for detailed information.

Messages for graphic and geometric signals are considered in this order: revolving discs, rotating discs, revolving panels, geometric signals (day and night functions can be separate), graphic signals (day and night can be separate), graphic signals (day and night are integral). Graphic, geometric and alphanumeric signals, which are all-lighted, are reviewed in Chapter 4B5.

5E1 Geometric Signals: Rotating and Revolving Discs and Panels

Many, perhaps all, of the revolving disc signals are UK and UK-derived/influenced markings. Despite the restricted range of functions for these signals they represent a complex situation. The “face” with the stop indication is usually a white disc with a red bar (horizontal) or a solid red disc (see for example, WA, 486-487). The lamp is usually red though a limited number have purple (for example, VR-A, 28; SA 1947, 113). The “face” with the proceed message offers more variation. In some instances this side is a “blind side” indicating proceed by a lack of a specific message (which can

suggest some signal boards, and US style targets. In other instances a band is added to the housing to indicate proceed while in yet other instances a white disc with red (but slightly smaller than that of the stop side) is present.

Colors for proceed indications are green or white; white possibly representing the proceed color at an earlier time, or as a substitute for green of mainline indications. Other less common formulations are solid green and solid white discs (PR TWS, MACLS5). Colors at night include red for stop indications and white or green for proceed indication. UK has one, now obsolete, solid red disc with an upright green rectangle (K&W 1963, 51 [UK]).

These signals serve as points/switch indicators and as shunting signals. There is no clear differentiation between shunting and points/switch signals. Though it would appear that these revolving signals are more often employed for points indicators than for shunting purposes. The Appendix offers a summary of specific uses for the signals according to the individual systems.

Rotating disc signals are found largely with those systems employing revolving disc signals. SA offers a rotating signal though no revolving models (SA 1947, 113). Not infrequently the two forms of discs include considerable usage of white discs with red horizontal bars. The variant forms include full discs with signal lamps, full-disc with floodlights, partial disc with signal lamps, and the glass-enclosed signal with arm or bar.

The white disc with red indicates stop if the bar is horizontal and proceed if at a diagonal position. Lights are red and green for two positions and red/green/yellow for three-positions. These colors bear the standard meanings. In some instances green is explicitly stated to be a clear but slow indication (SA 1947, 113).

In the case of SA, purple indicates stop for a “platform starting signal” (SA 1947). Red for ANR indicates a shunting signal. A review of signal codes including the rotating disc signal indicates that they are primarily used for shunting purposes. A variant form, white disc with yellow bar (K&W 1963, 23) is a points indicator; a second UK variant, the black disc with yellow bar, is a shunting signal.

The full disc without signal lamps -- but illuminated by floodlighting -- is closely related to the main form of the disc signal with signal lamps. The glass-enclosed signal with arm is included here because it too is a disc signal. The signal has a black arm on a white background. It serves as a repeater signal (a signal repeating the indications of a signal which is difficult to see because of obstructions) in UK and as a shunting signal in NSW (K&W 1963, 23; NSW, section 23).

5E2 Free-standing Geometric Signals and Geometric Signal Messages

The variety of messages and the lack of central code stipulations creates a problem in discussing message indications for open geometric signals. An individual railway (at least in the US) has a broad range of shapes of targets to

choose from and perhaps an equal freedom to determine the meaning of the shapes, colors and positions. This range and freedom is counterbalanced by a conservative principle often at work in Transportation-Markings: specific shapes and meanings have often been handed down from generation to generation. So that shapes and meanings found in Victorian times continue to be used by many railways. While this coverage can provide precision in summarizing meanings it can suggest meanings for such indications that will often hold true.

The shapes that these targets or open geometric shapes: arrows, prisms, ovals, circles, rectangles, squares, diamonds, lozenges, “masks.” And many of these shapes can develop sub-patterns of their own. Targets vary from a few inches in height to ten feet or more. Some US sources number targets (Bethlehem steel for one), and railway systems may group all of them under terms such as switch lamps or switch indicators. This compiler has found it necessary to attempt a word description for the forms though that may be arbitrary and perhaps idiosyncratic. Sources for targets include SAR 1947, 136, 137, 138; EFEA 1958, 145; FNC, Ch II, Art 33; FNM, 127-128; PNKA 1971, fold-out; UN TAAEC 1954, 22; SBB 1981, 22; UK and UK-influenced systems have targets as a part of disc and other signals though these are not exclusively target indicators.

A special shape found in North America, and SA is the “mask” shape. This term was coined from the resemblance of the target to face masks and most have “eyeholes” drilled into the metal though there are also some “eyeless”

version. Arrows represent a relatively common form; other forms include arrows, squares, rectangles, and “prisms” (the last-named is a rectangular-shaped stripe of metal with pointed ends mounted diagonally) are other available shapes. Obround-shaped can also be termed a lozenge-shaped form. Since many targets are double-vaned, two different shapes are often found together; arrows and masks are common components of double-vanes. Double-vaned targets with a single shape are sometimes employed but there are drawbacks to one shape for both indications (Camp 1903, 345).

Messages bear some resemblance to those of semaphore signals. For example, the nineteenth century target of prism and mask suggests a proceed indication by the diagonal position of the prism, and the horizontal position of the mask vaguely suggests a stop message. This specific target is in use in the US and SA and bears these messages (Bethlehem 1981; SA 1947, 172). The message of proceed is seen from the perspective of the mainline and also the message of stop. A target with one vane and a blind edge suggests a European signal board in that the non-message or blind-edge indicates proceed. Arrows and “fish-tails” can indicate the “side toward which the switch is thrown” (Camp 1903, 346).

Colors, day and night, are in harmony with those of mainline signal usage. There are instances in which white is a clear color (SA 1947, 137) and it is conceivable that this dates back to the time when white was the clear indication not green. This is also true of the Phillipines

where white discs are employed for mainline though red lamps are in use at night (UN-TAAEC 1954, 22). White can also provide an alternative of green in mainline situations. Clear, green, and red meanings are from the viewpoint of the mainline with the opposite meanings from the siding or other divergent line. Purple is sometimes found with derail situations (again SA); purple is also in use in Japan (JNR, 2-8).

Messages for various forms of disc signals are complex because of the variety of forms even though many of those signals are only found in a few systems; the extensive coverage may belie the limited usage of those signals. Graphic signals present the reverse situation: many signals that can be briefly summed up.

Graphic signals generally use simple forms: rectangles, arrows, circles and partial circles. Within these forms the specific design may show variation: an arrow can be very representational; it can also be an abstract form. But all forms of arrows can be subsumed under the heading of arrows. The Germanic mode of signals for points is a common form of those signals. Many of these graphic signals are found in European systems. (*Signalbuch* 1981; *Oxford-Duden* 1980, 203; other European signal codes).

In nearly all instances the signal housing of these signals is black and the shape of the message indication is cut into the housing walls. The signal lamp, when in operation, is seen through translucent white glass. White on black provides a clear contrast and the resulting message is unambiguous. As noted earlier with graphic signals, single forms can be seen

when unlighted; double-crossings (such as in Germanic systems) can not be seen and therefore are included with all-lighted graphic signals. (*Signalbuch* 1981).

Basic messages for graphics signals include an upright rectangle for a straight route for a train. Arrows indicate right or left. Circle indicates route set for mainline usage. Partial-circles indicates route set for a divergent line. The variant classification (Ch 2B provides illustrations of the basic forms and also variant forms of graphic signals).

Messages for track indicators follow a simple pattern: track occupied or track not occupied. While the means of displaying that message can vary the actual message does not. Semaphore indicators present standard indications though the message is couched in term of occupied or not occupied rather proceed and stop (This segment is based on an amalgamation of several sources treating of track indicators: Southern Pacific, Sante Fe, SA, Rock Island, Union Pacific, US&S 1911, 1929, Hall Signal). The position form consists of several dots in a vertical plane for not occupied and the same number of dots in a horizontal line for occupied. There are two lighted versions: one that is turned on when the track is occupied but dark otherwise, and the second that has standard green and red indications. Due to its limited power it may be asked whether this is a fully lighted or a partially-lighted form.

The pointer type has three indications: the pointer, when positioned to the right of center (green panel), indicates one of four messages all of which denote no danger; the

indicator, when positioned to the left of center (red panel), indicates one of four messages all of which denote danger; when the pointer is positioned in the center (the word train is provided in place of a color such as yellow) it indicates “train is approaching” and appears to constitute a cautionary message. Three-position indicators were employed on double tracks at main line switches. The disc form displays a red disc for any of four messages; all of which denote danger; the withdrawal indication denotes one of four messages all of which signify clear. SA has a variant form that partially resembles a semaphore arm but also bears resemblance to a check mark (SA 1947, 139). NZR form has a bar-shaped symbol that is referred to as an arm. NZR provides a dual means of portraying the message: illumination or lack of it can substitute or supplement the arm (NZR 1979, 115).

5F Non-Sign Markings

5F1 Problems of Terminology for Markings & Signs

It should not be difficult to define sign in Transportation-Markings. Yet below the surface meaning of sign, problems can develop: how to distinguish between objects that appear to be signs yet are notably different? This matter arises in signal boards but is resolved since signal boards have changing messages and the attached lamps are integral to the board. There is a larger problem in describing markings and how they differ from signs.

The first problem is one of terminology: the entire Series is centered on T-M and to label certain objects as markings within markings is confusing. Markings (with a capital "M") originates with Traffic Control Devices (TCD). TCDs are divided into signals, signs and markings; markings lack words and graphic symbols (and/ or vertical objects). There are similar non-signal and non-sign objects within railway "signals", and the term marking is no more adequate in rail matters than in road situations. But there is no adequate substitute and it seems necessary to continue using markings in a double sense. The compiler has modified the term to non-sign markings in many places.

A second problem is the defining of signs, and of markings (or non-sign markings) accompanied by an explanation of how they differ. The sign has at least two characteristics: 1) they have two basic components: sign board, and the supporting structure (often a post, sometimes a more elaborate framework). The supporting structure is not

eclipsed or made obscure by the sign board. 2) The sign board serves as a background for the principal message. That message consists of numbers, letters, or graphic symbols or some combination thereof. The board is painted and while it may contain a border color, the centerpiece of the message are the symbols superimposed on the board.

Markings, though of many different shapes and sizes, have one basic characteristic: the message is coterminous with the dimensions of the object. The message may be a solid color, stripes, bands or other symbols which usually extends to the limits of the object. Symbols are the message; there is nothing superimposed (a word, a graphic picture, etc.) over the primary symbols. A second characteristic applies only to some forms: many non-sign markings have no separate support structure and, if present, it is largely invisible since many forms of boards lack that characteristic. Some markings, especially posts and stakes, may exhibit kilometer or mileage numbers. These markings are retained since in all other respects they fit the category of non-sign markings. There are also board markings mounted on sign posts and more similar to signs than to markings. But in these cases the message is very similar to marking messages and hence these boards are retained with markings.

It may be possible to find enough exceptions to undermine the basic characteristics of signs and of markings. But the available evidence supports the characteristics as described: signs contain symbols imposed on a board and do not envelop the board. Non-sign markings exhibit symbols encompassing the complete area of the surface without regard

to shape or size. The classification of AREA though headed “Railway Signs” also includes non-sign markings. It is not difficult to split apart the two forms of Transportation-Markings though it seems to confuse the issue to have what are clearly signs and what are non-sign markings merged into one undifferentiated classification (AREA 1987, 1-7-2 and 1-7-3 [American Railway ...]).

5F2 Types and Messages for Non-sign Markings

Dividing the type of markings from the message is not very workable since the physical dimensions and messages are closely “tied” together. This statement can be made of signs as well though not to the same degree: messages and the physical dimensions can be separated with signs. The classification and explanatory notes provide a foundation for this coverage.

Pillars or posts are tall objects that are slender, or narrow, and either straight or tapered. They are employed by only a limited number of systems. Norway, Australia, and Poland are the larger users of pillars (NSB Sikkerton; OBB 1979, 86ff; PKP 1975, 138). White is a common color but usually in conjunction with a second color (often black, yellow or red). Colors are in bands not stripes and following a horizontal pattern. The bands are frequently the entire message though Austria employs pillars for km markers and these have numbers as well. Because the km markers are in other respects a non-sign marking they are so included. Available information indicates that only Poland maintains lighted pillars. Functions for pillars include marking of

boundaries, railway crossing and kilometer distances.

In this study petites are small vertical and horizontal markings. There is no rule for height or width though they are small and would not be confused with pillars and posts. Petites may be squat as well as short. There is no adequate term in English for this form of marking; the Polish term “slupniks” meaning pillaret (slup being pillar) sums them up well (PKP 1975, 138). Vertical forms are usually rectangular or cylindrical; tops can be flat, curved, or peaked. Bands or stripes constitute much of the messages. White is a commonly used color though possibly eclipsed by black. No lighted petites are found only in Poland (PKP 1975, Rozdzial III). Petite uses include the marking of junctures of tracks, advising of upcoming signals, and the noting of kilometer distances.

Marking boards are primarily an European object though a few systems elsewhere employ them (for example, RAN and SNCA). OSShD includes boards and that organization includes board and that organization included some non-European member systems (OSShD 1962, 21-22). The largest and most diverse system is found in the Netherlands. Board shapes are usually rectangular though Poland include some square forms (PKP 1975, 150f). They are boards rather than pillars or other forms since they display substantial width but little depth (Italian tavola can be translated as plank; it can sum up a general category; FS 1983). Supports are often visible though less so than with signs. Boards are usually vertical though the Netherlands includes some slanted forms; this may be construed as a variant form (NS 1975-83, 48ff).

Symbols for boards can vary widely. The most common are diagonal stripes; straight lines, zigzags and chevrons are other forms. Black symbols on a white ground is the most common color pattern; other patterns including black on yellow are in use. Frequently there are three boards with each in turn denoting a decreasing distance to an approaching signal. Distances denoted by the symbols varies greatly. The Netherlands places the boards at intervals of 50 meters, 60 meters and again 60 meters (NS 1975, 48-54). DB employs a more common pattern of 100, 175, and 250 meters (Oxford-Duden 1980, 354). Norway sets the boards well back from the signal: 400, 800 and 1000 meters (NSB Sikkerheten). Symbols are triplicate for the board that is farthest from the signal; the second is in duplicate and the final one has a single symbol. For some systems chevrons denote signals on a curve or at the end of a curve. In the Dutch system a board with curved ends marks a mechanical signal and zigzag symbols denote curves (Op de Rails 1980, 57). Italy's approach is singular in that multiple boards are not in use but rather variant patterns of symbols mark specific functions. These include horizontal white and black bands, diagonal stripes, yellow stripes imposed on diagonal stripes and yellow and black checks. These markings denote signals off-center signals, and railway crossings (FS 1983).

Sign-like objects within non-sign markings suggest vagueness; see Explanatory Notes (Ch 2B) for an explanation of the terminology. There are only a limited number of these objects. South Africa, DB and Poland employ them for stop or halt boards (SAR 1964, 47; DB 1981, 79, 83; PKP 1975, 159 and following references). In these instances the

object is a large, horizontal board. Symbols include black border on white ground for South Africa, and diagonal stripes for DB and Poland. Trapezoid stop boards and inverted “V” snow plow markings are other members of this category; Austria is a one user of the trapezoid (OBB 1979, 73) and DB is one user of the latter (DB 1981, 83). Additional forms are employed by Norway, Western Australia and New South Wales (NSB, WA 1974, 456, NSW 1952). NSW 1952). NSW presents a complex situation: land marks contain elements of signals and signs yet tend toward a marking form; brakes landmark suggestive of a marking yet conceptually a sign (NSW 1952).

5G Railway Signs*

5G1 Introduction and Types

Even this brief coverage of signs is provisional and tentative in character: written documents are uneven in describing signs, and signs are very much localized. Signal code materials received by this compiler frequently emphasized signals rather than signs. This is very much the case for some signal codes. Signs were either not very important in many systems or left to local authorities to deal with. Even AAR, which produces an exhaustive listing of signals and messages, has limited information on signs in their files from individual railroads (AAR, Foley 3-12-1975 [US]). However, AREA provides an extensive classification of signs (and non-sign markings) that provides a valuable perspective on both categories and individual types of signs. This classification is

accompanied by information on materials and design (AREA 1987, 1-7-2 and 1-7-3 [American ...]).

Signs are of a very individual character. They lack commonality even more than non-sign markings. Many signs do display black letters or numbers on white grounds and that often is the extent of shared characteristics among signs. Shapes, sizes, locations, inscription vary greatly from one system to another. Only the electric traction signs of Europe represent a large body of signs that are similar in many systems.

Despite these problems it is possible to describe the basic characteristics of signs. Signs, without regard to location, refer to the same kinds of situations: tracks, junction, stations, yards; political boundaries; geographical features and so forth. Common referents thereby shapes the forms and symbols of signs. Even if one can not build up a comprehensive and definitive system of signs one can discuss the major roles of signs and how they carry out those roles. The classifications of this study provide a foundation for the type of signs which in turn provides a framework for 5G1 and 5G2.

Signs, among Transportation-Markings, are associated more with traffic control devices. And originally this compiler thought of using the three-part arrangement (warning, regulatory, information or guidance) of traffic signs for a framework for railway signs. But railway signs have a character of their own and parts of the TCD form would have a limited place in railway signs. For example, the category of warning signs would have little value for railway signs while conversely

speed signs, just one category for roads, are often the main kind of signs in railways (see Volume IIE of this series). The Classification of Chapter 2 and this segment divided railway signs into speed control signs, and non-speed signs; the second category includes a diverse group of various forms of regulatory and guidance lacking any clear focus.

The classification and explanatory notes try to sum up the kinds of signs succinctly but without obscuring the kinds of signs in the various categories. This “succinct summing up” can be seen very clearly with Approach signs (5310) and Station and Other Geographical Features-related signs (5311). The intent was to bring together independent yet related signs without “squashing” a diverse grouping of signs. Approach signs include any sign advising, warning, noting that the upcoming arrival of station, bridge, rail (level) crossing, railway yard and other objects or destinations for the train crew. There are signs for many of these same objects at their actual location (for example, signs will be found at bridges, level crossings, etc). The illustrations in Chapter 2C providing a sampling of these signs.

Location signs include kilometer and mileage signs. These signs provide a classification and description problem since some forms are closer in definition to a non-sign marking than to a sign. These objects sit astride a narrow and uncertain line between those categories. For this study if a kilometer/mileage object is clearly a sign then it is so listed if its form is closer to a non-sign marking then it will be placed in that category (even if letters and/or numbers are present). Portugal is an example of a system employing a sign for

kilometer indications (CP 1981, 51). Location is a recurring concept in the AREA classification and appears in several of the categories beyond the specific location group (AREA 1987, 1-7-2 and 1-7-3). Signal-related signs (5312) are of two forms: one is an identification mark for the signal rather than a direct safety aid. These signs display letters and/or numbers for each signal installations. A second form relates directly to the signal operation. In France these signs are important adjuncts to the signals noting the beginning and ending of sections and various regulations (SNCF 1985).

Stop boards are also of two forms. In the first form the stop board indicates the point on the track where an approaching train is to stop; DB is a system employing this sign (DB 1981, 83). In a second form, which is found with several non-European systems, the stop board announces an approaching stop point. The two kinds of stop boards overlap in function but some differences are easily discerned (DB 1981, 82; SAR 1936, 19). Some stop boards are clearly signs while others are closer in design and symbols to non-sign markings. The problem of objects found in both sign and non-sign markings was previously discussed with kilometer/mileage markings.

Section and block signs includes a large variety of signs. They include signs denoting the beginning and end of specified segments of track or specific functions; an example of the latter would be signs. They include signs denoting the beginning and ending of specified segments of track or specific functions; an example of the latter would be signs noting where shunting movements are permitted and also where

forbidden. These signs while diverse but, nonetheless, share a relatively close function. Electric traction signs (5316) constitute the only international systems of signs. These signs are found in Europe from the USSR to Portugal. There are some national variations in colors, design and the number of types of traction signs. Yet the points of commonality remain strong for these signs.

Speed control signs can be described briefly because of the narrow range of functions that they perform. Brevity of coverage can belie the importance and abundance of these signs. Speed signs have been divided into three categories in the classification 2A. While that may be accurate there are other forms of signs, other perspectives on speed signs that are possible. Each of the three categories can be either temporary or permanent. Temporary signs frequently are shaped or colored differently from permanent forms. Speed signs, whether temporary or not, are often in a three-part pattern: announcing upcoming signs, then the actual speed limits, followed by announcement of the ending of the restriction. Speed signal types exist for general purposes and they also include signs for special rail lines, or special categories of trains (e.g., branch lines may have separate speeds, and separate speeds may be in force for passengers and freight trains). Many of the railway signs that are lighted include speed control signs especially in Europe.

Only limited information exists on materials for railway signs. Again, AREA provides an introduction to that topic. Posts can be of several materials including wood -- if treated,

concrete, and steel. AREA recommends the use of aluminum (plates or of an extruded form) for signs though fiberglass (GRP in Europe) is acceptable (AREA 1987, 1-7-3).

5G2 Messages for Signs

If sign types are both complicated and more uncertain then the messages for signs magnify those problems. A single type of sign (for example, a station sign) can exhibit a variety of shapes, colors, graphic and alphanumeric symbols. It is still possible to discuss sign messages if one accepts imprecision and some degree of indefinitiveness.

AREA recommends “definite sign shapes” without giving particulars (AREA 1987, 1-7-3 including paragraph). Sizes are not standardized though size of legend is a determining factor for sign size. A sharp contrast between symbol and backgrounds is recommended with white or yellow backgrounds with black letters offering good contrast. Symbols should be brief and bold with limited use of words.

The announcing of speed restrictions can be indicated by either word messages, a letter, or by the actual speed indication. In the last case a second sign with the same indication denotes the beginning of the speed restriction. Shapes of signs, colors, and other means accompany the actual message and forms part of it. The actual restriction is usually presented in numbers or in abbreviated numbers. In some European systems a number such as “9” on a sign is multiplied by a factor of 10 which translates into a speed of 90 km/h. In some instances a graphic symbol indicates a speed restriction

without the display of actual numbers. In those and other instances an important part of the signal messages is found in signal colors, other documents or from a body of shared, common knowledge. Symbols and the reading of symbols frequently requires more information than an actual sign can convey; invisible social and cultural underpinnings plays a major role with any markings even if they are seemingly intangible. Ending of speed restrictions can be indicated by signs with a word message or by a single letter. In a number of instances a graphic symbol is used which is known to have the meaning of end of restriction or resume previous speed.

Sign shapes appear to be carefully regulated in some systems while in other systems a broad variety is in use. Most geometric shapes are in use. Circles and triangles are commonplaces in North America, and triangles in Europe. Rectangles are common for UAR (horizontal, Annex). Variety in shapes is eclipsed by variety in colors and combinations of colors. Black on white is a common combination not only for speed signs but for many forms of signs. Black on yellow is a frequent combination for speed signs; a variety of European systems employ that form. White on black is in use by SNCF and systems influenced by SNCF (SNCF 1985, SNCF 1968, 15). Some systems employ a two-level approach: yellow for announcing a restriction, and white for the actual restriction. Special color patterns may be invoked for express trains, branch lines, freight trains and mainlines. Temporary and permanent restrictions can be distinguished through color as well. Among signs that are lighted the lamp indication reflects the day color; a sign with a yellow background is accompanied by yellow lamps, while a sign with

a green background is marked by a green lamp.

Speed signs refer to a relatively narrow range of functions. Non-speed signs refer to many points of reference and are a more amorphous subject as a result. The classifications and explanatory notes provide some structure for these signs and for their purposes. Messages are more word-related than those for speed; alphanumeric symbols are more important than graphic or geometric symbols though not overwhelmingly so. White letters on a black ground is perhaps the most common color combination. Blue and white is a common motif of electric traction signs in Europe. Other colors and combinations are in use including red as a ground color for stop or halt signs. Frequently there is a high degree of individuality in railway signs especially for non-speed forms.

Messages for non-speed signs requires only brief coverage. In part because the subject is very diffuse, and in part because simply listing and classifying of the types of these messages. This is in contrast to speed signs which require considerable treatment though they can be summed up briefly in the classification. An exception to this rule are the electric traction signs. They make up a coherent body of signs. Messages are generally graphic symbols in blue on white grounds. The shapes are frequently diamond-shaped. Messages denote areas of traction services, permissible and closed areas, specific tracks of usage and related concerns. Alternate color patterns include yellow and black, black and white, red, yellow and blue. These signs are most often unlighted forms (SBB 1982, 27; see also DB 1981, 35). The illustrations in Chapter 2C included standard forms

and also variant forms. These may give an impression of marked individuality rather than commonality. That impression is caused by including variant forms found in a few systems or even a single system. Nonetheless, most of these signs are very similar.

*This treatment of signs is a compilation of ideas from many sources. It is not possible to give individual citations for all of the sources except where a specific system is mentioned.

CHAPTER SIX

OTHER SIGNALS: MOBILE & OTHER NON- TRACK-SIDE SIGNALS, ACOUSTIC & RADIO SIGNALS, INTER-MODAL DEVICES (LEVEL/ GRADE CROSSINGS)

6A Mobile & Other Non-Trackside Signals

6A1 Introduction to Chapter 6

The first edition included visual signals that were fully, partially lighted and unlighted devices. It did not include acoustic, and electronic signals (both small units). It did include movable signals in an appendix though some nontrackside signals were omitted (termed Staffs, Tablet, Tickets & Tok-ens [STTT] which has been expanded). It also excluded level/grade crossings (inter-modal devices). However, *T-M Database: Railway Signals, Signs, Marks & Markers* (DB-RR 2009) included all of those entities in a single chapter (as well as unlighted devices). This edition includes missing topics and moves the appendix to this new chapter.

Terminology can be an uncertain process including this chapter. “Movable” in the first edition is replaced by “mobile” (Calvert 2004). Sound terms are also uncertain: Sound, acoustic, acoustical, and audible are available and each usable and questionable uses for this and other T-M studies. For example, sound devices can be so labelled and a variety of other titles (e.g., acoustic and audible signals). Sub-divisions in turn can generate a variety of terms. Related

terminology in other T-M forms adds to the confusion especially when comparable terms are applied to other modes. An attempt has been made to establish satisfactory terms but it is no more than partially successful.

Mobile and other Non-trackside Signals (6A) coverage is based on the first edition material. Only Time-Interval is a new topic. Other topics in Chapter 6 have made considerable use of DB-RR 2009. New sources and other uses of T-M information have been added. The first edition included a very brief reference to sound devices, and none at all of radio forms. However, a new segment, Acoustic and Radio Signals (6B), adds a variety of acoustic devices as well as one radio devices for a type of token. Acoustic devices employed for older forms and partial use for train control are included. A final sub-chapter, Inter-modal Devices: Grade/Level Crossings (6C), was omitted in the first edition but included here. It includes both visual and sound devices.

6A2 Introduction to 6A

This study and its companion studies are concerned with human communication. However, the study is specifically concerned with indirect communication (via electromagnetic devices, graphic symbols, electronic and acoustical devices, etc.) rather than direct human communication. Human communication in a direct mode (arm and hand signals), , though often found in signal codes, is not included in this study. Signals and related devices for this study are clearly external to the trains and their crews with a possible exception are cab signals which, though mounted in the engine cab,

are connected to track-mounted sensors. Cab signals are therefore similar to other signals; they are not a purely internal train system.

One aspect of signaling that remains an indeterminate and uncertain area is that of staffs, tablets, tickets, and tokens. These objects, while remaining signals, are of a mobile nature. They are different from wayside signals and they are also different from train to train or station to track communication systems. Put simply, they are signals that move about. While it may be logical to include them with wayside signals, their character and mode of operation are at variance from wayside signals, and for that reason they are included in this chapter.

A variety of these systems were still in use late in the twentieth century (and no doubt dwindling more in the twentieth first). The devices began in the UK in the nineteenth century and spread to many systems especially those influenced by UK practices. The systems were devised for single track railways as safety insurance since trains travelled in both directions. A common denominator in all of them is an object that is given by a signal crew at the beginning of the block section. This object allows the train into the block. Other train crews (especially those from the opposite direction) cannot gain access to the same section as long as the object is in the possession of the crew. In many instances there are semaphore signals as well as the token or other objects (K&W 1963, 59-62; AAR 1953, 11; see also Hammond 1964, 64).

The simplest form is the wooden staff form that is employed for “dead-end branches carrying only light traffic” (K&W 1963, 59). This form lacks semaphore signals. A variant form known as staff and ticket allows for permissive working of a section. In this form a traffic crew is able to view the staff but receives instead a paper ticket (In some instances metal tickets were employed in South Africa (SAR 1947, 117). In this form several trains are able to follow the first train into the section; each in turn receives a ticket after seeing the staff. The last train through actually gets the staff which they then carry to the signal hut on the opposite end. The process can begin anew from that point on the block (K&W 1963, 62-64; AAR 1953, 11; Hammond 1964, 133).

Hammond includes mention of a multi-part staff that can serve in lieu of staff and tickets. The multi-part staff unscrews into several pieces so each of several crews can receive a portion as they travel through a section (Hammond 1964, 64). The tablets in forms were discs six inches in diameter and installed in electric interlocking machines. This system, following the token form, allowed removal of a single disc but no additional discs until the first was placed back into the machine (Hammond 1964, 64, see also AAR 1953, 11).

The electric staff or token machine began in 1870 and the key token version in 1912 (Field and Grant 1987). This is similar in operation to the electric tablet machine. This form of machine is integrated with a block apparatus that includes wayside signals. The Neale ball-token instrument receives little attention in the literature. It is currently available

and employs ball-tokens 1.6 inch in diameter (United Nations 1954; Westinghouse Saxby Farmer, Neale's). The US did not make extensive usage of these various systems. Though some units of the Webb & Thompson Electric Train Staff were in use during the 1890s (AAR 1953, 11).

Two electric token systems are currently available: They include Tyler models (Field & Grant) and Neale (Westinghouse Saxby Farmer, Ltd). The former is a key token operation; the later is a ball token apparatus. The Tyler equipment is an updated version of much older systems while Neale appears to be a more traditional system. Other sources include STS No. 12 Key Token Instrument (STS Rail Technologies); See also Token (railway signalling), Wikipedia.

While key tokens and ball tokens are very much removed from fixed signals in some respects, they bear a striking resemblance in a context of symbolic meaning. The shapes of signal boards and the graphic symbols of key tokens are very close; even the color schema is very similar (and as noted elsewhere in this study, the UN at one time considered a shape/color traffic signal, which was very close in shape to tokens and signal boards) (UN 1968, 72-4). Is it possible to go further and suggest a correlation in meaning of color and shape as well? That would be more difficult to establish but it possible that green may indicate more significant (or longer) sections, yellow may indicate lesser lines and so forth. At least on two of three points the correlation of symbols is very high. Less can be said of the ball token though there are graphic symbols that may parallel symbols of other signals.

Other systems important for train operations were the time table, train order systems, and time interval. The train order system involved written orders handed to the crew at the station. Train orders can be regarded as objects (as are paper tickets) though in a different mode. Some forms apparently were not accompanied by train order signals (UN 1954). But in many systems such signals were an important element (SAR 1947, 161-170; Armstrong 1957, 4). Armstrong also notes the existence of standard train orders. For example, if the semaphore was at the stop position then a "Form 31" was given to the crew; this form was regarded as a stop indication since the order "may restrict the right of a train where delivered." A "Form 19" was marked by a caution signal and could be picked up on the fly; it did not adversely affect safety if missed (Armstrong 1957, 4).

Train working also included time tables and time intervals though largely outside signal systems. Time tables provides an structure for operations though unforeseen incidents could lead to disasters. Train intervals proceeded by placing an interval of some minutes between trains. If trains were delayed a flagger would walk up the tracks with a red lantern to warn of the stopped trains. Torpedoes (detonators) and fusees were carried if need further warning was needed. These are signals are of a sort. (Cloud and Simons, RSD 1911, 28); Armstrong 1978, UN 1954, Calvert 2004.

An addition to STTT is the Radio Electronic Token Block (RETB) though electronic in nature. RETB refers to exchange of electronic tokens rather than physical tokens. The token is a visual message on a locomotive screen

(De Vilder, F; ERS-1995, 226). Train crew requests token if block is open; the token is issued if open. The crew then prepares for reception of token. Token is transmitted by radio. (Radio Electronic Token Block, Wikipedia). Tokenless Block can indicate RETB but it can also refer to a system involving radio transmissions without a computer generating dimension. DB-RR 2009 includes a variety of sources that indicate one form or the other.



“If North America (and particularly western North America) is the spiritual home of the train order, the Highlands are the place to go for token signalling.”

Brian Hollingsworth, *The Pleasures of Railway* 1983, 45

6B Acoustical Signals

6B1 Introduction & Detonators & Fuzees

a) Introduction

This type of safety devices was largely omitted in the 1991 edition (save sound signals for cab signals). While a relatively small aid it has significance in many railways (and roads in level/grade crossing situations). DB-RR 2009, by contrast, includes many forms of audible signals. A variety of terms are also present in the history monograph (2002). DB-RR 2009, in particular, influences the spectrum of terms in use. A discussion of terms for the overarching signals, as well as individual forms, is required.

Acoustical signals in this study present a spectrum of devices: Cab signals and train control; detonators and fuzees, level/grade crossings, and other forms). The sound devices are often attached to visual forms of devices. The complete coverage of acoustical/visual devices is found elsewhere in this study.

b) Detonators and Fuzees.

Detonator is an explosive device placed on track and exploded by a passing train. The term was employed in UK, European nations and South Africa among other locales. The term Torpedo has been used in the US. (Guidance on Railway Fog Signals) 2006; Hollingsworth 1983, UAR 1983, SA TWR 1964; Vanns 1997, 129-130; T-M History 2002, 181-82; DB-RR 2009, 378-381).

Detonators are often associated with fog (e.g., Fog Signals, Fog Detonator, Fogging Machines). Other uses have been employed: accidents, track works, immobilized trains. Fog is not the only weather conditions for detonators. Snow has required use of these devices. (Detonators (railways). Messages can be applied to the number of exploded detonators. One to three explosions may indicate caution, stop or be prepared depending on a rail system's operational instructions. (DB-RR 2009, 380).

A related aid is the Fuzee which an equivalent of the flare. Its use was employed in the train order system (UK) or time interval system (US). It was a form of chemical fire and the fuzee could be thrown off the train or inserted in the ground (Dictionary of Words, Terms & Phrases ... in RSD 1911, 1-36). It is available in red, green, yellow colors. (Calvert 2004; DB-RR 2009, 381- 382).

6B2 Other Acoustic Signals

The previous coverage, Detonators and Fuzees, are free-standing units. While they affect the workings of lighted signals they are substantially apart for other signals. This group of devices are an integral unit with visual devices. To a degree they are overshadowed by visual forms (e.g. gates with markings, lighted signals, road signs, even road markings). This segment includes sound devices only. They include crossing devices, cab and train control and other forms including miscellaneous devices, and various track indicators). This monograph includes the visual aspects of the signals as well.

i) Level/Grade Crossings

Bells are a common feature of crossings. References to the use of bells include many national safety systems. The character of the bells can take various forms which may not be specified. Traditional bells are mechanical (or electro-mechanical) in design. (Level Crossing, Wikipedia; Westinghouse Brake & Signal, Australia [WBS]). Newer electronic bells are increasing in designs and numbers. Some include mechanical forms though electronic in nature. Others employ microchips that emulate older mechanical versions. (WBS, Australia and General Signal). Bells can be designated for pedestrians (Audible Warning Devices [WRSC} 1957). Bells often include a gong as part of the components yet remain a bell. By contrast the gong (maritime usage) can be a separate unit and fully functioning device. The actual operation of the bell for crossings may include a gong yet the resulting sound can be deciphered as a recognized bell sound. (T-M History 2002, 186). In summary, sound devices are included without specific usage of motor vehicles or pedestrian

Bells are employed in the Western Hemisphere and other areas including Australia where similar or identical signals are employed (e.g. Westinghouse Brake & Signal (UK). Numerous European nations include sound signals. Frequently they are described as audible warnings without specifics of sound-producing mechanism. Luxembourg includes both bells and gongs. (Middelraud ERS 1995, 347-348, [Bailey]). Both UN conferences include mention of sound-only signals. Seemingly, there is no mention of specific forms. (UN 1949, 107; UN 1968, 98). Hall and Mark includes a less mentioned

term: warblers in Europe usage. They also add a more explicit term: beepers. The Free Dictionary refers to this as [a] high-pitched sound as from an electronic device.” (Free Dictionary 2014).

Several other sound terms have been in use. Some may be in current use while others are archaic. The Hoeschen bell is an historic term from the earlier 20th century. It was powered by a magneto-generator by levers activated by train passing over interconnected rail. (King 1921, 308 ff; also DB-RR 2009, 385). King also includes a Locomotive Type Crossing Bell (King 1921, 303). WRSC includes that bell in addition to more common place systems. It is one of several devices known as Audible Warning Devices (WRSCo, 1957, 20ff; DB-RR 2009, 385). AAR dictionary includes Vibrating Bell and Single-stroke Bells. The former does not cease until the opening of the circuit. The former has a single stroke of operation. (AAR, Definitions 1965, 10; DB-RR 2009, 386).

ii) Cab Signals

The devices in this segment are employed for use in cab signals. Some are directly attached to the visual signals while others are linked to forms of automatic train control (including older forms of train stops, other automatic train controls, and a newer automatic warning systems) that have an impact on the use of cab signals including a variety of devices. Visual and sound devices in cab signals are an integral part of the T-M study while some forms of train control assemblage are only a partial aspect of it.

Nock 1979 notes that “[t]he principle was to give dissimilar audible signals in the engine cab” (1979, 780) and the result was a considerable variety so that signals for indicating a safe message (if distant signal was clear) or a caution message (for restrictive signals) are distinct. As a result a variety of sounds has been created for those needs. Over time, in different nations or rail systems encompasses a range of bells, sirens, whistles, hooters and klaxons [Note: hooters are often linked to klaxons]. Double sounds have been replaced by a single sound in some instances (often a whistle). And in other situations a klaxon with a short sounding (with a clear message) is distinguished from a long transmission for danger. (Barwell 1983, 104-105; Blythe 1951, 105; Henry 1942; 165; GRS 1954, 604; Taylor 1949, 51; Automatic Safety: Systems of ATC in Mike’s Railway History; Automatic Warning Systems in Wikipedia). An infrequent sound, the gong, has been used only sparingly with a danger indication (Vanns 1996, 130). On occasion there is mention of audible sound devices without designation of type of sound and usage.

iii) Other Forms

Other Forms include a single term termed the Fog Gong, and a group of terms under the theme of track crews safety. It was affixed to visual signals as a warning in foggy weather especially when in danger of overrunning a signal position. Only one source includes the fog gong: Jackson (1992, 106). It is seemingly, or at least infrequent, for a broad range of sources to omit a device. Gongs are employed in Luxembourg; that is an infrequent usage (Middelraud ERS 1995, 347-348). One other rare usage is that of warblers.

However the source, Hall & Mark, includes it but lacking details (2008, 94).

Forms of track crew warning devices are likely to be visual more than sound. Nonetheless, some audible forms have been in use. This term is included in the classification. A more limited device, Track Indicators (US) includes the use of bells. A broader system in Europe usage employs the term of Staff Warning Systems including several forms. References are made to visual and occasionally audible. The nature of the of the sound alarm is not described (Hammargren, J; ERS 1995, 359-361 [Bailey]; King 1921, 21; Hall Switch & Signal ca. 1913. The first edition of this study, and also DB-RR 2009 provides information on this topic.

6C Inter-Modal Devices (Grade/Level Crossings)

a) Introduction

Grade/level crossing safety devices is a complex issue. It involves two of the transportation modes (road and rail) and many forms of safety devices can be employed for crossing safety. *Traffic Control Devices Handbook (US)* describes it as “a unique environment.” (1983, 8-1). A crossing can require lighted flashing signals (older forms may include a moving device), traffic signs of various designs, sound signals (bells and gongs), and physical barriers which move and display graphic markings (such markings may bear a partial resemblance to traffic barricades). A road dimension, traffic markings, adds a final feature to the assemblage.

The range of grade/level crossing devices is global. The number of devices (and type) is massive. Some large systems (e.g., US, Canada, Australia) maintain a relatively simple pattern of devices despite size. But overall there is a more complex of devices and employment. A classifying and inventory system is needed to sort out and arrange forms. A system exist to some degree in the UK. That extensive system of forms and acronym has been developed over time. Complexity increased over time and change but a simpler version has been applied in this study. Certain terms or acronyms have been relatively common. One example can be found with AHB (Automatic Half Barrier (Hall and Mark in *Level Crossing* includes an index for authors, pictures and texts). AHB is applied to similar devices which lack that

term (e.g., the standard lifting gates in US and other nations). Various terms aids in sorting and arranging devices beyond UK (Hall & Mark 2008, 94).

b) An Outline of Level/Grade Crossing Devices

Active Crossings:

Manually Controlled Gate (MG)/Barrier (MCB)

Automatic Half-Barrier (AHB)

Automatic Barrier (with local monitoring) (ABCL)

Passive Crossings:

Open Crossings (OC) (NR includes two other forms in Automatic OC which are attached to monitoring processes).

User-Worked Crossing (UWC)

User-Worked Crossing (with Miniature Warning Lights) (UWC-MWL)

Footpath (FP) (May have Miniature Warning Lights; ORR adds Bridleway)

Sources for the outlined terms include Network Rail (former British Rail) an important source of types and meanings. The UK Office of Rail Regulation (ORR) is a contributor as well. (Both under Types of Level Crossings).

Various persons and organization have also contributed terms and meanings. The following modification is workable though of a simple cast. An effort has been made to conform to earlier outlines of terms.

6C2 Description of Terms & Messages

a) Terms

A fuller summary of terms includes basic forms: Active and Passive forms, and Barriers and Gates.

Devices for Level/Grade Crossings can be divided into Active Warning Devices and Passive Warning Devices (Miller 1989; also Network Rail). Active forms include Lighted Signals, Gates, Bells, Passive forms includes Crossbucks (An alternate term is Saltire (St Andrew Crossing) (Level Crossing, Wikipedia). Other sign forms can be included. Lighted signals and bells can be present without gates (Miller 11-1989).

Barriers and Gates include a wide range of designs. Some are in the form of lifting gates while other gates literally move on wheels. UK views lifting gates (US and others) as a barrier while gates are devices that roll on wheels. Some basic forms are found in many nations while others display a broad range of gates are complex in design and technology. A pattern can be divided into two categories: nations with a single form of lifting gates (US, Canada, Australia are frequent users along with many other systems). Some European nations have a variety of forms (Hall & Mark 2008, 94; Level.

Crossing, Wikipedia 2014

Other gate and barrier forms are in use though of a more reduced usage:

Automatic Double Barrier (ADB). This form has two additional “half-barriers booms.” They are located at road users exits. (Hall & Mark 2008, 94).

Automatic Full Barrier (AFB)/Manual Full Barrier (MFB). This refers to two barrier booms that blocks the entire road. Folding skirts are a common option. (H & M 2008, 94).

Boom Gates. According to Allen & Woolstenholmes “[T]hey give the appearance of a low garden fence.” It is moved by use of wheels (A & W 1991, 73).

Full Barrier closes off the entire road. Half-barriers are more common. This refers primarily to UK. (Level Crossing, Wikipedia 2014, 9).

Lifting Barriers, Swinging Gates. Terms provide a more explicit description of the devices and how they move. (Allen & Woolstenholmes 1991, 73 [A&W]).

b) Messages

UN 1968 provides an overview of lighted and unlighted messages. Flashing red light (s) are included to mark a train approaching a grade/level crossing or immediate of gates/barriers. Many national systems also include such light (s) which can be flashing or of fixed display. Gates and barriers can display one of several painted patterns: Red/white, Red/ yellow, Black/white, Black/yellow. A single color can be displayed (white or yellow); a substantial red disc is added to the single

color. Signs and a panel can be included (UN 1968, 98).

White light(s) are included in a variety of crossing systems. Hall and Mark refer to one form for AOC locations (H & M 2008, 94). Wikipedia mentions flashing white in Finland (when red is not flashing). Flashing yellow lights are employed in Australia for Advance Active Warning Signals (AAWS) (Level Crossings, Wikipedia 2014). Yellow is also used for an initial warning stage in flashing mode. This refers to AHB (Hall and Mark 2008, 94).

GLOSSARY

Alphanumeric. Refers to signals displaying letters and/or numbers for a signal indication.

Aspect. The appearance of a signal (G, Y, R, etc). In some systems aspect refers to the number of signal lamps per unit (for example, a two-aspect signal or a three-aspect signal). This is confusing if one is accustomed to systems in which aspect means the physical aspect of an operating signal lamp. Position has the meaning of lamp units in some system.

Block. Section of track whose boundaries are marked by signals. An absolute block prohibits entrance of a train into an occupied block. A permissive block permits an additional train(s) to follow an earlier train into the same block. Operation of block includes manual and automatic blocks.

Colors. Major colors include green, yellow and red. Secondary colors include blue, purple, white and lunar white (the last-named also termed blue-white by color authorities). Orange is in use by SBB but they regard that as within the boundaries of the yellow spectrum. Amber is another word for the yellow spectrum. Amber is another word for the yellow hue in use by railways. Violet is substituted for the word purple by some European systems.

Color-light Signal. The main form of signal in which messages are portrayed by one or more colored lights with an agreed-upon meaning. There are two forms: multi-lens with

one lens and lamp unit is available for each color, and the searchlight form whose housing contains all lenses which are rotated into position as required.

Color-position Signal. A signal employing rows of lights (two per row). The colors for each row are standard colors. Some color-position signals are labelled as position-light signals but that is a misnomer.

Configuration. In this study it refers to the arrangement of signal lamps on the face of the signal housing or backplate. Arrangements of configurations include straight-line forms (either horizontal or vertical), and scattered or random.

Disc Signals. These signals display disc-shaped target; they either incorporate lamp units in the face or are flood-lighted. Discs may be either single- or double-faced.

Distant Signal. A caution signal that indicates the status of upcoming home signals. Warner is an alternate name.

Formsignal. Term associated with German and German-influenced signal codes. It includes all partially-lighted signals whether semaphore or not.

Fixed. This can refer to a fixed signal (as opposed to a human hand signal, cab signal and so forth). It can also refer to a lighted signal with a steady or fixed character (as opposed to a flashing signal).

Flashing Signal. An exceptional signal in railway sys-

tems though some systems include significant numbers; in particular, URO. In some systems flashing signals display a single rate of flashing while other systems such can include both slower and faster flashing modes.

Grade Crossing. (An alternate term is level crossing). The point where a motor vehicle roadway and a railway track intersect. Often marked by lights, bells, gates and signs. A more significant signalling concern for traffic control devices.

Home Signal. Those signals marking the boundaries of block sections. They are an absolute stop signal when at the danger position. The definition of home can vary from system to system.

Indication. The meaning or significance of an aspect. See also Aspect.

Interlockings. Interconnected signals and appliances which sequentially succeed one another in their operations. It includes the interlockings operations buildings, signals, switches, various apparatus. By orderly operation of the components as a unit, safe movement of numerous trains is thereby ensured.

Mainline. Principal tracks for a railway system; train movements are governed by signals and related safety aids.

Mainline Signals. Signals for major lines. In UK these are known as Running Signals and are concerned with running lines and movements and exclude such situations as sidings.

Marker Lamp. An auxilliary lamp attached to a regular signal that provides additional information and may qualify principal indications.

Markings. An ambiguous term denoting largely unlighted safety aids lacking alphanumeric messages and whose symbolic messages are most often coterminous with the dimensions of the physical structure. Sign messages, by contrast, are imposed on, and within, the bounds of the physical structure, but they do not encompass its totality. See also Transportation-Markings which is the over-arching term for all safety aids external to a mode of transportation.

Points. Tapered rails at the beginning of a branch track adjacent to a main track. A switching mechanism can so adjust points that a train can travel either on the main track or the siding or other ancillary track.

Points and Switch Indicators. These indicators (also termed signals) are markings for points and include a diverse group that includes unlighted, partially- and fully-lighted mechanisms. Most are two-position signals and denote whether the main or the branch line is open.

Position-light Signal. An all-lighted signal in which rows of one color lights imitate semaphore arms. Lights are either white or amber (yellow). A few systems employ it for main-line uses; many others use one or other version for non-main-line purposes.

Roundel. In some sources roundel is a substitute for

Lens. For AAR the lens is an object that collects light rays from signal lamps and thereby creates a beam of light. While the roundel is an object that spreads, deflects or provide color for that light beam and thereby produces a patterns (AAR 1965, 52, 83).

Route Indicators and Junction Indicators. These signals are especially associated with UK systems. They mark divergent routes. Junction indicators - consisting of rows of lunar white lights - indicate which of several routes are open. Route indicators, often found in train yards, denote which of many routes are open by alphanumeric indications.

Searchlight Signal: See Color-light Signal.

Section: See Block.

Semaphore Signal. A partially-lighted signal denoting messages by the position of arms. There are both upper-quadrant and lower quadrant versions. Some semaphore display fully-integrated blade and lens units while others separate blades from lens and lamp apparatus.

Semiotics. This is the study of signs. The sign stands for something else (T-M Fnd. 2013, 45-48). Signs, in this sense, encompass all symbols though semiotics usually excludes language symbols. An important element of semiotics is Semiosis or sign process. This involves a multi-part relationships involving the actual sign, what it refers to, who views the sign, etc. In Signification and sign (for railways that means the operational signals, signs and markings). Signification is

the meaning that a sign has (green for proceed, etc). SNCF uses the word signification in its system and it has the semiotic meaning of the term. The word meaning is more common in signal codes.

Siding. Auxilliary track for storage of unneeded rail cars, shunting operations, movement to and from rail yards, industrial and other rail users, or as a passing track for mainline trains.

Sign. This has reference to specific markings not sign in a semiotic sense. They are predominantly a day safety aid employing alphanumeric and occasionally graphic or geometric symbols.

Signal. General term for railway mechanisms are at least partially-lighted. Major forms include color-lighted, color-position, position, semaphores and signal boards sig-nals. The term can be restricted to mainline usage though it is also restricted to mainline usage though it is also extended to specialized indicators (switch, point and shunting devices especially). It would appear that Signal at times is an umbrella term for any railway safety aid. Major components include the housing or case, optical assembly (lamps and lenses), hood, backplate (background, backboards or baffles), signal masts (and in some instances signal bridge and ladder).

Signal Code. The book of rules governing the use of signals for a railway system.

Signaling. “The whole of the methods and means by

which the movement of traffic is controlled” (Nock 1962, 20). It includes signals, non-signal communications, block systems, centralized traffic control, automatic train control, interlocking systems, etc. This study is primarily concerned with signals, signs and markings.

Speed Categories and Speed Values. Categories refer to message indications in word forms to which numerical speed indications are attached. Speed values are messages in numerical forms only. Signal messages are in one of these two general divisions.

Speed Signalling. The form of signalling in which various combinations of light indications denote route and speed; a complex speed signal system can project a broad range of messages. Speed signalling can be contrasted to route and junction signalling.

Switch Lamp. A non-mainline signal that can provide either fully-lighted or partially-lighted indications of switch position. A partially-lighted form requires the addition of targets for day indications.

Targets. This term can have two meanings. It can refer to an unlighted or partially-lighted signal consisting of a day signal (target), or it can refer to the day portion of a signal which integrates day and night dimensions. Many US targets have lights but they can as easily have a day only indication. UK and related Disc signals are examples of the second form.

Token. (and also Tickets, Staffs and Tablets). A key,

disc or staff-shaped object given to a train crew allows them to enter a block. It is a means of insuring safe train operations on single-track lines.

Track Indicators. A device frequently employing miniature semaphore arms or graphic symbols that indicates whether or not a train is approach the location of that indicator. Indicators, which are found on only a few US railways, and in Australia, are primarily for the benefit of train crews workin on the track or maintaining switches for divergent lines. They are also known as switch indicators, track car indicators, block indicators, train approach indicators, train occupy indicators or motor car indicators.

Transportation-Markings. All devices, lighted, unlighted, electronic, acoustical external to a mode of transportation that provides guidance/information, regulation and warning information.

Wayside. Designates the area adjacent to tracks. Frequently it is attached to signals that are alongside a track and can be contrasted with human signals and cab signals.

Yard. A delineated area containing an arrangement of multiple tracks for assembling, dissembling trains, storage of rail cards, accepting and disembarking of passengers and goods.

APPENDIX

MAJOR RAILWAY SYSTEMS: SIGNAL TYPES & MESSAGES

Argentina

	R	Y		R
Two-aspect:	OR		Four-aspect:	Y
	G	G		G
				Y
	R			
Three-aspect:	Y			
	G			

Legend: R= Stop; G=Proceed; Y: Caution;
YY= Preliminary Caution

Australia

(South Australia [Australian National Railways incorporated the former system])

Signal patterns are very similar to those of Victoria Railways (see below). SA includes searchlight signals as an alternate, and permissive signals have the lower signal housing off-center. There is one additional indication: a “caution (low speed) signal” with the indication of “Proceed at low speed, prepared to stop.” This is comprised of two red lights and a yellow marker lamp; absolute signal only.

(New South Wales Railways) G
R

G
Y
R

Legend: 2-R=Stop; G/R=Caution (“proceed, next signal at stop”); G/Y=Medium (“proceed, next signal at caution but signal within braking distance”); G/G=Proceed.

(Queensland Railways)

Three-aspect: G Clear
Y Caution
R Stop

Four-aspect: Y
G
Y
R

Caution has meaning of “Proceed, prepared to find next signal at stop.” Double-yellow has caution message of “Proceed, prepared to find next signal at caution.”

(Victoria Railways)

G G/Y “Clear normal speed, ‘ proceed prepared to find signal at proceed.”
Y Y/R “Normal speed warning, ’ proceed prepared to stop at the next signal.”
R

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R/G “Clear medium speed,’ proceed at 25 mph prepared to stop at next signal.”

G R/Y “Medium speed warning,’ proceed at 25 mph prepared to stop at next signal.”

Y

R Y/G “Reduce to medium speed,’ medium proceed at normal speed but pass the next signal at 25 mph.”
R/R Stop.

(Western Australian Government Railways)

G Proceed

Y “Proceed at normal speed prepared to stop at next signal.”

R Stop.

Note: purple marker lamp attached to signal post below main signal; if centered signal is semi-automatic; if off-centered then it is automatic.

Note

Australia formerly produced a variety of railway systems. These state-owned systems produced a signal system for their safe needs. In 1996 the national government established Australian Rail Track Corporation (ARTC) to oversee interstate railway systems. A few smaller entities also manage

China

Home:	G	Exit:	G
	Y		Y
	Y		R
	R		G
			LW

Home:	G	Passing with normal speed on mainline, exit & route signal cleared
	Y	Entry into station mainline & stop, exit or route signal closed.
	YY	Entry into station side line & stop.
	R	Stop
	GY	Entry into station & stop, route signal cleared, exit signal closed.

Exit (Automatic Block):

G	Depart from station, at least two rear blocks cleared.
Y	Depart from station, one rear block cleared.
R	Stop
GG	Depart from station into non-automatic block section.
LW	Shunting operation, when signal acting as both exit & shunt signal.

France

This system employs a broad range of signal types and shapes; see Ch 2B and Ch 2C for outline of types and representative illustrations; this segment will be narrative only.

- R Train protection/interval signal. Stop then run on caution level.
- RR Vertical or horizontal. Compulsory stop.
- FLR Flashing red, 15 km/h.
- YR or RY Vertical or horizontal; safety signal.
- P Stop before signal.
- Y Stop at next signal.
- YY Horizontal. Speed-restriction signal. Distant signal of the speed-restriction warning signal.
- YY Vertical. Speed-restriction warning signal. Maximum speed of 30 km/h.
- G Line clear.

Germany

Y G -- G

Y G R Y

Distant Signal:

YY "Be prepared to stop at next signal"

Home Signal:

R Halt
GY "Proceed at low speed"

YG (Bottom Y, Top G), G Proceed
“Be prepared to proceed at low speed”

GC “Proceed main signal ahead”

India

Y Caution, “Proceed & be prepared to stop at the next stop signal.”

G Proceed

R Stop

(4-Aspect signals: YY, “proceed pass the next signal at restricted speed).

International Union of Railways

The IUR/UIC has not created an operational railway signal system but it has set up a series of general principles which can be used by member-systems and other interested parties. The following material comes from UIC Code, 1961, 732/r,

First Principle:

A green light indicates that the section of track ahead of the signal is free and can be traversed at the maximum speed permissible for that section.

Second Principle:

- a) A yellow light indicates a warning to stop.
- b) The future system of signalling should provide for a preliminary warning.

Third Principle:

A red light indicates “stop.”

Fourth Principle:

The permissive stop indicating “stop,” proceed with caution” can be shown by means of an additional sign.

Fifth Principle:

The speed signalling system using luminous aspects (lights or symbols) should be based on the four separate ranges of speed set out below:

Sp. 1 = 30/40 km/h.

Sp. 2 = 60/70 km/h.

Sp. 3 = 90/100 km/h.

Sp. 4 = 120 km/h.

When use is made of speed indicator boards, the speed restriction can be shown in multiples of 10.

Sixth Principle:

The future system of signalling should provide for the

indication, when necessary, of the speed to be observed when passing the signal or when running over any points protecting by it (1° = proceed), as well as the indication of the speed to be observed when passing the following signal or when running over any points protected by it ($1'$ = warning).

Seventh Principle:

Experiments have shown that lights are more easily recognizable from a great distance than symbols or numbers, and that the use of fixed lights and flasher lights on the same panel is possible.

Eighth Principle:

The adoption of entirely different aspects for the four speed ranges (Sp. 1 - Sp. 4) is recommended for warning indications ($1'$) as well as for indications to proceed (1°).

Ninth Principle:

a) If indications 1° and $1'$ have to be shown at the same place, they can be grouped together on one panel.

b) Indications grouped together on the same panel should be arranged in order of importance.

For example:

- The stop indication eliminates all other indications.
- The warning indication ($1'$ (warning to stop or speed restriction warning) eliminates all line clear indications (1° m).
- The indication to proceed (1° eliminates, in

in principle, the clear indication (1° m).
 Conversely, when no restrictive indication is shown, a single
 “line clear” light is displayed.

Italy

Signals of Announcement: (G & Y only)

G&Y (All S-L)	G&Y
	G&Y

Y	Stop
FLY	Advanced Announcement of Impeded Way (Stop)
GY	Proceed, 30 km/h
FLY/FLG	Proceed, 100 km/h
F./FLY/F.FLG	Proceed, 100 km/h

First Category Signals:	(G & R only)
	G&R
G & R	
	G& R

R	Stop
G	Proceed
RG	Confirmation of Reduced Speed

Japan

	G	Proceed
3-Aspect:	Y	Caution
	R	Stop
	I	II
4-Aspect:	Y	Y
	R	R
	Y	G
	G	Y
		Type I: YG Reduced Signal (ranks between proceed & caution signals)
		Type II: YY Restricted Signal (ranks between caution & stop signals)
5-Aspect	Y	
	Y	Second Y & G: Reduced Signal
	R	Signal
	Y	First & Third Y: Restricted Signal
	G	Signal

Mexico

Permissive Signals (All S-L)

R/Y/G Stop/Precaution/Proceed

Absolute Signals (Double S-L)

RR Absolute Stop
YR Proceed, prepared to stop at next signal
GR Proceed

RY Proceed at restricted speed for branch line

Rumania

Y		Y
G	R Stop	G
	G Proceed	G
R	Y (upper) Caution	R
	FLY	
Y	GY	
	YY	

(See OSShD for at least partial elucidation of meanings)

South Africa

G	G	Y
Y		
	(S-L)	(M-L)
R	R	
R=	Danger-stop	
Y=	Proceed with caution -- be ready to stop at next signal and/or to negotiate points beyond next signal at restricted speed.	
G=	Proceed -- next signal at 'Proceed' or 'Caution'.	

Spain

G	
Y	G= Proceed

R Y= Announcing of Stop Signal
 R= Stop
 GY= Announcing of Precaution
 RY= Permissive Stop

Sweden

G FLG
 R FLW
 G FLG
 G

GGG= 40 km/h
 GG= 30 km/h
 G= Proceed
 GG+ sign "7" = 70 km/h
 R= Halt

Union of African Railways

Absolute Stop Signal: G Clear
 Y Caution
 R Stop

Distant Signal: G Clear
 Y Caution

OSShD

1) A summary of OSShD (Wolfgang Meinberg)

Color Light Signals are employed for the member stations. Semaphores may display variations in some nations by mechanical models of OSShD members. Members use signals that reflect Russia (former USSR) models. Russian system employs two heads for main signals with two; distants have one.

Upper heads: Distant messages denotes the expected aspect at the following signal. Light can be green or yellow [See page 101 on yellow and amber]. The light can be fixed or flashing for four aspects. It is possible to have six light units. Flashing can be slow or fast).

Main signal is found with lower head and denotes speed in upcoming block. Three aspects contain red/amber.

Remaining aspects in OSShD are employed in member states located found in members. Nonetheless, signal head styles are found in individual systems. These include Czech and Slovak republics along with Hungary and Rumania. They use flashing mechanisms that can be slow and fast for the upper signal thereby providing more distant messages. Most nations also include light bars that are green or amber. This indicates additional speed messages in main light.

2) Older chart of horizontal and vertical signal uses
(OSShD 1962)

Signal Marks

(kms)	160	120	90	60	40	0
160	Gr	FF Gr	F Gr	FF Y	F Y	Y
120	Gr Y Gr Brs	FF Gr Y Gr Brs	F Gr Y Gr Brs	FF Y Y Gr Brs	FY Y Gr Brs	Y Y Gr Brs
90	Gr Y Gr Br	FF Gr Y Gr Br	F Gr Y Gr Br	FF Y Y Gr B	F Y Y Gr B	Y Y Gr Br
60	Gr Y Y Br	FF Gr Y Y Br	F Gr Y Y Br	FF Gr Y Y	F Y Y Y	Y Y Y
40	Gr Y	FF Gr Y	F Gr Y	FF Y Y	FY Y	Y Y
0	R	R	R	R	R	R

The modification is a simpler version of the original chart that display horizontal and vertical versions.

3) OSShD Signal Terminology

Terminology: Acronyms and terminology for OSShD and other terms can easily generate confusion. According to W. Meyenberg OSShD is a translation into Latin (or western language) from the original Cyrillic. The acronym can change in various Latin forms: OSShd is accompanied by OSJD or OSZhD. W. Meyenberg translation form is Organisation for the Combined Operations of Railways. en.osjd.org employs Organisation for Co-operation between Railways (OSJD). Wikipedia has a slight alteration of “Organization for Cooperation of Railways” (OSJD or OSShD). One source of Wikipedia employs OSShD-Organization for the Collaboration of Railways (Organization Wikipedia 2014). M. Mashour (1974) used an alternate of United Railway in Eastern Europe (OSJD). This researcher attempted to translate a German language publication (Warsaw 1962) but resulted in a flawed term of United Railway Organization.

Further information of Wolfgang Meyenber’s signal research and writing is available on OSShD:

<http://www.sh1.org/osshd/s.htm>

<http://www.sh1.org/eisenbahn/shhl.htm>

<http://www.sh1.org/osshd/>

United States and Canada

Canada and the United States can be reviewed together though there are increasing changes (e.g. Canadian Rail Operating Rules). An older era displayed considerable resemblance between UCOR and SCOR based on a common source of AAR. The related usage of terms, meanings, numerations, color and aspects overlap is notable. The core of signal includes major codes: AAR, BOTC, and CROR. The following core coverage links a list of terms, numbers and a comparison from AAR 1965, and BOT1962. That is augmented by a summary of color usage as well as a review of codes and outstanding features. An additional primary source has been produced by Donald Kanner in his *Red Doesn't Always Mean Stop* (1992) that presents color systems in many codes and documents.

	UCOR AAR	UCOR Canada
	Names	Numbers
Clear	281	x
Advance Approach Med.	281A	-
Approach Limited	281B	282A
Limited-Clear	281C	283A
Approach Medium	282	x
Advance Approach	282A	-
Medium-Clear	283	x
Medium-Advance Ap.	283A	-

Medium-Approach Slow	283B	-
Approach Slow	284	-
Approach	285	x
Medium-Approach	286	x
Slow-Clear	287	x
Slow-Approach	288	x
Permissive	289	-
Restrictive	290	x
Stop & Proceed	291	x
Limited Approach	-	286A
Grade	-	291A
Station Protection	-	291B
Take (or Leave) Siding	-	293

Note: Color patterns for the above categories are complex and may have more than a single color arrangement. More than one color may be employed and various subdivisions of signals may have different appearances. .

Aspects

Clear	Gr only or combinations: gr or gr/r
Ad Ap Med	Gr/Y or G/Y/R
Ap L	Y over G
Limited-Clear	R followed by Gr
Approach Medium	Y followed by G; possibly R
Advance Approach	Multiple Y; possibly by R
Med Cl	R over G; R over Gr & R

Med Adv Ap	R over Y and Gr
Med Adv Sl	R over Y and Gr
Ap Sl	Y over R over Gr
Ap	Y over Y over R
Med Ap	R/Y/R
Sl Clear	Two R over Gr; Low Level G/R or G
Sl Ap	Y over R
Permission	Y (& letter plate or other qualifying markings)
Restrictive	2R over Y/R/Y [R/Y or Y] L-L
S & P	R with markings
Stop	R

Note: Color and apparatus reflected by multiple aspects are displayed in signal code charts. It displays the range, colors and arrangement of multiple forms. This can range from a single color to multiple colors. Other codes are included though only in summary. (See Aspect in Glossary)

Indications

Many of the Indications are under the heading of Proceed. They constitute approximately 12 forms. Headings under Stop are represented by about 5 forms. A variety of code sources presents details.

Other Railway Signal Code Systems

These forms include the Canadian Rail Operating Rules, which is a full system, as well as other more specialized systems. Kanner presents a coverage of CROR's word expressions as well as aspects and indications. CROR has a different number system (e.g. 405 instead of 281). It also employs a frequent use of flashing lights. Terms often display alternate forms (e.g., "Clear to Medium" instead of the older "Medium to Clear Signal"). Indication explanations are frequently similar. However, a series of signals that include the word "passing" stand out from the older system. Color combinations include some changes as well as basic color combinations.

AAR system focusses on Color Light usage. They also includes coverage of Position Light Signals and Color Position Light Signals. To a degree, Position Light Signals reflect older semaphores since light units employ horizontal, vertical, and angled positions often with one color. Vertical denotes proceed while horizontal indicates stop. Marker lamps can add nuanced meanings. Color Position displays colors and position. Clear is vertical and green; stop is horizontal and red. Marker lamps add an additional message. Lunar white hue indicates permissive messages. Kanner supplied this information as well.

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Abbreviations for Sources

I Signal Codes

AAR	United States, Association of American Railroads
ANR	Australia, Australian National Railways
BOTC	Canada, Board of Transport Commissioners
BR	Bangladesh, Bangladesh Railways
CFR	Rumania, Chemins de fer Roumains
CP	Portugal, Caminhos de Ferro Portugueses
CR	China, Guang, Hu Tong of Xian Railway Signal Factory (for Chinese Railways)
CSD	Czechoslovakia, Automatizace zekeznicki Dopray (for Ceskoslovenske Statni Drahy)
DSB	Danische Staatsbahnen
DB	German Federal Republic, Deutsche Bundesbahn
DEV	German Empire, Deutscher Eisenbahn-Verwal- tungen
DR	German Democratic Republic
EFEA	Argentina, Empresa Ferrocarriles del Estado de Chile
EFEC	Chile, Empresa Ferrocarriles del Estado de Chile
ENF	Bolivia, Empresa Nacional de Ferrocarriles
ET	Thailand, <i>Encyclopedia of Thailand</i>
FE	Uruguay, Ferrocarriles Estado
FNM	Mexico, Ferrocarriles Nacionales de Mexico
FNC	Colombia, Ferrocarriles Nacionales de Columbia
FS	Italy, Ferrovie dello Stato
IR	India, Indian Railways

IRSE	Institution of Railway Signal Engineers
JZ	Yugoslavia, Zajednica Jugoslovenskih Zeleznica
JNR	Japan, Japanese National Railways
KR	Kenya, Kenya Railways
KNR	Korea (South), Korean National Railways
MAV	Hungary, Magyar Allamvasutak
NRZ	National Zimbabwe Railways, AJ Turner
NS	The Netherlands, Nederlandse Spoorwegan
NSB	Norway, Norwegischen Staatsbahnen
NSW	Australia, New South Wales Railway
NZR	New Zealand, New Zealand Railways
ÖBB	Austria, Österreichische Bundesbahnen
OSShD	United Railway Organization/Organisation für die Zusammenarbeit der Eisenbahnen
PNKA	Indonesia, Perusahaan Negara Kereta Api
PKP	Poland, Polskie Koleje Państwowe
PR	Pakistan, Pakistan Railways
QR	Australia, Queensland Railway
RENFE	Spain, Red Nacional de los Ferrocarriles Españoles
RAN	Ivory Coast & Burkina-Faso, Régie des Chemins de fer Abijan-Niger
RFFSA	Brazil, Red Ferroviária Federal S.A.
SBB	Switzerland, Schweizerische Bundesbahnen
SAR	South Africa, South African Railways
SJ	Sweden, Statens Järnvägar
SNCB	Belgium, Société Nationale des Chemins de fer Belges
SNCF	France, Société Nationale des Chemins de Français 1934 Code des Signaux de 1934 1981 Les Principaux Signaux de la S.N.C.F. 1885 Rapport

- SNCA Algeria, Societe Nationale des Chemins de fer
Algerians
- SZD Soviet Railways
- TCDD Turkey, Turkiye Cumhuriyeti Devlet
Demiryollari
- TRA Taiwan, Taiwan Railway Administration
- UAR Union of African Railways
- UIC/IUR Union Internationale des Chemins de fer/
International Union of Railways
- UK United Kingdom: see Kitchenside & Williams
- UN-TAAEC United Nations Technical Assistance
Administration, & Economic Commission for Asia
and the Far East
- VR Finland, Valtionrautatiet
- VR (A) Australia, Wooley, Victorian Railways
- WA Australia, Western Australian Government
Railways

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