TRANSPORTATION MARKINGS: A STUDY IN COMMUNICATION
MONOGRAPH SERIES

VOLUME I FIRST STUDIES IN TRANSPORTATION MARKINGS:

Parts A-D, First Edition [Foundations, A First Study in Transportation Markings: The U.S., International Transportation Markings: Floating & Fixed Marine]
University Press of America, 1981
Part A, FOUNDATIONS, Second Edition, Revised & Enlarged
Mount Angel Abbey 1991
Parts C & D, INTERNATIONAL MARINE AIDS TO NAVIGATION
Second Edition, Revised, Mount Angel Abbey, 1988

VOLUME II FURTHER STUDIES IN TRANSPORTATION MARKINGS:

Part E, INTERNATIONAL TRAFFIC CONTROL DEVICES, First Edition
Mount Angel Abbey, 1984
Part F, INTERNATIONAL RAILWAY SIGNALS, First Edition,
Mount Angel Abbey, 1991
Part G, INTERNATIONAL AERONAUTICAL AIDS TO NAVIGATION,
In Preparation
Part H, A COMPREHENSIVE CLASSIFICATION OF TRANSPORTATION MARKINGS
Projected

TRANSPORTATION MARKINGS:

A STUDY IN COMMUNICATION

Volume II F International Railway Signals

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Mount Angel Abbey

1991

Library of Congress
Cataloging-in-Publication Data

Clearman, Brian.
International railway signals /
Brian Clearman.
p. cm. -- (Transportation markings :
a study in communication
monograph series ; v. 2, pt. F)
Includes bibliographical references
and index.
ISBN 0-918941-03-2 : $18.95
1. Railroads--Signaling. I. Title.
II. Series: Clearman, Brian.
Transportation markings ; v. 2, pt. F.
(TF615)
629.04'2 s--dc20
(625. 1'65) 91-67255
CIP

DEDICATION

FOR BONNIE

No More

No More Does The Whistle Blow

In The Lonesome Valley

No More

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PREFACE

Volume II of the **TRANSPORTATION MARKINGS: A STUDY IN COMMUNICATION MONOGRAPH SERIES** continues the studies begun in Volume I, Parts A-D. The earlier volume reviewed communication concepts - especially those of semiotics, and of the role in transportation markings (Part A) - and it presented a survey of surface, air, and marine markings in the U.S. (Part B). The first volume ended with an examination of one segment of international transportation markings: marine aids to navigation (Parts C and D). Parts C and D were revised and republished as a separate unit in 1988 under the title of **International Marine Aids to Navigation**. A major revision of Part A is projected: an enlargement and revision of semiotic considerations, an addition of material on electromagnetic and acoustical waves and their role in transportation markings and an addition of material on design and transportation markings.

Volume II continues the international studies begun in Parts C and D. There are four intended parts to the second volume: **International Traffic Control Devices** (Part E) published in 1984, **International Railway Signals** (Part F) - which is the focus of the present volume, **Aeronautical** Aids to Navigation (Part G), and **A General Classification of International Transportation Markings** (Part H).

The present monograph examines currently employed signals, signs, and markings and their messages. Officially-sanctioned signals - as found in signal codes and other documents - provides much of the foundation and focus for the study; this is true of all the monographs of the Series.

The monograph is a study of signals (and accompanying signs and markings) , not of signalling (the control and operation of signals and accompanying safety appliances and procedures). Systems, simple block systems, interlockings, CTC and electronic configuration are related to signals but signals can be examined independently.

Source materials present a significant challenge since a central source of information since is lacking. Methodology will be examined in Chapter 28C centering on the problems of sources and how these problems were overcome. Significant patterns of signal usage can be found even when central sources are lacking; threads of commonality are not lacking even if frequently obscured.

Finally, it can be stated that the monograph may not please railway experts. This study is not a "super signal code" nor a general compendium of signals. Rather it is an introduction to signals (and signs and markings), with the messages they produce. (It is also an informal semiotics if one can agree with the view of some practioners 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.

Even if the study falls short of the expectations of the expert, an effort has been made to be faithful to the subject and its underlying literature. The compiler has been very much concerned to include the many types of signals and signs, and to be accurate in using railway materials.

ACKNOWLEDGEMENTS

To Abbot Peter Eberle and the Monks of Mount Angel.

To the many railways that have provided assistance: Régie des Chemins de fer Abidjan-Niger, Abidjan; Österreichische Bundesbahnen, Wien; Empresa Ferrocarriles Del Estado Argentino, Buenos Aires; Rede Ferroviária Federal, S.A, Rio de Janeiro; Baltimore and Ohio Railroad, Baltimore; Canadian National Railway, Edmonton and Montreal; Canadian Pacific Railway, Vancouver; Ferrocarriles Nacionales de Colombia, Bogota; Dänishe Staatsbahnen, Kobenhavn; Finnish State Railways, Helsinki; Société Nationale des Chemins de Fer Francais, Paris; Deutsche Bundesbahn, Hannover; Deutsche Reichbahn, Berlin; Empresa de los Ferrocarriles del Estado, Santiago; Kowloon-Canton Railway, Hong Kong, Magyar Államvasutak Vezerigazgatosaga, Budapest; Indian Railways, New Delhi; Perusahaan Jawatan Kereta Api, Bandung; Kenya Railways, Nairobi; New South Wales Railways, Sydney; New Zealand Railways, Wellington; Nederlandse Spoorwegan, Utrecht; Pakistan Railways, Islamabad; Polskich Kolejach

Panstwowych, Warzawa; Schweizerische Bundeshbahnen, Bern; Red Nacional des los Ferrocarriles Espanoles, Madrid; South African Railways, Johannsburg; Southern Pacific Transportation Company, Portland and San Francisco; USSR Railways, Mockba; Tukiye Cum Huriyet Deviet Demiryollari, Ankara; Ferrocarriles Del Estado, Montevideo; National Railways of Zimbabwe, Bulawayo.

To the many libraries and information centers that have provided assistance: Joyce Koeneman and the Library of the Association of American Railroads, Washington, D.C.; The American Library, Paris; Bangladesh National Scientific & Technical Documentation Centre, Dhaka; Edward Bremson of the Hill Library of North Carolina State University, Raleigh; Unions Scientifique et Techniques De Bulgarie Conseil Central, Sofia; California State Railroad Museum, Sacramento; Pin Yang of Technical Information Research Institute, Ministry of Railways, Beijing; Instituto Centro Americano de Investigacion y Technologia Industrial, Guatemala City; Institute of Transportation Studies Library, University of California, Berkeley; Libraries of University of California, Davis; Alice Pignal of the Canadian Institute of Guided Ground Transport Information Centre, Queen's University, Kingston, Ontario; Sandra Holtz of Technical Library of General Railway Signal Company, Rochester; Humboldt State University

Library; George Drury of the Library of Kalmbach Publishing Company, Milwaukee; National Library Service (Malawi) Lilongwe; Science & Technical Information Service of National Library of New Zealand, Wellington; Libraries of Case Western University, Cleveland; Lawrence Crumb of Knight Library, University of Oregon, Eugene; Kerr Library, Oregon State University, Corvallis; Millar Library, Portland State University, Portland; Oregon State Library, Salem; Comiaion Nacional De Investigacion Cientifica y Technologica, Lisboa; Turkiye Bilimsel Ve Teknik Avastirma Kurumu, Ankara; Virginia Polytechnic Institute and State University Libraries; Library Board of Western Australia, Perth; Hugh Feiss, Sister Therese Eberle and Darlene Strand of Mount Angel Abbey Library, Saint Benedict;

To many other individuals and organizations that have aided the project: John Armstrong, associate editor, Railway Age; Asociacion Latinamericana de Ferrocarriles, Buenos Aires; Australian National Railways Commission, North Adelaide; Nederlandse Maschinefabriek Alkmaar N.V., Alkmaar; American Short Line Railroad Association, Washington, D.C.; Embassies of the United States: Algiers, Buenos Aires, Harare, Lagos, La Paz, Dhaka, Rangoon, Bogota, Cairo, Mexico City, The Hague, Montevideo; American Railway Engineering Association, Washington, D.C.; Bethlehem Steel Corporation, Frog and Switch Division, Steelton, Pennsyvlania; Hu Tong Guang of Xi'an Railway Signal Factory, China; Corning Glass Works, Corning, N.Y.; Harold B. Crawford of McGraw-Hill Book Co.; Embajada De Cuba, Ottawa; Federal Ministry of Transport

of the Czechoslovak Socialist Republic, and Ing. Beohumil Bocknak, of Automatizace Železnicni Dopravy, Praha; Fielding and Grant (Tyer), Kingswinford, West Midlands, U.K.; Consulate of Finland, Portland; Ralph Fisher, author; GEC-General Signal Ltd., Borehamwood, Hert., U.K.; Bill Matthews of General Railway Signal, Rochester; George Washington University, Continuing Engineering Education, & Library, Washington, D.C.; Thomas Givon of the University of Oregon; The Stephen Greene Press, Lexington; Transport Dept. of Colony of Hong Kong; R.L. Weedon and Institution of Railway Signal Engineers, Reading, Berks, U.K.; Integra Signum, Zurich; Embassy of India, International Railway Congress Association, Brussels; Washington, D.C.; Vice Consolato D' Italia, Lake Oswego; Piergiuseppe Bozzetti of Embassy of Italy, Washington, D.C.; Relazioni Aziendali of Ferro Stato, Roma; Kopp Glass, Pittsburgh; Hans Lindenberg and Siemens AG, Braunsweig; Myrna Oakley and Marylhurst College; Marylhurst, OR: M. Mashour of the University of Stockholm; Organisation für die Zusammenarbeit der Eisenbahnenr, Warszawa; Research & Training Institute, Ministry of Railways, Walton-Lahore; Centralny Osrodek Badan i Rozwoju Techniki Kolejnictwa, Warszawa; Rev John Riegel of the Hill School, Pottstown, PA.; Fred Spurrell; Bengt J. Sterner of Statens Järnvägar, Stockholm; Sportshelf & Soccer Associates, Publishers, New Rochelle, N.Y.; The Consulate General of Switzerland, Vancouver, B.C.; W.R. Smith of UIC-ORE, Utrecht; Institute of Science & Technical Research, Bangkok; U.S. Department of Transportation, Federal Railroad Administration; Westinghouse Saxby Farmer, Calcutta; Fr Jerome Young, OSB, Mount Angel Abbey.

A very special acknowledgement to:

Robert McKnight, Formerly of the Association of American Railroads, and Signal Historian

Jack McLean, Signal Afficiando,
Writer & Library Consultant

And Andrew McLean
A Silent Participant

A Note on Notes

This study does not include traditional forms of notes whether footnotes or endnotes. Instead the monograph has adopted the "author-date" system of the **Chicago Manual of Style** of the University of Chicago (13th edition). The notes in the text include author, date and page number or abbreviation, date and page number for organizations. The later form can be identified by a listing of abbreviations for organizations at the beginning of the Bibliography. A limited number of substantive notes are in the text and these are identified by astericks. The acronym "TISRP" found in some of the notes stands for "This Is The Source for the Remainder of the Paragraph(s)." This eliminates repetition of source references.

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	Change 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
ULH/LRH	Upper-Left-Hand/Lower-Left-Hand
LLH/LRH	Upper-Right-Hand/Lower-Right-Hand

MISCELLANEOUS TERMS

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

*Abbreviations for sources are on pages 237-239.

CHAPTER TWENTY-EIGHT

RAILWAY SIGNALLING: INTRODUCTION, HISTORY & METHODOLOGY

28A Introduction, Physical Properties and Semiotics of the Signal

28A1 Introduction

The railway signal (and accompanying signs and non-sign markings) presents a diverse and variegated appearance. The railway signal is not only very complex but has a markedly reduced degree of commonality in comparison with marine, road and aeronautical transportation markings. This means that this monograph is not based on an already existing cohesiveness. Therefore it is necessary to include several basic perspectives in order to integrate the existing fragments of railways 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 (for example the historic underpinnings of U.K., North America, the Communist bloc, and so forth). An overview of the "schools" may not create convergence but it can present the various approaches together and thereby provide a degree of convergence (Chapter 30A provides introductions to the "schools" of signals).

Roland Barthes (1988,180-190) has written an eassy in which he notes that a human-made object is the focus of two connotations and of two coordinates (See also Chapter 1B2 of Part A, 2nd 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. Chapter 28A2 will examine that dimension within the headings of signal mediums, signal configurations within those mediums, and the nature of message capabilities. Technology in itself is not a focus of this study though a measure of technology is inherent with any study of transportation markings.

The symbolic (or semiotic) coordinate of the signal, examined in Chapter 28A3, places emphasis on the semiosis and signification dimensions of the sign and how they can relate to railway signals. Chapter 28A3 gives only brief treatment of the classification coordinate since all of Chapter 29 is devoted to signal taxonomy.

Chapter 28B centers on a review of the history of signals. The history segment illustrates some areas of commonality and shared developments for signals. Methodology, Chapter 28C, has importance for this study because of the fragmention both in signals and in documentation; an integrated methodology can help to bridge the fragmentation in signal and sources.

28A2 The Physical Properties of the Signal

The physical properties of the railway signal, sign and marking include the specific

medium signals can adopt, the actual configuration of the signal, and the nature of the message that the signal is capable of producting and emitting. The technological mechanism is not examined in this study because of the communication and symbolic 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 some inroads by electronics. The 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, and alphanumeric (which 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 Chapter 31.

Partially-lighted forms include the semaphore and what in the monograph is termed the signal-board. 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 largely found with signs and markings. Acoustical devices are not very common and are usually 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 may have a square housing or backplate while another can be circular. 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 29B, 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 consitutes a second area of differences. A system using only basic message indications requires a simple housing but a more complex system requires multiple signal heads and other features including marker lamps, light strips or flashing lights. Chapter 31B2 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 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 partakes both of the physical and of 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. Therefore that topic is placed with signal meanings and configurations which do not deny 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 permits a variety of messages (proceed, caution, stop) while 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/Multiple Message (C3M);
2. Message capability that permits only Changing Message/Single Message (CMSM);
3. Message capability that includes an Unchanging Message but with Multiple Messages (U3M);
4. Message capability that is restricted to Unchanging Message and Single Message (UMSM).

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 for whom few, if any, predications can be made.

C3M is the most important for railway signals since those signals emit a variety of message in an alternating order; for example, caution follows proceed and stop follows caution. CMSM, a rare category for any type of transportation marking, includes a few railway signals. For example, U.K. has installed signals at some secondary locations which operate only when that track is in use. The message is a single form but one that undergoes change.

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 junctions 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 sub-category 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.

28A3 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 semiotics 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 that are important to a semiotic analyis: 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 equalling sign, and indication as equalling 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; regretably not all codes contain the key words. In most instance, those codes containing an illustrated chart of signals will 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 those terms. A representative 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 1978, 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; that is the semiotic word as well. 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 beld" can be translated as the definition of the sign image (NS 1978). The Germanic form (in this case for SBB) employs "Signalbild am" or signal picture or representation, and "Bedeutang" or meaning or significance (SBB Signale). 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 precise role the signification may perform, and the type of symbol the signification is expressed. The roles in which signification can be expressed (in terms borrowed from traffic control devices), are whether a marking fulfills a regulatory, a 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

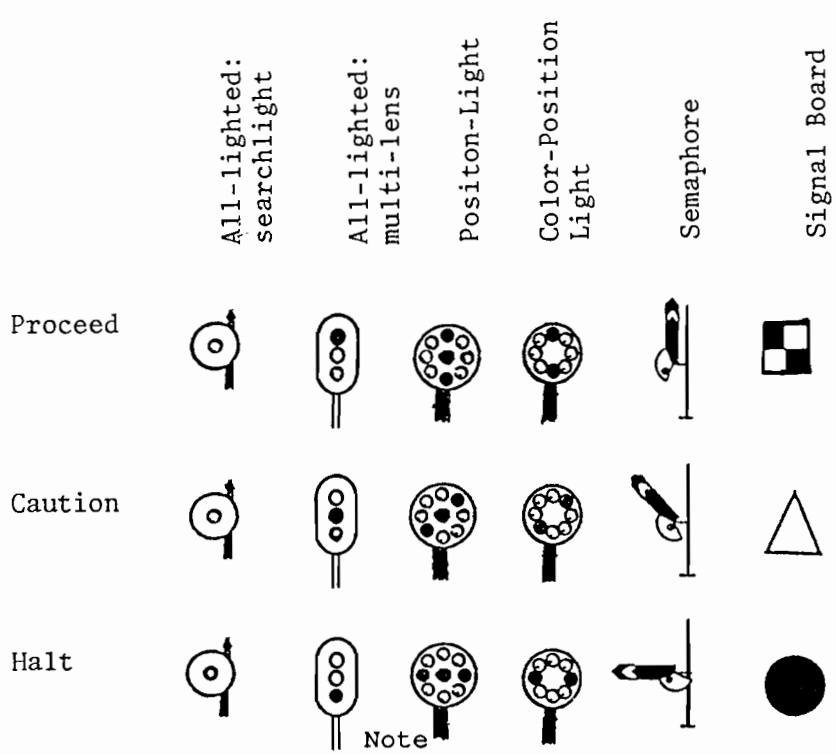
signification is emitted: whether speed categories, or speed values (see Mashour 1974, 34). Speed categories attach word symbols to the signal message; for example, a yellow aspect in North America has the meaning of "Proceed preparing to stop at the next signal". Trains exceeding medium speed must at once reduce to that speed" (AAR 1956, BOTC 1961). Medium speed for the Association of American Railroads (AAR) is 40 mph though an individual railroad may substitute a lower speed. The medium speed is 35 mph in Canada. 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 at least partially touches on the issue of stability of meaning) is considered in Chapter 30B.

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 should 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.

URO is the chief example of a complex system employing only number symbols (URO 1962). While Canada and the U.S. are examples of a complex system based on word symbols accompanied by

numbers (AAR 1956, BOTC 1961). Other systems use a much smaller range of signification and accompanying symbols whether speed categories or speed values.

Chapters 28A2 and 28A3 are separate yet closely interrelated topics. The physical and the semiotic parts of signals ought to manifest some relationship in this chapter as well as separateness. 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).



A projected unit of Part A (Design and the Transportation Markings, Ch. 6) will focus on transportation markings as an aspect and manifestation of design for this Series. However, brief comments on railway signals and design will be included in this note.

The railway signal in many of its forms may appear very dated; a prime example of low-technology, more than a little quaint, and a frequent reminder of the Victorian and Edwardian eras and all that they may conjure up. Microprocessors and electronic train control add 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 early twentieth centuries; many other signals follow designs that are derivatives of the early signals.

Despite dire predictions of the imminent demise of visual signals of whatever form, not infrequently the trains have vanished well 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 notable examples of minimalism accentuating clean and unencumbered lines. Simplicity, function- inspired form and minimalism contradicts neo-traditionalst design especially in architecture of both the 1880s and 1990s. Yet many other forms of design also exhibit those 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 U.S.) and no longer a trend-setter, then it may be possible to view the signal as an object that, if not timeless, is at least an object that follows a timeless path of simple geometric shapes, economical usage of materials and excludes superficial and useless decoration; it is less often influenced by what is momentary (this does not eliminate the need to study the meaning of signs and changes in their meaning). 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.

28B Aspects of the History of Railway Signals

28B1 The Formative Period, 1830-1920

The history of signals can prove to be elusive. Only limited independent treatments exists, 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 U.K. 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 embeded 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 28B1 may give undue coverage to U.K. and U.S.* 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 U.K. and U.S. foundations. Chapter 28B2 will give greater attention to other systems.

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 they 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); a good example are signals with a blind-edge which fell out of use in the U.K. but are in use in other systems to the present (Ellis, 35).

Early U.K. signals were often boards or flags for day use and lamps at night. The dominant color scheme was white for clear (which continued in U.K. and the continent of Europe until the later nineteenth century, later in the U.S.); 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 signal boards (Allen, 140). O.S. Nock (1962, 89) notes the on-edge approach in early twentieth century France yet U.K. is the probable source of that signal even if it died out in the U.K. A ball signal was employed in U.K. for a limited time and more extensively and for a longer period of time in the U.S. (Allen, 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, 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 most unlikely that any historical connection exists (Ch 31B4). U.S. practice moved away from balls to large red discs which employed the edge-on indications for line clear. U.K. and U.S. 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, HT, 329). It was in the U.K. that they first became a railway signal system (Nock, HT, 329). The earliest semaphores were three-position lower-quadrant forms (in contrast to later U.K.-U.S. practice which has two-position LQ (however, some three-positions LQ semaphores were made in the U.S.; 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; for example, Southern Pacific of San Francisco; Southern Pacific, 130-132, 137). The early version required the clear indication to be located in a slot in the signal post (yet another 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-fall 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 lead 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, 146-147, SNCF 1961 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 connections would also cause the signal to return to that position (Shackleton, 232). German semaphores were of the upper quadrant form and two positions; these signals are of a different design that those of UK. UK employed fewer aspects but provided bracket signals at junctions while Germany increased the number of aspects and thereby addressed signal needs at junctions (Allen, 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 1978). British practice extended to systems outside of Europe including the rapidly expanding system in India (IPR 1896).

The earlier part of the twentieth century is marked by further developments in the semaphore (both the high point, and the beginning of its decline occured 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 semphores with the mechanism of operation occupying the top of the mast rather than the bottom (AAR, HDRS, 69; the 1981 Brigano and McCullough study, though commissioned by a single railway signal works, is also an important source with many interesting points).

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, 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, 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 U.S. in

1904 though it required an incremental development to finally produce long-range signals (in about 1914) (AAR, HDRS, 70; also Brigano 1981, 139).

A new form of all-lighted signal, the position-light, began service in 1915 (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).

At the end of the 1900-1920 period a searchlight signal was invented (Brigano 1981, 140 and other sources). 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 U.S. 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 139; McKnight 1990). What are termed position-light signals in many systems (and for usually 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 U.K., as well as other European systems, were employing red for halt/danger and green for proceed/line clear (see previous segment). The very large U.S. 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 (ARSPAP-11, TISRPS; also Brigano). And the conversion to green was made quickly after the decision was made (McKnight 1990).

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 (U.S.) Railway Signal Association 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 (of course 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 color hue, and thereby created a cautionary color that permitted green to become the proceed color. The U.S. was more inclined toward three-positions than many other systems; at least in the developmental stage.

Note

Early in the twentieth century (EB 1910 Vol. 22, 823-824) noted that the U.S. had just short of 40% of the world's trackage. Six additional systems had from 3-6% of the trackage, and four other systems had 1-2.5% each. These 13 railway systems had 85% of all of the operational tracks. U.K./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 U.K. 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 permier role of U.K. during much of the first development stage. In 1840 U.K. had nearly three times the trackage of Germany and France combined; by 1850 U.K. maintained its lead though more narrowly. Even with major German and French expansion, U.K. maintained its first place position though only by a thin margin in 1870. Colors, blind-edge signals, semaphores were all areas where U.K. created and where others frequently adopted or at most adapted (EHS, 581-583).

28B2 Further Developments, 1920-1980

1920-1980 is a time of great changes for railway signals and signalling. It was a time, especially after World War II, of major switching from semaphores 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 would be attempts at international cooperation; regional and more than regional cooperation would 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, TISRP). But 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 U.K. 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 U.K. 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 U.S. 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 U.S.). In 1922 New Zealand introduced the three-position UQ automatic semaphore but in less than two years all-lighted color signals were also introduced (NZR, "Century"). "Fine-tuning" 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 Germans have a less-complex system housed in sharp and angular signals. The Italians and Dutch make 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 transplated to non-European nations the curved signals and the

angular signals crop up in far-removed locales; for example, RAN followed SNCF practice, and Siemens influenced SAR. U.K., U.S. and Japanese upright rectangles and and searchlight signals (through Westinghouse companies, GRS, USS, Nippon and others) have also moved beyond the original borders so an overlapping mosaic of various shaped signals results. 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, URO 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 30A). URO, the Communist Bloc 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, DDR and other member-states. The system also includes some older signals 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 to the UAR form (see codes of IUR, URO, UAR, PKP, DR, etc for references to this segment).

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 messages bear some similarity though a convergence akin to road, marine or aero markings will probably never take place.

28C Methodology of the Monograph

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. And it is possible that in bringing together very different materials, without a central structure, may create misinterpretations and error. This is not the intention of the compiler.

The intent of the compiler is to bring together different railway signal systems and - while respecting the specific and special character of the individual systems - to build up a single cohesive system of signals through classification and narrative description. This lack of a pre-existing, external system of signals may have lead to a possible mis-use or mis-interpretation of materials and resulting in a study badly flawed both in theory and in application. It is very much hoped that this does not prove to the case. If a single, cohesive system has been brought into existence (with due respect to differences) then a third component of the monograph series in transportation markings has been achieved.

In the light of the previously described problem, what sources have been used in the monograph, and what method has been used to

carry out the study? There are several trans-national organizations that have produced signal codes or at least general guidelines for signals. And there are also the individual railway codes. The International Union of Railways (Paris) has members not only in Europe but in systems scattered about the world. That organization, which is nearly 70 years old, attempted too late to build a signal code (Smith 1987). But they were able to establish general principles and these have shaped newer developments.

The United Railway Organization (Warsaw), 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. 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 offers a wide spectrum of signal information and has had influence beyond North America. One national system, that of the United Kingdom, 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 bear the imprint of British principles and practices. The U.K. system is no longer among the largest signal systems but its historical impact continues on to the present.

It has not been possible to include all of the railways of the world in this study. In order to decide which ones to include the compiler elected to use track length as a

criteria. This may not be a perfect standard since a short railway may have more signals than a long one. But it is more likely that a longer railway would use more signals and exhibit more complex signal messages than a short system. 2500 kilometers in length was decided upon as a minimum figure for inclusion in the study. There are four classes of railways: "A" systems with a minimum of 20000 (c. 1.5%) km of track (and two sub-divisions within A: those with at least 50000 km and those with less than that); "B" systems have at least 10000 (.75%) km but less than 20000; "C", 5000 (.4%) to 9999 km; and "D", 2500 (.2%) to 4999 km of track.

A1 Systems include the U.S. (with over 20% of the world's track), 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). West Germany, Brazil and Poland have each about 2.00% of the track; South Africa and Japan have about 1.75% of the 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 system and all sent information though it varied greatly.

"B" nations have from .75% to 1.49% of the world's trackage. These include the United Kingdom and Italy with 1.25% of the trackage each. East Germany, Spain, and Czechoslovakia have slightly over 1% each; Sweden and Rumania slightly less than 1% and

Yugoslavia and Turkey have near .8%. The nine nations have slightly about 1/12 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 includes 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 and sometimes 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: a small number of manufacturing companies produce much of the world's output of signals. Materials from a number of these concerns has 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 about by 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 many problems in obtaining materials the end result of piecing together many fragments has made it possible to build up an image of what signals are in use and the kinds of messages they produce. This greatly 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 very similar in a variety of reference works, the figures for other systems vary greatly - even wildly - 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 USSR creating a total of 240,000 KM. More often the differences stem from definitions: one book lists only the state system and not small private lines; or sugar and mine lines are included/excluded. Reputable reference works thereby give accurate figures which at the same time clash with one another.

For this study there are two primary sources of statistics: **Jane's World Railways** (1988-1989 edition with recent consultation of

the 1989-1990 edition), 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 slightly 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**.

There are some special cases to note. Iraq has some 2800 KM in **Jane's** but only 1113 in IRCA and it is probably not necessary to include Iraq. Peru, Syria, and Taiwan all have well under 2500 KM according to the primary sources though 2500 KM according to one or other secondary sources and it may not be necessary to include those systems. However, available information on any system no matter how small is included in the study. RAN (seemingly disbanded though possibly alive once again), Taiwan and the Philippines are included because of available materials.

What is the world's total 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 World in Figures** presents a newer figure that is not that much more: 1.3 million KM. The second figure forms the basic of 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 2000 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 other lines; these additional lines include some 2800 km of track. The DB system is the concern of this study.

IRCA shows nearly 3000 km for Ireland yet other sources indicate less than 2000 km. The discrepency 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 6000 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 some 5000 more km for Poland than does IRCA; IRCA figures have been employed for this study. IRCA has apparently used the SBB trackage figure for Switzerland. Though there are some 1300 km of other lines. These other lines may be tramways and other specialized operations. IRCA, however, has the higher figures for Turkey and Yugoslavia.

The U.S. provides a complex situation. Figures for the U.S. 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 experience of some territory, Yugoslavia is experiencing great strife. 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 organizations presented in this study may not always be as accurate as one would want. But presumably signals and signals codes are slow to change and perhaps the reduction in accuracy is minimal.

CHAPTER 29 CLASSIFICATION

29A The Main Classification

29A1 Introduction

Each succeeding classification in this series of monographs on transportation markings has required special explanations and qualifications. A point has not yet been reached in which a general classification - with a uniform nomenclature - can be established. The classification for Volume II, in turn, also requires special explanations and qualifications.

Perhaps the most satisfactory of the transportation markings classification has been that of Volume IB (both main and variant forms) which focussed on a single and restricted subject: the U.S. That narrow focus allowed for precision and a substantial degree of completion. The classifications of Volume I C & D were less precise and detailed. Those shortcomings came about because the classification encompassed the marine markings of many nations not one nation. Broader-scope classifications face the option of a general and superficial coverage or of becoming enmeshed in voluminous detail; for example, to have included all of the forms and sub-forms of marine aids to navigation in Volume I would have bogged down the classification in massive amounts of minutiae.

If the classifications of C and D suffered from weaknesses in some respects, they were strengthened by other factors: the undergirding of international marine agreements

and conferences on aids to navigation. The diverse contents of the classification were thereby firmly attached to an over-arching framework. Unfortunately, principles of uniform guidelines, existing foundations and integrative cohesion are less available for railway signals.

The end result of fragmented and limited integrating materials for railway signals means that the classification will be yet more tentative and provisional. Precision and comprehensive treatment of signals may not be a fully attainable goal for the classification; nonetheless, it is hoped that the classification has value. An effort has been made to incorporate historical documents, signal codes, trade literature as well as publications from regional and trans-national signal and rail groups in the classification. If successful the classification may reasonably illustrate the range and shared ties of railway signals, signs and markings.

The classification represents, to some degree, an abstract construction. It has not been possible to completely build up a classification based on existing materials; the data was too fragmented and incomplete to allow for that. This has meant that some extrapolation from actual codes and other publications became necessary. No system or groups of systems matches the orderly and possibly logical character of the classification. Instead the various segments were pieced together into a kind of mosaic. But a mosaic that, hopefully, authentically synthesizes the disparate and diverse world of the railway signal.

The original classification (Volume I A-D) employed the number 1 for all-lighted transportation markings; number 2 for +50% lighted markings; number 3 for half-lighted and so on. But this proves unworkable in practice: how does one distinguish between a marking 50% lighted/unlighted, and one in which the lighted part is 75% and the unlighted part 25%? In short, it would be difficult to determine that one marking was so many percentage points lighted and so many unlighted.

Therefore, in this revised classification number 2 indicates partially-lighted markings, and number 3 denotes unlighted ones. It may yet be possible to suggest various gradations in markings that are less than fully-lighted though that would prove to be a difficult and uncertain practice; it may well be one of dubious value as well.

29A2 Classification of Railway Signalling

51 All-lighted Signals

510 Signals Governing Train Movements on One Track (SGTMOOT) Trackside Signals
- 5100 Color-light: Multiple-lens
- 5101 Color-light: Searchlight-lens
- 5102 Color-position
- 5103 Position
- 5104 Symbols: Graphic
- 5105 Symbols: Alphanumeric
- 5106 Cab Signals

511 Signals Governing Train Movements From One Track to Another Track (SGTMFOTTAT)
- 5110 Color-light: Multiple-lens
- 5111 Color-light: Searchlight-lens

5112 Color-position
5113 Position
5114 Symbols: Graphic
5115 Symbols: Alphanumeric

52 Partially-lighted Signals

520 SGTMOOT, Semaphores
5200 Blade-spectacle Fully-integrated (BSFI) UQ (Color-shape-position)
5201 Blade-spectacle Fully-integrated (BSFI) LQ (Color-shape-position)
5202 Blade-spectacle Integrated Through Linkage (BSITL) (Color-shape-position)
5203 Blade/Lens Partially Integrated (BLPI) (Position-only)
5204 Blade/Lens Separate (BLS) (Position only)
5205 Composite: Blade/Lens Integral, UQ-LQ (Position, Color-position, Color-position)
5206 Double: Blade/Lens Integral

521 SGTMOOT, Signal Boards
5210 Single-units: Stationary
5211 Single-units: Hinged
5212 Single-units: Revolving
5213 Double-units: Revolving
5214 Composite: Semaphore-Signal Board

522 SGTMFOTTAT, Semaphore & Rotating Signals
5220 Dwarf Semaphores, BSFI, UQ
5221 Dwarf Semaphores, BSFI, LQ
5222 Disc Signal-Open, with Signal Lamps
5223 Disc Signal-Open, Indirectly-lighted
5224 Disc-Semaphore
5225 Pillar-Disc
5226 Miniature Graphic Symbol Indicators

523 SGTMFOTTAT, Revolving Signals
5230 Disc Signal (Entire unit revolves)
5231 Disc Signal (Only signal apparatus revolves)
5232 Panels
5233 Graphic Symbols-enclosed (day/night dimensions integral)
5234 Graphic Symbols-open (day/night dimensions may be separate; see also 530)

524 SGTMOOT & SGTMFOTTAT, Lighted Signs
5240 Sign with Lamp
5241 Lighted-sign, Internally-lighted
5242 Lighted-sign, Externally-lighted

53 Unlighted Signals, Signs and Markings

530 Targets & Track Indicators
5300 Color
5301 Shape
5302 Position
5303 Color-shape
5304 Miniature Graphic Symbol Indicators

531 Signs - Other Than Speed Regulations
5310 Approach: Station, Yard, Crossing, Bridge, & Whistle Posts
5311 Station, Yard, Track & Political Units
5312 Location Signs (Mileage Posts)
5313 Sign & Signal Identification & Signal Function
5314 Stop Boards
5315 Section & Block
5316 Electric Traction
5317 Limit and Restrictive Signs

532 Signs - Speed Regulations
5320 Temporary Regulations

5321 Temporary Regulations - Announcing and Ending
5322 Permanent
5333 Permanent - Announcing

533 Markings
5330 Marking-posts
5331 Petite Markings
5332 Marking Boards
5333 Sign-like Objects

29A3 Explanatory Notes

51. All-lighted railway signals are divided into 510, Signals Governing Train Movements on One Track (SGTMOOT), and 511, Signals Governing Train Movements From One Track to Another Track (SGTMFOTTAT). The terms may suggest more precision than is actually the case. However, the terms are not altogether arbitrary; they provide a workable division between signals generally functioning as main-line trackside signals and signals providing 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). In all likelihood the categories overlap; this is especially the case with all-lighted dwarf signals.

5100, 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 markings throughout the classification).

5101, Color-light: Searchlight-lens. The signal unit contains three inter-connected lenses sharing a single lamp; each is brought into position as required.

5102, Position-light Signal. This signal, an all-lighted form of the semaphore signal, produces messages through rows of uni-colored lenses according to semaphore patterns. Color-position lighted signal, 5103, combines a color message with positions of the lamps. The colors and messages are from color-lighted signals and positions are from the semaphore (and position-light) signal. Signals designated as position-light in other systems that contain color are included with color-position signals in this study.

It can be debated whether or not symbol signals are found in 510. Graphic, 5104, and Alphanumeric, 5105, are included to cover that possibility. It can also be debated whether 5106, Cab Signals, are within regular signals or belong in Appendix I, special signal forms. This matter is discussed in Chapter 31A3 and 31B4. There are several forms of cab signals and they are included in Chapter 29B.

512, SGTMFOTTAT 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.

5110, Color-light signals. These often parallel full-sized models though often they are only two-position signals; searchlight models are also in use. Searchlight signals, 5111, 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. Position-light signals, 5112, include only true position-light signals; so-called position-light signals - but which are in reality color-position signals - are assigned to the latter category. The 511 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 5103.

5113, 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.

5114, Symbols: Graphic, and 5115, Symbols: Alphanumeric are an amalgam of very diverse signals. Some include graphic designs - often arrows - while many others include letters and/or numbers. 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 520, Semaphores; 521, Signal Boards; 522, Semaphore

and Rotating Signals (SGTMFOTTAT), and 523 Revolving Signals (SGTMFOTTAT), and 524, Lighted Signs.

520, SGTMOOT Semaphore signals into six segments for this study. The first segments, 5200 and 5201 are very similar but are in two groups because some are upper-quadrant (UQ) while others are 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 and these are taken up in Chapter 29B and 29C.

5202, Blade-spectacle Integrated Through Linkage (BSITL) is part of the "family" of semaphores that includes 5200 and 5201. But it requires separate listing because the blade is connected through linkage and not directly. But the day and night portions are one unit and have the message patterns of 5200 and 5201.

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, 5203, separate the blade and lamp unit but the blade has an opening in it so that in some positions the lamp unit shines through the opening. The Blade/lens Separate type of semaphore, 5204, has a completely separate lamp assembly and blade and therefore no integration at all. A combined UQ and LQ form, 5205, is found only in the Netherlands. A double form found in FS, 5206, in which two

blade spectacles operate from a single mechanism.

521, Signal Boards. The term is discussed in Chapter 32C1. They are a signal rather than a sign because of the changing character of the messages and in some systems offer a full-line alternative to the semaphore. The stationary, 5210, is a rare unit that appears to be a sign yet conforms more to a definition of a signal; they are seemingly found only in UAR. The hinged (or Klapbarr) form, 5211, presents visible caution or stop messages; the hinge permits the unit to lay flat and is not visible for proceed indications. The revolving form, 5212, removes non-operative messages by turning the board so it is parallel with the track. Double and single units refer to the number of separate signal boards in a single installation; double forms are designated 5213.

5214, Composite: semaphore/signal board. This form could be located either under semaphore or under 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 and which qualifies the signal board message, and a final form that superimposes a center-attached arm on a signal board.

522, Semaphore and Rotating Signals, and 523, Revolving Signals (both SGTMFOTTAT) contain the many forms of other-than-mainline signals (dwarf, ground, miniature switch/ points indicators and so forth). 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 crew 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. 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.

522, Single-sided models. These include semaphores, 5220 and 5221, which are dwarf versions of BSFI full-sized models; seemingly only BSFI includes dwarf semaphore types. Disc signals come up models with signal lamps in the face of the signal, 5222, and those flood-lighted forms, 5223, that exhibit the same message aspect day and night. The

disc-semaphore, 5224, is an integral unit of SAR and not a composite signal. The pillar-disc, 5225, is a rare signal that may be defunct. Track indicators, 5226, are partially-lighted devices with miniature graphic symbols.

523, 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 U.S. 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 target).

5230 and 5231, Disc signals. The secondary distinction is included in the classification though it is not primary for signal descriptions. These signals are largely UK in origin. Assigning proper names to signals is more common in UK and UK-derived systems. The term "Panel signal" has been coined by the compiler. This signal, 5232, of U.K. origins, shares many of the characteristics of the disc signal. But it has a square housing without additional day targets. It seemingly has no specific name. Painted panels on the housing serve as targets.

5233, Graphic-symbol signal enclosed, and 5234, Graphic symbol signal-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.

524, Partially-lighted signs and markings, a small category of four members, will be considered with the much larger unlighted versions of those devices.

53, Unlighted signals, signs and markings, consists of four categories: 530, unlighted targets and track indicators (which form an adjunct with partially-lighted graphic signals 523), 531, signs for other than speed regulations, 532, speed signs, and finally, 533, non-sign markings.

531 and 532, Signs - Other than speed regulations, and Signs - Speed regulations respectively. Some thought was 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 more appropriate. A.R.E.A. classification of signs provides pointers for the complex and uncertain topic of signs.

531, signs category may appear to be excessively truncated and conflated. However,

the broad diversity of signs requires broad and general categories. Separate categories are required for approach signs, 5310, and object identification signs, 5311, because of the many forms of each type. Categories 5312 through 5317 includes only one easily recognized and understood group; that of electric traction signs, 5316. Chapter 29B provides a sampling of illustrations that may help to identify and understood the welter of sign types. Limit and Restrictive signs, 5317 has been added to reflect the A.R.E.A. classification and the importance given to these signs.

532, Speed regulation signs is a much narrower category, and one more readily grasped, than 531. Because of the individual character of sign speeds and related information only categories of an over-arching nature are here included. Chapter 29B offers details on the components of 532.

533. Markings or non-sign marking are a difficult object to clearly define and distinguish from signs. Chapter 32G discusses the problem at some length. Chapter 29B and 29C also consider these markings. They are a smaller category of railway safety devices and are largely unknown in many systems. A general classification of the markings uncovers four principal groups. Marking posts, 5330, are relatively tall and slender objects with distinct colors and patterns. Petite-markings, 5331, are short object and again marked by special coloring and patterns. Marking-boards, 5332, are literally that. They are frequently tall, wide and thin. The category designated as 5333 is a confusing group of objects quite similar to signs but without the symbols associated with signs.

29B Variant Classification

29B1 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 posibilities. 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 unwieldly 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 preceeded 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.

d) or a four-digit grouping if shape configurations are very numerous; for example, 5332, Open Geometric Signals.

.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).

The Explanatory Notes for Chapter 29B include both the classification and the illustrations.

51 All-lighted Signals
510 Signals Governing Train Movements on One Track (SGTMOOT)

.1 Basic Shapes
.10 Rectangle/Rectangular Backplate: Vertical
.100 Rounded End(s)
.101 Rounder Corner(s)
.102 Cropped Corner(s)
.103 Fully Rectangle
.11 Rectangle/Rectangular Backplate: Horizontal
.110 Rounded End(s)
.111 Rounded Corner(s)
.112 Cropped Corner(s)
.12 Rectangular Backplate: Slanted
.120 Cropped Corners
[Lamp Configurations: Single Row (SR), Double Row (DR), Irregular (IR), Random

.13 Circles
.130 Complete Circles
[Lamp Configurations: Triangular Arrangement (3 Lamps), Single Lamp (Multiple Lenses), Circular Arrangement (8, 9 Lamps), Cluster Arrangement (4 Lamps)]
.14 Triangles
.140 Triangular
[Lamp Configurations: Triangular Arrangement (3 Lamps)]
.15 Octagons
.150 Full Octagon
[Lamp Configurations: Multi-row Arrangement]
.16 Square Backplate
.160 Square
.161 Cropped Corner(s)
.162 Rounded Corner(s)
[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).
.200 Emphasis on vertical plane
[Lamp Configurations: "L"-shaped pattern (5, 6 Lamps)]
.201 Emphasis on horizontal plane
[Lamp Configurations: "L"-shaped pattern (3, 4, 5 Lamps)]
.21 Rectangles (Vertical dimension more prominent; joined together in non-synchronic manner
.210 Two Rectangles with Minimal Connection
[Lamp Configuration: Assymetrical (3 Lamps)]
.211 Two Rectangles with Substantial Connection
[Lamp Configuration: Assymetrical (3 Lamps)]
.22 Rectangle/Circle Fused Together
.220 Single Form
[Lamp Configuration: Assymetrical (3 Lamps)]

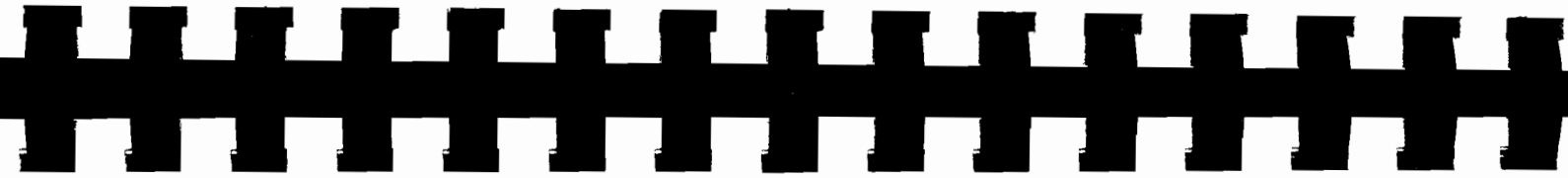
.2 Special Shapes: Other Nations
.23 Rectangular Backplates
.230 Rectangular with Triangular-shaped Lower Edge, DR
[Lamp Configurations: Double Row (2, 4 Lamps)]
.231 Rectangles Fused Together (Off-centered "V", rounded ends), DSB
[Lamp Configuration: "V"-shaped Pattern (5 Lamps)]
.232 Rectangle with Rightward Triangular Extension, rounded ends, SNCB
[Lamp Configuration: SR/DR (5 Lamps)]
.233 Rectangle with Rightward Rectangular Extension, cropped corners, PKP, [Lamp Configuration: IR (6 Lamps)]
.24 Truncated Parallelograms
.240 Single Basic Form, DR, PKP
[Lamp Configurations: Assymetrical Dr (2, 4 Lamps)

52

511 Signals Governing Train Movement From One Track to Another Track (SGTMFOTTAT)
.3 Basic and Special Shapes
.30 Rectangle/Rectangular-shaped Signals
.300 Fully Rectangle, Horizontal & Vertical
.301 Rounded End(s), Horizontal & Vertical
.302 Curved Ends, Vertical Only
.303 Rectangle-vertical, Partially Spherical Upper Edge
[Lamp Configurations: Generally SR; Some Irregular; also Graphic, Alphanumeric, Composite (1-3 Lamps and/or 1 or more other symbols)]
.31 Square-shaped Signals
.310 Square
.311 Cropped Corners
[Lamp Configurations: Double Row, Assymetrical, Circular, Graphic, Alphanumeric Symbols (3-7 Lamps, and/or 1 or more other symbols)]

53

.32 Triangle/Triangular Shaped Signals
.320 Rounded Points
.321 Truncated Triangle
.322 Truncated Triangle (Partially-Rounded Points)
.323 Triangle with Curvature
.324 Truncated Triangle (Right-angle)
.325 Triangle (Right-angle, Rounded Corners)
.326 Triangle Fused with Rectangle
[Lamp Configurations: Triangular-shape frequently; some arrangements are asymet
(1-3 Lamps)]
.33 Other Shapes
.330 Circles
.331 Octagon
.332 Arms
.333 Lozenge (Obround?)
[Lamp Configurations: Diverse (1 to nearly 20)]



52 Half-lighted Signals
520 Semaphore and 521 Signal Boards

.4 Basic and Special Shapes
.40 Blade-Spectacle Fully Integrated (BSFI): Rectangles
.400 Square-ended, Upper Quadrant (UQ)
.401 Pointed-end, UQ
.402 Fish-tail-end, UQ
.403 Square-end, Lower Quadrant
.404 Pointed-end, LQ
.405 Fish-tail-end, LQ
.406 Variant Form of Spectacle
.41 Blade-Spectacle Fully Integrated (BSFI): Rectangular I (A)
Tapered, Substantial
.410 Square-end, UQ
.411 Pointed-end, UQ
.412 Fish-tail-end, UQ
.413 Rounded-end, UQ
.414 Square-end, UQ
.415 Pointed-end, UQ
.416 Fish-tail-end, UQ

.42 Blade-Spectacle Fully Integrated (BSFI): Rectangular I (B) Slightly Tapered
- .420 Square-end, UQ
- .421 Pointed-end, UQ
- .422 Fish-tail-end, UQ
- .423 Square-end, LQ
- .424 Pointed-end, LQ
- .425 Fish-tail-end, LQ

.43 Blade-Spectacle Fully Integrated (BSFI): Rectangular II (Broader, Less Elongated)
- .430 Oval-end
- .431 Flat-end
- .432 Arrow-shaft Base-end

.44 Blade-Spectacle Integrated Through Linkage (BSITL)
- .440 Somersault Arm (Tumble-arm)

.45 Blade-Lamp Partially Integrated (BLP)
- .450 Rectangle with Oval-end, and Opening in Blade (Square)
- .451 Rectangle with Oval-end, and Opening in Blade (Circular)
- .452 Rectangle with Flat-end, and Opening in Blade (Circular)

.46 Blade-Lamp Separate (BLS)
- .460 Rectangle with Oval-end
- .461 Rectangle with Fish-tail End
- .462 Rectangle with Pointed-end
- .463 Rectangle with Flat-end

.47 Special Shapes
- .470 Propeller Arm
- .471 Double Arm
- .472 Lattice-work with Opening in Blade (Circular)

.48 Signal Boards: Rotary Form
.480 Disc
.481 Diamond
.482 Square
.483 Rectangle
.484 Triangle (Upward Pointing
.485 Triangle (Downward Pointing)
.486 Rectangle/Triangle
.49 Signal Boards: Hinged and Stationary
.490 Disc-hinged
.491 Square-hinged
.492 Rectangle-hinged
.493 Stationary: Diamond

58

522 Partially-lighted Signals: Semaphore & Rotating Discs & Composite Discs

5 Dwarf Semaphores, Rotating Discs & Composite Discs
.50 Semaphore, Dwarf (see details)
.500 BSFI, UQ
.501 BSFI, LQ
.51 Rotating Discs
.510 Open Form (Circular opening within disc face for lamps)
.511 Indirectly-light (Solid face)
.512 Enclosed (Disc-shaped signal encompassing movable arm within glass case)
.52 Composite Discs
.520 Disc-semaphore (Disc on semaphore arm)
.521 Pillar-disc (See also Targets)

59

523 Partially-lighted Signals: Revolving Signals

.6 Revolving Discs and Enclosed Graphic Signals
.64 Revolving Discs
.640 Disc Signal Apparatus Revolves (Openings for lamps within signal face)
.641 Full Signal Apparatus Revolves (Openings for lamps within faces)
.642 Panel Signal Apparatus Revolves (Openings with panel faces)
.643 Rectangle/Discs Composite Signal
.644 Special Miniature Graphic Symbols
.65 Enclosed Graphic Signals
.650 Circles - Whole
.651 Circles - Split-Vertical
.652 Circles - Split-Horizontal
.653 Circles - Split-Three-quarters
.654 Arrows, Single - To Right
.655 Arrows, Single - To Left

60

523 Half-lighted Signals: Revolving Signals

.7 Open Graphic Symbols (& 530)
.70 Mask-shaped Vanes
.701 Type 1 & Modified Lozenge-shaped Vane
.702 2A & Lozenge-shaped Vane
.703 2A & Type-2
.704 3 & Type-3
.705 5 & Prism-shaped Vane
.706 7 & Lozenge-shaped Vane
.707 8 & Lozenge-shaped Vane
.71 Arrow-shaped Vanes
.710 Double Arrow-1 & H-shaped Vane
.711 -2 & Mask Type 5
.712 -3 & Circle Vane
.713 Single Arrow-1 / Single Vane
.714 -2 & Circle Vane
.715 -2 & Oval Vane
.716 -3 & Diamond Vane
.717 -4 & Over Diamond Vane
.718 Diagonal Arrow & Mask Type 5

61

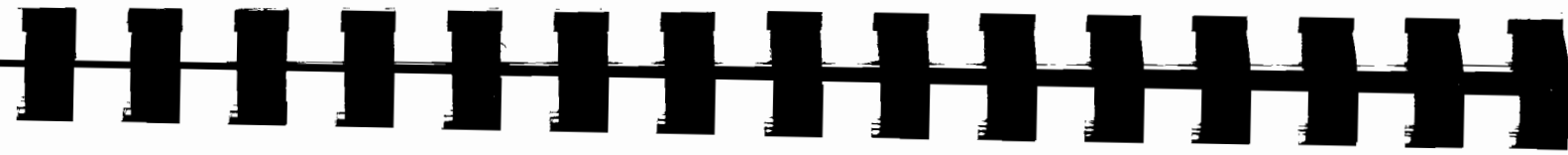
.72 Oval-shaped Vanes
.720 Oval Vane & Mask Type-4
.721 Mask Type-6
.722 Single Arrow-1
.723 Square
.73 Rectangle-shaped Vanes
.730 Rectangle Vane/Single Vane
.731 & Chevron Vane
.732 & Oval Vane
.733 With Fish-tail End & Circle Vane
.74 Obround Vane
.740 Obround Vane & Mask Type 5
.741 Obround/Single Vane
.742 Obround/Double Vane
.743 Obround (Elongated)
.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)

532 Signs - Speed Regulations

.8 Speed Signs
.80 Announcing of Restrictions
.800 Word Symbols
.801 Letter Symbols
.802 Numerical Symbols
.803 Graphic Symbols
.81 Ending of Restrictions
.810 Letter Symbols
.811 Graphic Symbols
.812 Geometric Symbols
.82 Within Categories of Restrictions: Nuanced Variant Forms
.820 Temporary/Permanent Differentiations
.821 Special Designation of Trackage: Branch Line
.822 Special Designation of Trackage: Main Line
.823 Designation of Train Speed Categories: Express
.824 Designation of Train Speed Categories: Passenger
.825 Designation of Train Speed Categories: Freight
.826 Lighted Dimensions to Signs
.827 Distance Dimension to Restriction Signs

533 Markings

.9 Pillars, Petites, Boards and Sign-like Objects
.90 Pillars
.900 Straight-line/Flat-top Forms
.901 Pointed-top Forms
.902 Tapered Forms
.903 Forms with Visible Undergirding
.904 Lighted Forms
.91 Petites
.910 Cylinders
.911 Square Post - Flat-top
.912 Square Post - Pointed-top
.913 Rectangular Post
.914 Horizontal Slab
.92 Boards
.920 Tall With Visible Undergirding
.921 Tall Without Visible Supports
.922 Intermediate With Visible Undergirding
.923 Symbols for Boards: Stripes (diagonal)
.924 Symbols for Boards: Stripes (straight)
.925 Symbols for Boards: Zig-zags
.926 Symbols for Boards: Chevrons
.927 Symbols for Boards: Checks



.93 Sign-like Objects
.930 Forms With Primary Horizontal Dimension, Double Support
.931 Forms With Primary Vertical Dimensions, Single Support
.932 Square Forms With Single Support
.933 Special Forms With Single Support

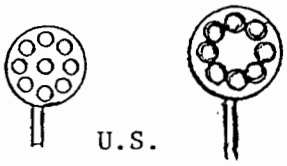
29B3 Variant Classification Illustrations

The illustrations for the variant classification cannot encompass all possible railway transportation markings; there are too many nuances and permutations to allow for that. Nonetheless, the illustrations provide a pictorial dimension for the systematic array of signal, sign and non-sign marking shapes and they provide as well a sampler of the range of symbols.

A single researcher with restricted budget, andno an elementary level of computer skills (but substantially augmented by elementary school skills in cut and paste with aid from the traditional technology of the template and the more contemporary technology of the photo copier) is confronted with a dilemma of providing adequate illustrations of salient features of a subject. The end result can, and is in this case, are decidedly funky illustrations; hopefully they are also effective. The following illustrations are miniaturizations of existing forms in some cases, and template constructions in others. Both forms have undergone modifications and simplifications in many instances. Few illustrations are even near-identical to source of the picture. All sources have been credited for the respective illustration. If any reader is of the opinion that any illustrations are sufficiently akin to the original to require formal permission please inform this compiler and any such illustrations will be replaced or only retained after gaining formal permission for a second edition of this monograph.

It may seem that a disproportionate use of some sources has been employed in the illustrations. This is probably not the case despite that surface appearance. For example Bethelehem Steel of the U.S. is a very large maker of targets and has a broad range of designs; their publications also include designs of A.R.E.A. Probably many of the target designs to be found anywhere are to be found in Bethlehem's catalogue. The broad range of markings and their symbols are of prime concern to the study even if some forms are found in only a few systems or nations. Many systems employ a limited range of markings and symbols while a restricted number of systems utilize varied and numerous designs. Again, comments on the readers on the markings and messages are welcome.

.13-.17



U.S.

U.S.

AAR

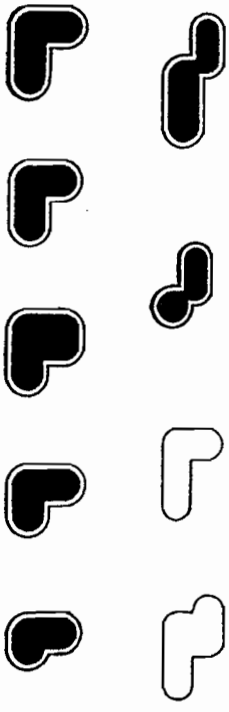
EUROPE

DR

DB

SNCF

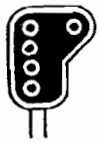
.20-.22



SNCF/SNCA

.23-.24

DSB



SNCB

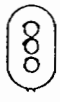
PKP

DR

.10

JZ

QR



NSW

.11-.12

AAR

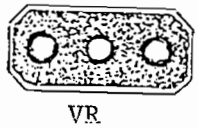
DR

SBB

DB

SBB

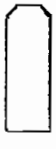
SNCF



VR

DB

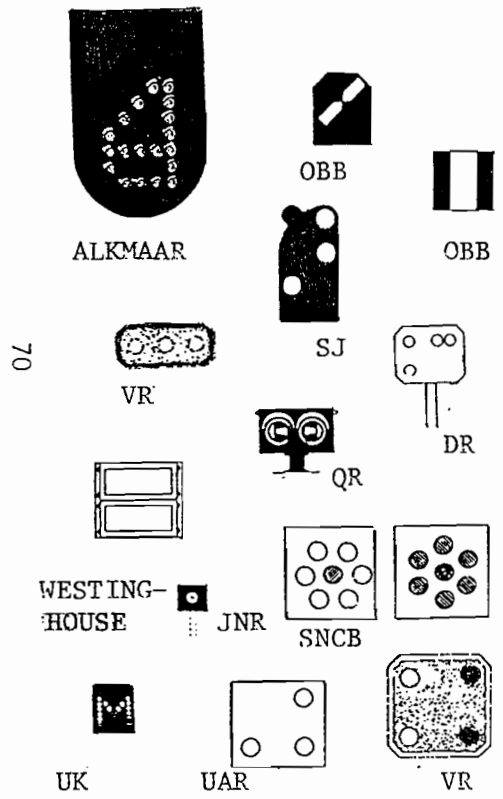
SZD



DR

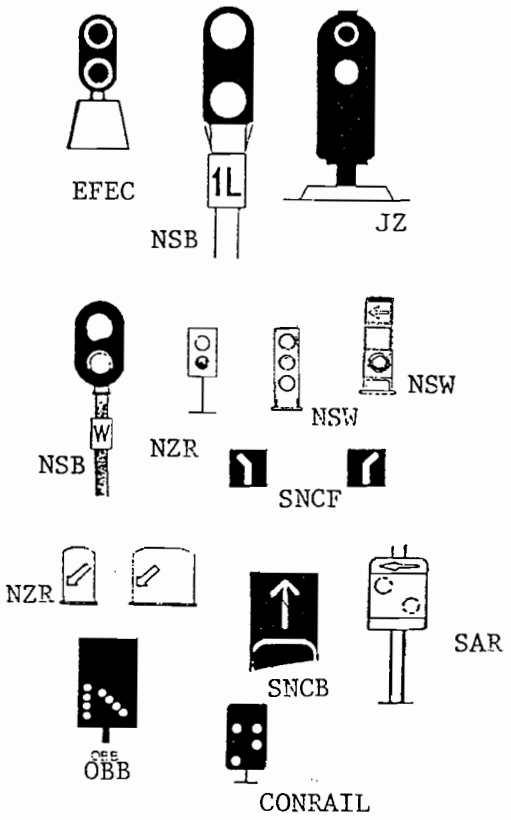
AAR

.30-.31

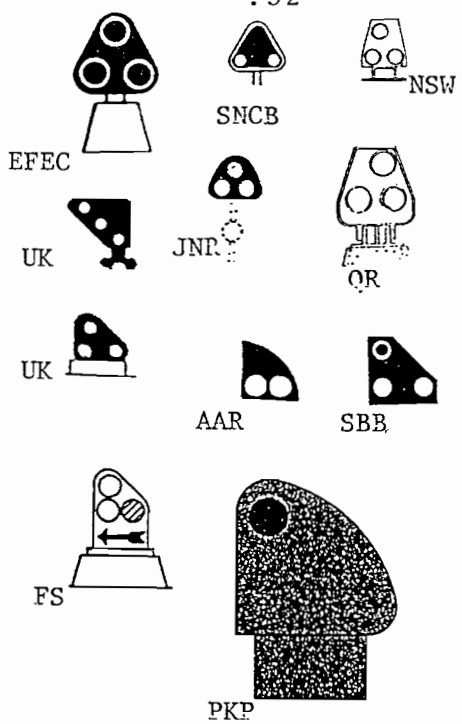


70

.30

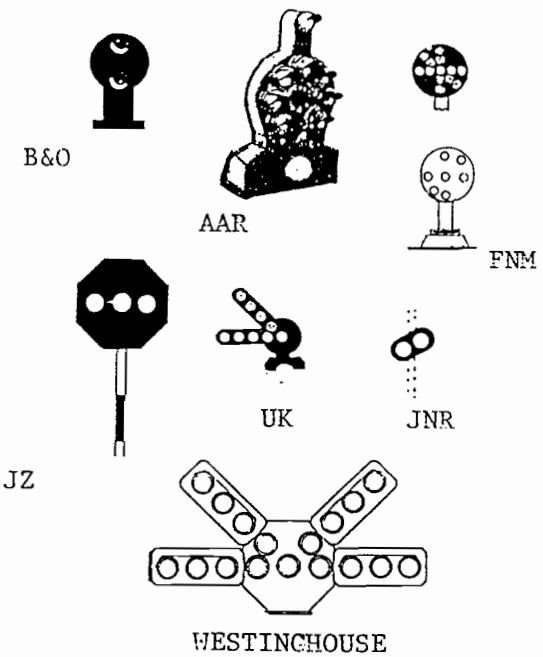


.32

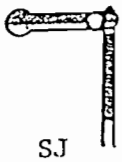


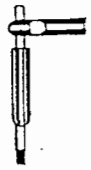
71

.33



.46-47


SJ


JZ

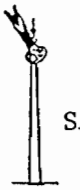

MAV

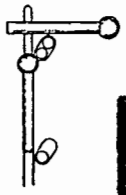
.40-.45


NSW


NS


QR

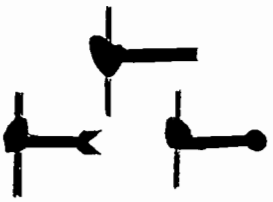

SAR


DB


CSD

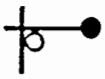

SBB


VR

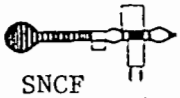

NS


U.S.


B&O


DSB

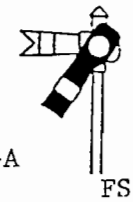

RENFE


SNCF


SNCB

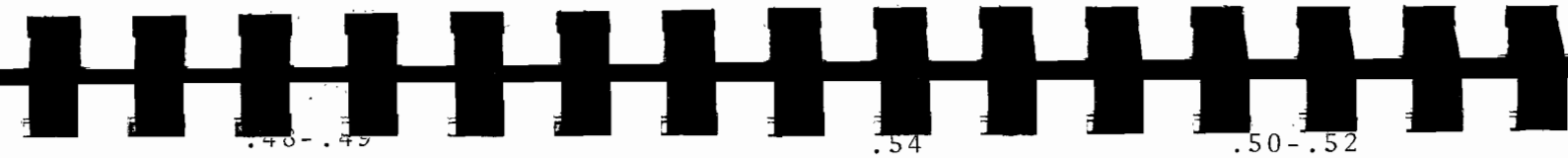

NS


VR-A


FS


B&O


EFEA



.48-.49

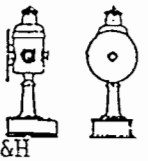
.54

.50-.52


QR

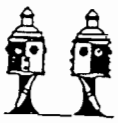

VR


UK


M&H QR


NSW


QR


QR


NZR

(See Notes)


UK

SAR

M&H

RENFE

DB

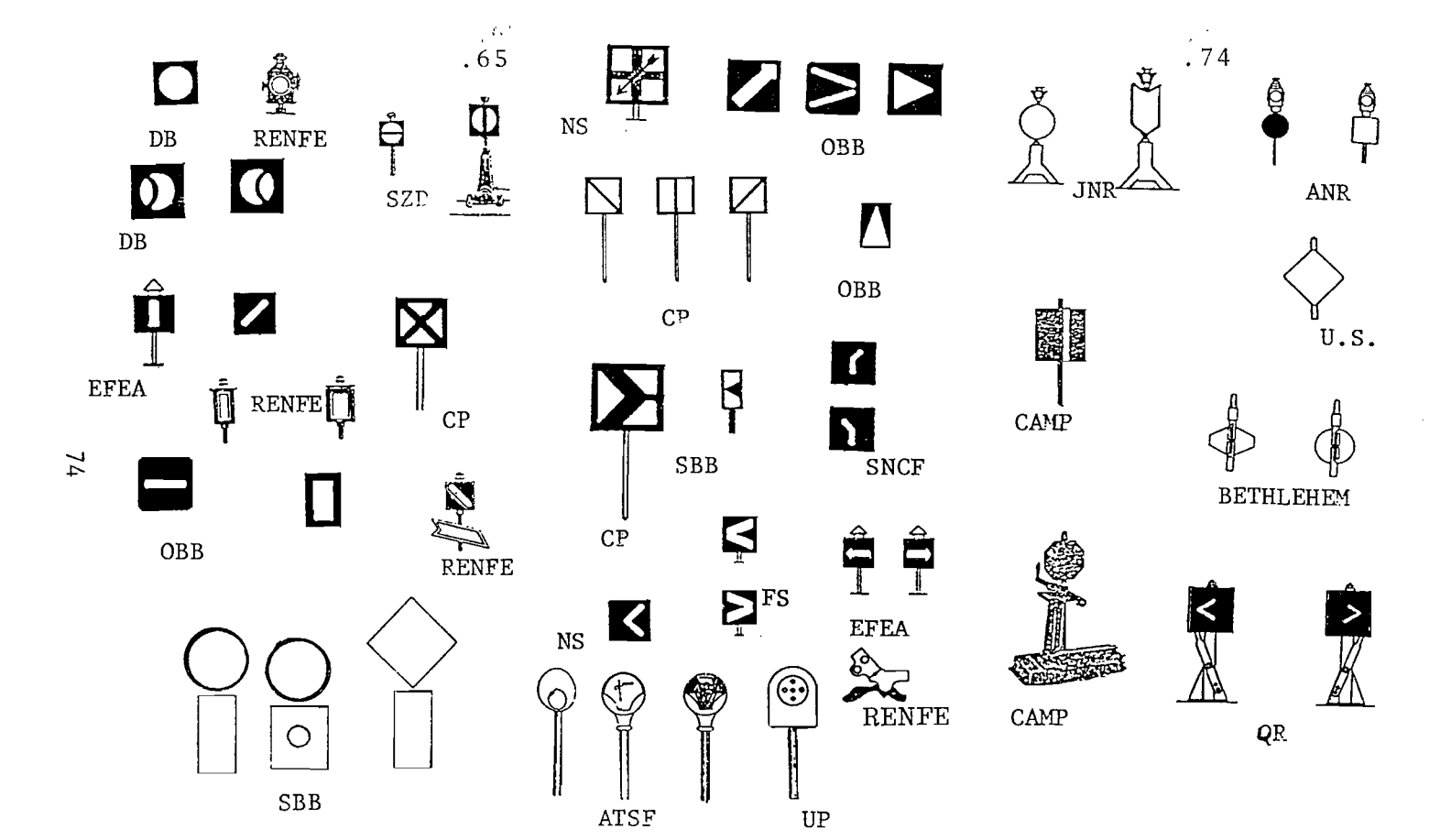
QR

NSW

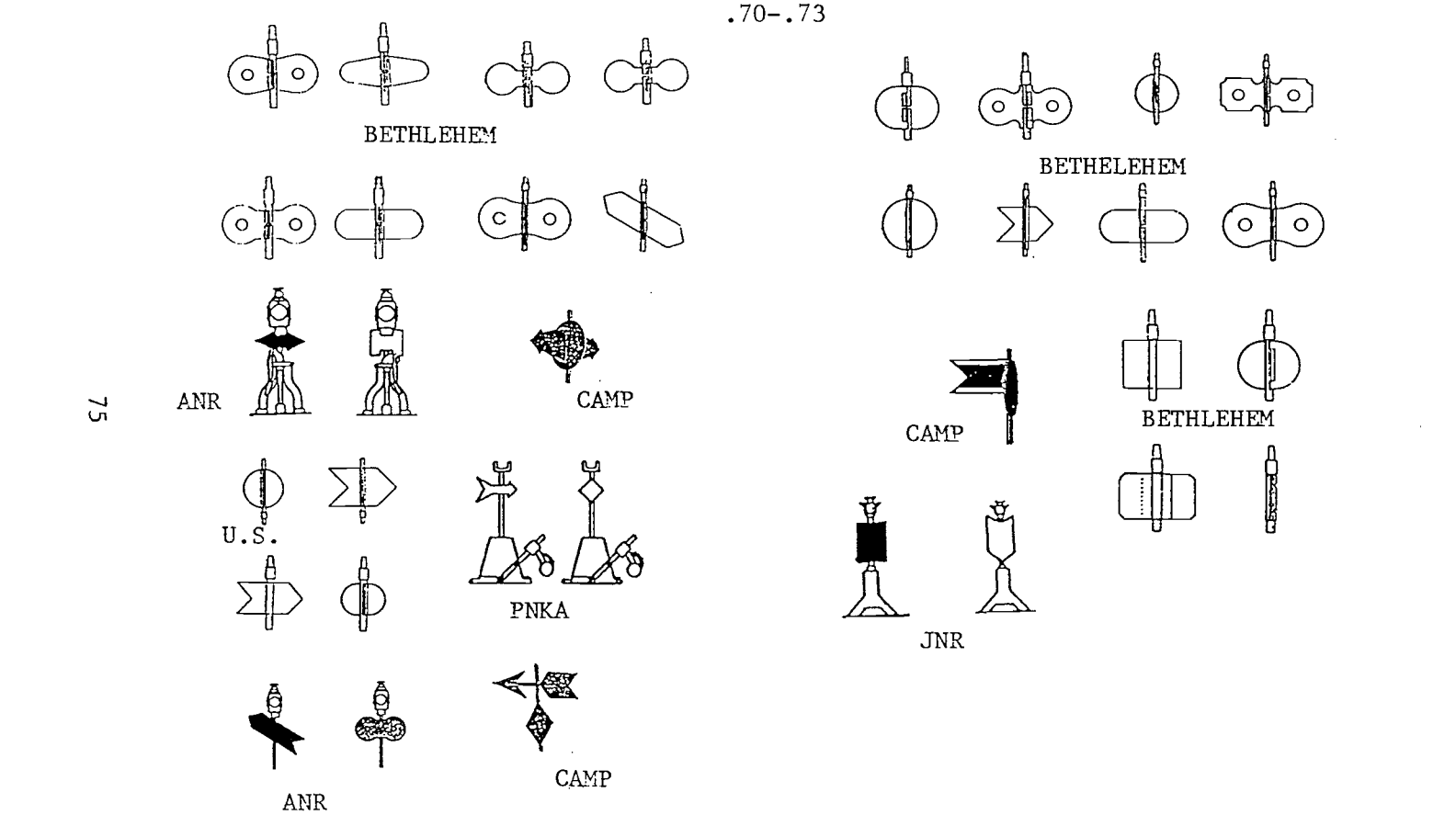
UK

QR

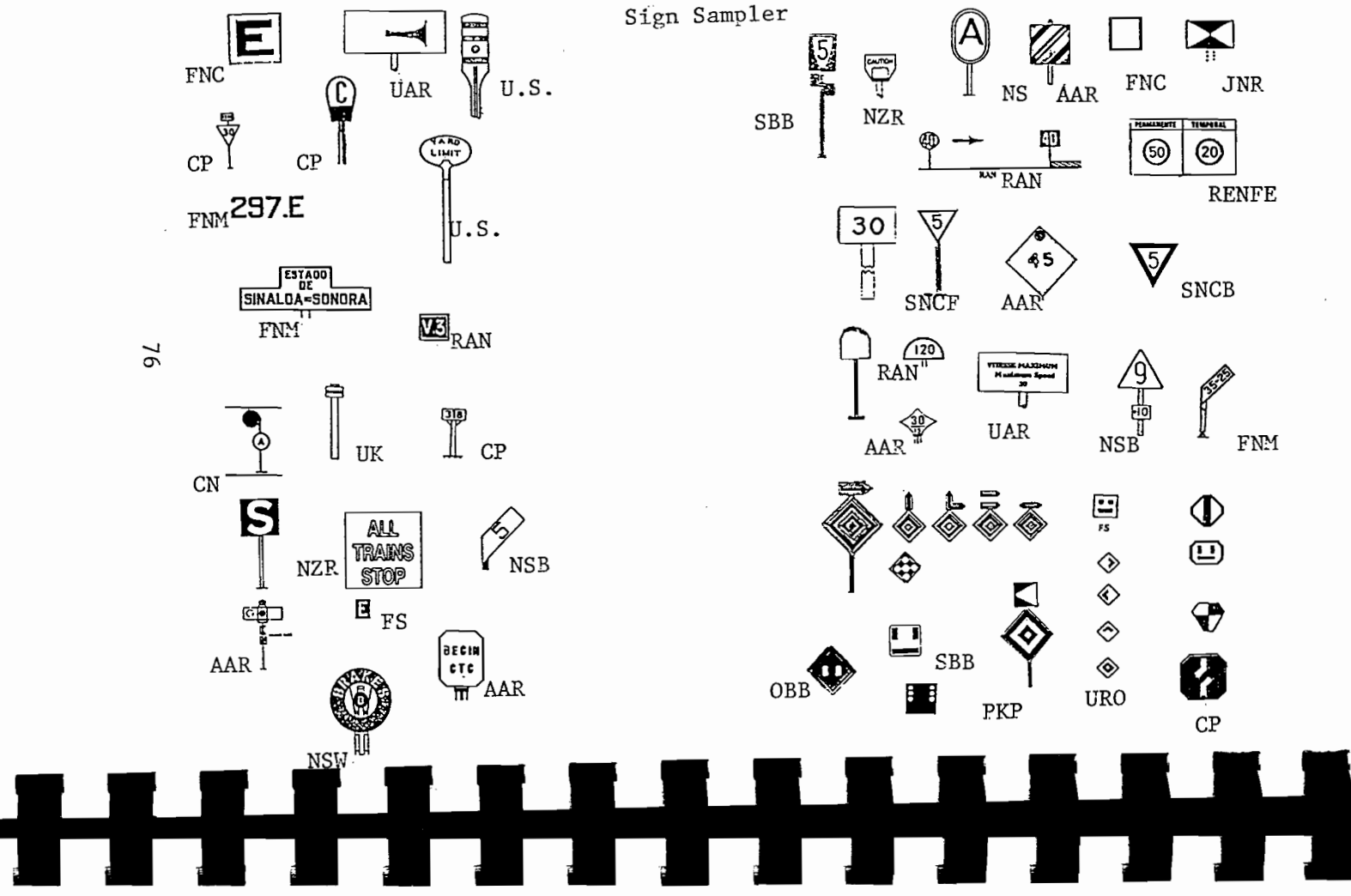
CAMP


.65
.74
DB
RENFE
SZD
NS
OBB
JNR
ANR
DB
CP
OBB
U.S.
EFEA
RENFE
CP
CAMP
SBB
SNCF
BETHLEHEM
74
OBB
RENFE
CP
FS
EFEA
NS
RENFE
CAMP
QR
SBB
ATSF
UP

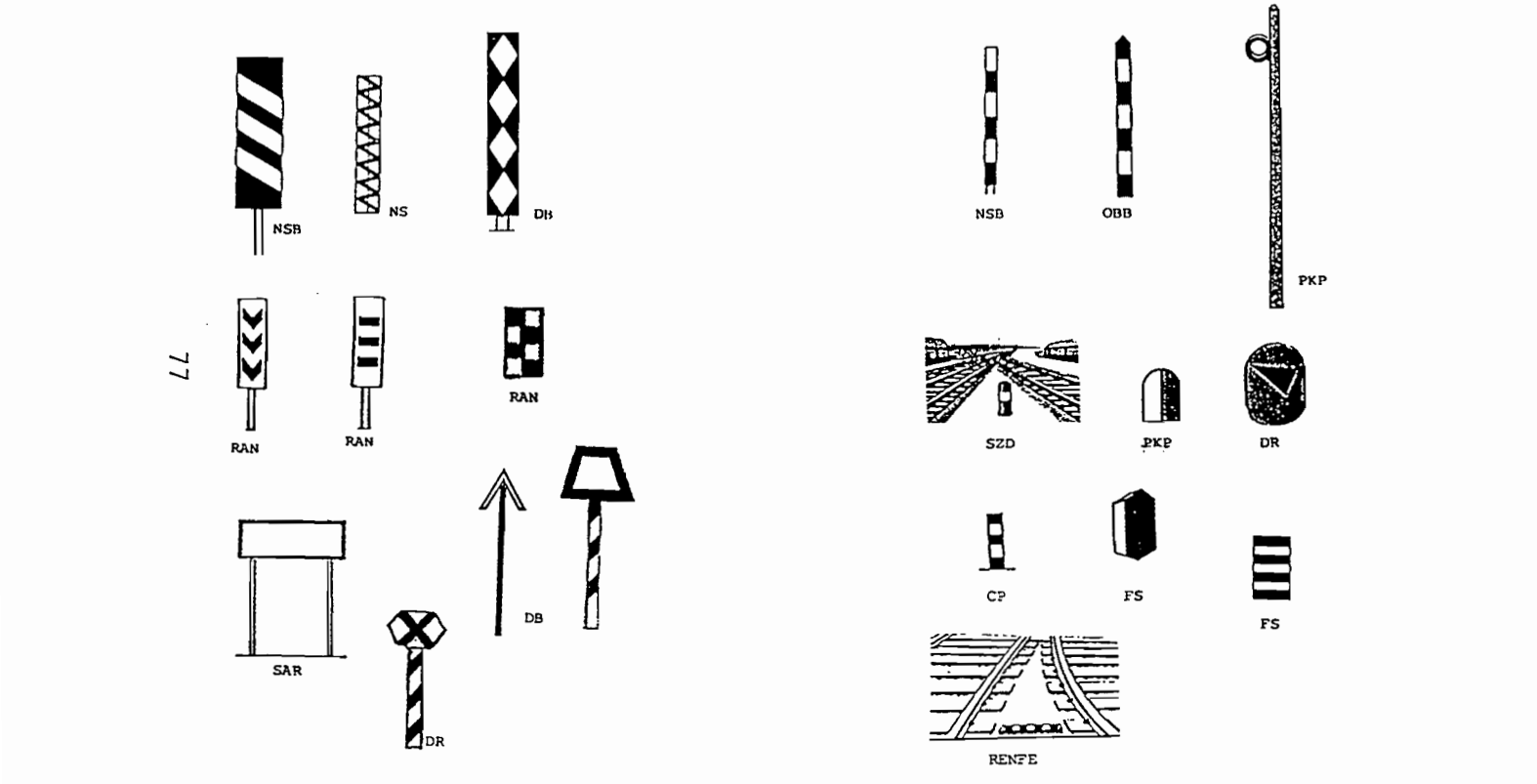
.70-.73


BETHLEHEM
BETHELEHEM
75
ANR
CAMP
CAMP
BETHLEHEM
U.S.
PNKA
JNR
ANR
CAMP

Sign Sampler



.90-.94



29B4 Variant Classification: Explanatory Notes

510

510 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 provence, and in systems influenced by Germany or supplied by 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 distant 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 (.130) 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 and may well be 511 signals in some instances instead. Square backplates (.16) are much more in use. The variant square shapes clearly suggest their origins: the rounded corners form (.162) is of French provence while the cropped corner version (.161) is of Swiss usage. Lamp configurations include SR, DR, and IR..

The second portion of 510 shape configurations, .2, refers to special shapes. 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. The illustrations of Chapter 29B4 are for understanding the complex and diverse forms that these signals exhibit.

Special shapes for other nations include four forms under .23. Many of these are at least partially rectangular in shape: .230 is from DR, (while it is possible to sub-divide .240 into variant forms, one designation should suffice); .231 belongs to DSB, .232 to SNCB and .233 to PKP. Two of the members of .24 are of DR provence and one of PKP and all are truncated parallelograms.

SGTMOOT Signals (510 .1 and .2) contain diversity but also predictability. But 511 (.3 of the variant classification) emphasizes 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 backplate 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 rectangularshaped signals display 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, assymetrical, 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 (.320) both muted and more sharply-defined forms; both modest angles and sharp angles. The Japanese version has both curved planes and points (.323, triangle with curvature, JNR 2-5). Other triangles are of a right-angle form (.324 and .325). These include an UK model which displays a relatively strong triangular shape, a more angular and truncated version (SBB), and a U.S. signal bearing perhaps only a fanciful triangle shape; a PKP signal somewhat resembles the U.S. form. 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.

Graphic Signals (.33) 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.

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 common in U.K. 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.

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. EFEA and FE employ a different style of spectacle (.406). 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 U.S. and areas affected by the US including ANR, VR-A and FNM. 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. Seemingly, .42 does not contain a version of the .413 signal (rounded-end). The Dutch version of the semaphore (.43) is fully integrated yet distinctive as a separate form. The arrow-shaft base-end (.433 within .43) is awkwardly phrased yet it describes the form.

The semaphore under the acronym, .44, BSIL, 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, WAGR, VR-A, and NZR. There is a single form, .440, within .44.

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. The .460 represents all of these signals though some variations are present. SBB has a variation of it as does DSB. Other forms of .46 (.461, .462, and .463) include

semaphores with ends similar to those of the Anglo-American model. RENFE and SNCF in fact employ signals very similar to US-UK models except for separating lamps and blades. The two final models, .463 and .464, are found only in Belgium.

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 "Accopiati" 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.

A special problem arises with signal boards (.48). The shapes are common and in use by a variety of systems but the color patterns are quite diverse and shape alone ignores a vital dimension. While these notes were not intended to describe messages in detail it seems necessary to include them.

Disc form (.480) is found both in south-west Europe and in central/eastern Europe. RENFE, SNCF and CP have a disc that is yellow with black border within a yellow band; RENFE adds a diagonal black bar. The three systems also include a red disc with black border and white band or rim. DR, DB, OBB, PKP, URO, CZD, MAV

employ a solid yellow disc with black border and white rim; there are nuanced differences but the disc in general terms has those features. JZ has a disc with white and yellow vertical stripes, black border, and white rim. RENFE, SNCF, and CP discs are revolving while the others are hinged.

Diamond signal boards, .480, include SNCF's yellow diamond with black border and white rim, and CP's yellow with white border. Hinged models include a solid blue with white border (PKP and MAV), blue and white vertical stripes and white border of JZ, and a simple solid yellow for URO.

Squares (.481) are quite diverse in patterns and systems. AUR employs two: one red that is divided by white stripes into checks, and one that is solid green with white border. CP maintains one that is solid red with white border and one that is purple and marked with a white border; SNCF employs an identical square. SNCF includes a second square with red and white checks; a white border for red checks and a red border for white checks outlines the body of the square. RENFE has a white and red check square with black border and white rim. The hinged type includes a solid yellow in square in MAV and JZ, and a check version of small blue and white checks for URO.

The .482 is limited to one rectangle in JZ. It displays white and yellow vertical stripes, a black border, and white rim.

All triangle-shaped signal boards are rotary by operation. That of Portugal is divided into yellow and white segment with yellow border. RENFE is yellow with black border and white rim. SNCF is yellow with black border, white rim, and

horizontal stripes. All of these are upward pointing (.484). One downward pointing triangle is extant: SNCF's with yellow ground, black border, white rim and black vertical stripe (.485). The Rectangle/triangle (.486) has one member: a rectange centered on a vertical plane with a triangular-shaped upper section.

The .49 designation includes hinged and stationary forms. There are three hinged forms and a single stationary type in a diamond-shape.

522 and 523 (Except 5234)

This segment, .5, includes the three sections of 522, and the first two of 523. All of these signals incorporate a princple of motion either of moving arms or rotating discs (522), and all of the signals in 523 rotate.

Dwarf semaphores, .51, 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 29B2 offer three forms of this signal. The variant classification is very brief with only two signals listed; both are fully-integrated, one UQ and one LQ. The previous segment on full-sized semaphores can supply details for those signals.

Rotating discs (.52) are in three forms; the first (.520) consists of one to three openings in the face of the signal lamps (a variation 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 (.521). The final form (.522) is a disc-shaped signal encompassing a movable arm within a glass case. Composite discs (.53) includes two rare signals: SAR's disc-semaphore (.530) consisting of a short arm attached to a disc, and the pillar-disc. The disc-semaphore (.530) acts much as any standard disc signal. The pillar-disc (.531) may be extinct though a possibly extant status can not be ruled out.

Revolving Discs (.54) and Enclosed Graphic symbols (.55) of the 533 category are also included within the .5 designation. Rotating

discs, .54, are U.K. and U.K.-derivative signals. Those within .540 have a revolving signal apparatus only; there are openings in the face for lamps as is the case with rotating signals. Fully-revolving are found under .541. A third signal, the panel signal, (.542), has rectangular targets though the signal is similar to disc types. A final version (.543) combines rectangles and discs but is not a current form. Miniature graphic symbols (Track indicators, .544) are also included in .54. Two members of .55 (.554 and .555) are in many ways closely related to .54 signals and are in fact a component of UK signals. But they remain within the definition of .55 and hence are located there.

Enclosed graphic signals (.55) 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. Arrows (.554 - .559) contain a great many forms: some representational, some partially-representational, and some quite abstract. Circles (.550 - .553) include both whole circles and various partial circles. Rectangles (.560) are frequently one side of a switch signal - the other side being an arrow - and signify the mainline track is open. A full circle indicates the junction from the siding or secondary side. A circle with cross bar indicates no admittance and a circle with vertical bar indicates proceed.

These signals can be seen (judging by various signal codes) in daylight without lighted lamps.

Double arrows (.556-.559) are similar to these signals but they are fully- lighted and not included with these. However, FS double switch signals (FS Tabella) are partially lighted models and are part of .55.

Open graphic symbols (.6) also includes 530, unlighted targets, since the day portion of 5230 is identical to unlighted targets. This portion of the classification presents a very complex situation. Instead of a few standard 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 U.S. (and North America in general). In all likelihood few American railways utilized more than a few models. This fecund phenomena is created through historical developments and the many different railways in operations.

Many of these signals have numbers not names for identication. An attempt was made by this compiler to apply appropriate terms to the signals in order to identify and distinguish among them. A representative sampling of illustrations is included 29C. Those entries in the classification accompanied by illustrations are marked by astericks.

"Mask" forms are the most common form (.60). Some masks have distinctive shapes while others vary only modestly from adjoining models. But all extant versions were included. Arrows (.61), 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. Miscellaneous shapes (.65) brings together at

least a sampling of more unusual and less-used forms.

General Note: 531

Even though variant classifications have been provided for all other railway transportation markings, a problem arises in providing such a classification for 531, Non-speed signs. The problem paradoxically arises because there are so many diverse variations among these signs. Other markings are often diverse yet there are some boundaries for the various forms. Yet here the many kinds of signs are so abundant that the general classification will stand as the only one for non-speed signs. However, a sampling of these signs are provided in 29C.

Speed signs (.7) can be classified only in a general sense because of the individual character of many of these signs. Segments within .71, .72, and .73 contain a listing of the type of symbols for those general purposes. Some details of special categories within the forms of restrictions are found in .74.

533

Non-sign markings tend toward localized and even individualized forms. These notes (as well as the classification and illustrations) may more represent a cross-section or even a sampling of markings than a systematic treatment of the subject; 533 and .8 are coterminous units.

Pillars (.80) are tall and slender objects. There are seemingly three major forms of pillars and one sub-form. This sub-form includes objects among the first three that have visible undergirding (.803).

The term "Petite" is somewhat vague: petites are shorter than pillars yet there are no actual size dimensions; to say they are short and not tall says very little. Many, if not most, petites are vertical and either cylindrical or rectangular in shape. Rounded or flat tops are the most common though the illustrations include one peaked petite. There are some petites of a more squat appearance though they are an exception. Horizontal petites are commonly rectangular in shape.

Boards (.92) are frequently just that. Many do not have visible undergirding though some, for

example .920 and .922, do. Boards numbered .923 to .928 present a general listing of symbols commonly found with boards. Boards are relatively narrow though actual dimensions are not available. The last part of .8 consists of what might be termed "Sign- like Objects" (.93). These include objects similar to signs yet lacking an alphanumeric, graphic, or geometric symbols (other than those coterminous with the spatial dimension of the object). These are relatively rare. All of these categories are admittedly vague and none more so than "Special Forms With Single Support" (.933) which encompasses the misscellaneous entries in the .93 category.

CHAPTER 30

COLORS AND MEANINGS

30A Toward Basic Principles in Signalling

30A1 Meanings 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 30B3.

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 tripart approach.

Each of the colors is visually different from all other colors. However, color meanings are not distinguished 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 structure 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, 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; which 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 substitutes for semaphore arms; for example, in the U.S. 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).

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

The following six segments of Chapter 30A may appear uneven. This unevenness is caused by the nature of signalling 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 II (a more detailed summary of all "A" and "B" class systems are included in that Appendix).

30A2 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 mega-system was not successful (Smith 1986). 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 signalling for new high speed trains (Smith 1986).

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 1961 TISRP 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 (UK K&W 1963, 12; also Nock 1962). 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 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 procedure might be closer to IUR guidelines; (BOTC 1961, 115; SNCF 1981). An earlier IUR publication regarded red as either permissive or absolute; the current practice is that of the more recent guidelines (IUR 1951 (1)).

Some systems, including those of Canada and the U.S., 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 28A (BOTC 1961, AAR 1965). The second approach is described by Mashour (1974, 34) and is reflected in a further principle of IUR: Speed-1 (30/40km/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.

A third IUR publication (IUR 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 U.S. and Canada are advocates of speed signalling even in complex situations of heavily-used tracks (Armstrong 1957, 19-20).

30A3 The URO System

A first examination of the United Railway Organization systems (URO 1962 TISRPS) 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, CZD, 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. Recent political changes have greatly altered central and eastern Europe. The impact of those changes upon URO is not known and therefore URO material is therefore retained in its original form.

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-Indikators) - 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. The URO 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. PKP and DR have a modified version of this: speeds of 100, 60, and 40 km/h 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.

Appendix II provides details on the workings of URO and variations of it. There are also elements in URO of pre-existing signals. These appear to follow older German practices (Smith 1987).

30A4 British Signal Practice

British signal practice has influenced rail signal systems - empire, commonweath and others - throughout the world. Modern and complex systems have been substantially affected by long-established U.K. principles and practices. This segment on U.K. practice

is brief which may belie the importance of U.K. contributions; brevity is engendered by the succinctness of these seminal concepts not by any marginality of import. Modern U.K. practice is summed up in Appendix II and only partially reflects the formative period (see Nock 1962, UK K&W 1963 and Chapter 28B).

British signals in the later nineteenth century are quite simple. Only two colors were in use (at least for mainline functions): red and green (UK K&W 1963 and other sources survey UK history). Signals were two-position semaphores: the somersault (which was 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 (UK K&W 1963, 12).

Some current 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.; SAR 1936). Other U.K.-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).

30A5 Signal System of Canada and the U.S.

The U.S. 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 U.S. signals can be a complicated matter.

The Canadian Uniform Code of Operating Rules (UCOR) (BOTC 1961 TISRPS), and the Association of American Railroad Standard Code of Operating Rules (SCOR) (AAR 1965 TISRPS - 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 U.S. pattern has several rules or sub-rules lacking in Canada, and Canada has some that are not found in the U.S.; 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 rules in sequence an anomaly becomes evident: the color pattern breaks down and contradictory groups of colors indications are placed together. The Canadian National Railway (CNR) offers an alternative pattern that ignores numbers but preserves color patterns and categories of indications (CNR 1975). CNR has arranged signal indications into categories of clear signals, approach signals in which the speed indication comes before the word approach, approach

signals in which the word approach comes before the speed indication, 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 qualification 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 even third lamp can be red without altering the clear meaning. A red/green indication remains 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 (speed listed before approach) 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 can exhibit more complexity than the simple word may indicate. In the U.S. 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 U.S.

30A6 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), and after consultation with other experts, the older signals are from the early part 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 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. 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. The Dutch Klapbord (Op de Rails 1985b, 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, striped and denote a specified number of meters to an approach signal. Speed restriction and 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.

30A7 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, TIRSPS). 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 provence 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 from a 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. 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 signals are found at stations - are often found in larger numbers 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).

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 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. In Europe proceed indications in signal boards manifest a blind edge but UAR provides a positive proceed marking (though RAN follows the the French practice of a blind edge). 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.

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 light, fixed or flashing, indicates caution. Any flashing light, yellow or green, denotes a less restrictive pattern.

Most audible signals are human-generated or issue from trains and are outside this study. Detonators that indicate trains are to run at caution for 1500m, and are track-

mounted constitutes a transportation marking. Railway signs for UAR are primarily yellow in background with black lettering or graphic symbols. Signs referring to stopping are black with white symbols.

30B Color Usage in Signals, Signs and Markings

30B1 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; UK K&W 1963, 10). U.S. railways did not follow suit until 1906 (AAR 1953, 73). Despite divergent meanings in the nineteenth century, green now has a clear and universal meaning for railways and traffic control devices (marine and aeronautical aids to navigation utilize green in a different mode).

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; PR T-A S). Multiple greens are found in more

complex configurations rather than basic message forms. Fixed multiple greens are not confined to the URO system; for example, Sweden is a heavy user of those forms of green (URO 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).

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

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; SNCF 1981. Some Australian systems also employ a form of double red for stop indications (McLean 1990). 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. Earliest uses of yellow for caution appear to be in the

U.S. (AAR 1953, 73), and the Orange River Colony (South Africa) (Institution 1944).

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 "annuncio de parada" (annoucement of stop) and Portugal, "precaucao" (precaution) (RENFE 1978, 1-9; CP 1981, 19). Brazil, a second Portugese-language system employs "limitado" (limited) (RFFSA 1965), 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). U.K. simply calls it a caution signal, and South Africa offers the variant, "proceed with caution" (UK K&W 1963, 52; SAR 1964, 16). The U.S. and Canada operate a variety of cautionary signals and all contain the word "approach" (BOTC 1961; AAR 1965). In URO yellow indicates a speed limit that requires a reduction of velocity (URO 1962). 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 (Taiwan; TRA 1989)), and divergent route (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; URO is a notable user of such signals (URO 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).

30B2 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 II 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 U.S. 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 URO and Western European systems frequently employ GY. It is present in African, Asian and American systems (including those of Canada and the U.S.). 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) (OBB 1979, 15). There are many forms of GY in URO including GY (40km/h), GFF/Y (40km/h to 120km/h) and GFF/Y and one Y strip (60km/h to 120km/h) (URO 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 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 U.S. 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 preceeds R for basic level, and R preceeds G for qualified forms. Three-aspect signals add an additional G or R (BOTC 1961, AAR 1965 TISRPS). 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 U.S. 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 (UK K&W 1963; see also various Australian signal codes). Zimbabwe combines white and yellow as well as red for shunting work (ZNR Thompson 1987). 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 various authorized movements including 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 (Xian 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 1978, 22, 23; also ETR 1952).

30B3 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 U.S. 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). It appears to correspond to the "restricted signal yellow" of the U.S. Bureau of Standards and allied agencies (Breckinridge 1964. 27). Robert McKnight (McKnight 1990) notes that amber is the hue employed for position-light signals and yellow for caution indications and this conforms to the previously mentioned GRS catalogue which assigns 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 that they designate as violet. Publications on color often mention both purple and violet but more technical works focus on purple. Spanish and Portugese signals 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 U.S. 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 employs yellow under the name of yellow (SBB 1988). Blue is a infrequently employed color. Several European systems use it to

designate permissive stops (ETR 1952). The U.S. 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 Chapter 31B5 for the role of white in alphanumeric signals). U.S., 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 U.S. it is employed with color-position signals (U.S. B&O 1953). The Netherlands uses a "melkwit" or milk- white color which appears to be lunar white (NS 1978, 60). In China employs lunar white is used for shunting (Xian 1989). This color is also discussed in Chapter 31B5.

30B4 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 amd graphic symbols. White and lunar white are probably the most important colors for fully- and partially lighted signals that include such symbols. U.K. and U.K.-influenced systems, the U.S. 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 and SNCF-influenced systems frequently have black backgrounds for signs) but it is more often used 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 U.S. 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 Chapter 28B).

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 (WAGR 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. (EFE, 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 (OBB 1977).

CHAPTER 31 ALL-LIGHTED SIGNALS AND MESSAGES

31A Types of Signals

31A1 Color-light Signals: Forms & Configurations

Color-light signals are the most common type of railway signal in use today. They are probably one of the very few visual signals that is experiencing any growth in numbers. This signal can be a simple signal consisting of the signal head, baffle and supporting mast or bridge; the head contains the lamp units, lenses, and electronic or electro-magnetic mechanism. The signal in its basic form exhibits green, red, and yellow lamps, with a resulting three messages. But the color light signal and messages are simple only in the abstract, and in the most basic form. Over many years, and through the mediation of many rail systems, the color light signal has evolved and expanded into many variant forms and configurations. The variant classification in Chapter 29B1, and the illustrations of representative signal shapes, Chapter 29C, will augment this segment of the study.

References to the beginnings of color-light signals favor the U.S. very much. This is due less to national chauvinism than to the fact that many of the lighted signal developments took place in the U.S. Short-range all-lighted color signals date back to the very early years of this century; long-range types were established in 1914. Search-light signals began in 1915. Color-position signals began the year

following the search-light signal (AAR 1953, 69-70).

The search-light 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 be preferred to the search-light signal in some territories because of problems in using the former type of signal where special problems occur including that of track curvature (Armstrong, 1957, 12); it can be noted that some rail specialists are not in agreement with Armstrong on problems of the searchlight signal on curves. The precision of the search-light signal can be illustrated by the former usage of it by the U.S. Coast Guard in marine ranges (General Railway Signal, 1960).

The color-light signal can be divided into two basic forms: the multi-lamp/multi-lens form, and the single lamp/multi-lense forms. The second form is frequently termed the "Search-light" type though it is also known as the "single-lens" in South Africa (SAR refers to the multiple-lamp as "Multi-lens"; SAR 1964, 13). 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 requiring more than three aspects are permitted. This is also true of the searchlight signal since it is incapable of more than three aspects per unit. The searchlight has one configurations 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 initially find this puzzling since they may be accustomed to a signal housing consisting 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 (URO and North America are prime examples of complex systems).

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 with irregular lamp arrangement, or a signal-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, for example, "scattered" over the face of the signal are not standard.

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 not uncommon. 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 re-ordering 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 in fact be "scattered" about the surface depending on the needs of the signal operation. Despite the arrangement of lamps the shape of the signal head is a simple geometric form.

Type II configuration consists of those signals comprizing 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 rectangular portion, and a single lamp in the triangular portion; see Chapter 29C for an illustration. 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 operate as a unit, and other symbols which can be loosely summed up as graphic symbols. All of these diverse offerings, for example, can be found in the URO 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 containing standard signal heads; 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. Chapter 29C 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 (30cm) are noted but those from five to eight inches or more in diameter are not separately noted as significant for the study.

31A2 Semaphoric Signals in All-Lighted Forms: Position and Color-Position Light Signals

Probably 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. However, the influence of the semaphore is more evident with the position and the color-position signals. This is perhaps more true of the wayside position and color-position signals but it has importance for specialized forms of these signals as well.

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 U.S., Argentina, and Mexico signal practice (and to a degree in some other systems). The basic signal, that of the color-light, projects a message by color only. This means one lamp of one color, or of two lamps either 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 "scattered" over the face of the signal. This is in contrast to the U.S. 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. Lavelle who notes that the U.S. style of color-position and position-light signals are "illuminated in horizontal, diagonal, or vertical planes" while the European models have the signal lamps "staggered" over the signal face (Lavelle 1953 (1), 9). The distinct planes of the U.S. 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 according to clearly defined planes. Other "position" light signals will be included with color-light signals. A special form of the position-light is that of the pedestal signal. This 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, and Conrail 1985).

Some nations in Europe employ a true position-light signal but these are for shunting purposes and for marshalling and humpyard work. This signal never has more than 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 positions they are a bonafide 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 could be avoided if all systems maintained one or at most a few forms of signals for mainline usage, but this is not the case obviously. Because of this a differentiation of terminology accompanied by an involved classification and nomenclature is required. The world of signalling - when seen through such a classification - may appear superficially rational and logical but beneath that imagery signalling portrays an apparently unkempt and messy appearance; which is perhaps no more than an indication that signals stem from, 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 - utilizes 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 routes 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 (see Chapter 29C for illustrations; 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.

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

31A3 Cab Signals: Introduction and Types

Perhaps cab signals ought to be placed with special signal forms (staff, tickets and tokens in Appendix I) 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 produce conventional

messages though without color intermediaries and are therefore placed with the regular signals.

Information on cab signals is sketchy. Even full-scale codes may not mention cab signals. Journal and trade literature is often a better information source than signal codes. The available information is sufficient, though limited, to suggest something of cab signal forms. Cab signals seemingly have 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 take up the subject of ATC and other related systems of train control, nor with cab-signal-track delivered signal control impulses. There are three systems for delivering operational impulses to the signals: the continuous, the intermittent and a composite version (Fratassi (1977, 193; see also Union Switch and Signal 1984).

Major users of cab signals include the U.S., USSR, Japan, West Germany, Italy and France. URO 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.

31A4 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 is even more individual and local practice with these signals than with more conventional all-color forms. Some systems may not have any of these forms of signals and yet other systems have only limited numbers. There is great diversity, nonetheless, 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: the mechanical, the multi-lamp, and the stencil (see UK K&W, NSW, QR, Westinghouse Brake and Signal, etc.). 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 B and S). 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 desired message is not lighted 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.

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 a split treatment. The compiler has not lost sight of the commonality of such signals.

Dividing signals according to nature of message is an uncertain matter since all dimensions of graphic and geometric signals are virtually fused together. But some tentative remarks on this topic are possible. All revolving signals, whether graphic or geometric, are less than fully-lighted. Of those that are single-sided a limited number are fully-lighted. Most that are all-lighted are graphic rather than geometric.

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

31B Messages for All-lighted Signals

31B1 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 and the rectangular of France. Triangular and an elongated rectangular form are other possibilities though they are seemingly less often used. Chapter 31B2 reviews speed signalling's impact on message configurations, the URO system, as well as systems with more complex configurations for essentially basic message patterns (for example, DB, DSB, and SBB). Signal systems in 31B1 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 lamp units 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 U.S. triangular-shaped signal (G in the upper left-hand point, Y the upper right-hand point and R in the bottom point), the U.S. horizontal version (G on the left, Y in the middle and R on the right), and the U.K cluster

signal (Nock 1962, Plate 9).

The continent of Europes offers a broad range of color arrangements; these comments refer to basic three-color arrangements. If one examines form signals - 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-hand 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 right of the mast, and a second unit to the left in order to denote automatic signalling (CN 1975). 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, 345ff).

31B2 Complex Message Configurations

Complex message configurations for this study are of two types. The first includes URO 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 31B1 though a case for its inclusion here could be made.

The URO (URO 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 I. 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 URO by member-states creates differences from the theoretical system. Poland, for example, employs moderate-sized signal 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 URO 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 I. 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, TISRP) 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 90 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 signal 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.

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, TISRP). 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-position 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).

31B3 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 U.S., 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 U.S. 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 U.S. 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/LLH 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 ULH/LRH axis and by a single marker lamp. Slow-approach is marked by vertical lamps accompanied by a three-unit marker assembly on a URH/LLH axis; this signal aspect can be supplied by a two-position dwarf signal (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 U.S. 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).

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, 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 than 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. UK (UK K&W 1963, 53) has a similar signal. West Germany and Austria employ position signals with small lamps of a numerous nature (DB 1981, 31-32; OBB 1979, 25-26). In Austria these signals serve a repeating function and in Germany they provide indicators of acceleration, delay and track variation.

31B4 Messages for Cab Signals

There are two forms of speed indications: speed categories and speed values (see Mashour, see also Chapter 31A). 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). U.S. and USSR employ the more traditional form while other systems mentioned here and in Chapter 31A3 utilize numerical types. 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 U.S. 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 eliminates the approach medium and a two-indication eliminates approach 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 indicates changes in signal indications (Armstrong 1957, 15; General Railway Signal, 605).

USSR, which maintains 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, TISRP), 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 an absolute stop and two variant 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). The system is 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 "

c) " " " 80 " (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 squares). In the first of these the driver "must stop at next section marker." Maximum speed is 80 km/h unless preceeding 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 signalling system.

31B5 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).

32A Introduction to the Semaphore

32A1 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 formsignals 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 Signaux 1981) which employs semaphore not form signal. It

may be further noted that the term formsignal 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).

Characteristics of the semaphore (beyond the core elements of arms 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). U.S. 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, PKNA). 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 has three movements: horizontal (halt), three-quarters upward (caution), and vertical (proceed). Two-position signals contain halt and proceed indications only. Three-position LQ signals

are very rare (Signals & Signal Symbols 1911, 15).

Locations of LQ and UQ signals display diverse patterns. UQ are quite common on the continent of Europe; the Netherlands by contrasts 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 (UK K&W 1963, 12). The most mixed picture is probably in Australia: Western Australia includes somersault LQ as well as US-style UQ. ANR employs mostly three-position UQ though some LQ remain; New South Wales and Victoria include both forms; Queenslands is a LQ strong-hold (see respective signal codes: AAR, UK, WAGR, ANR, NSWR, 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 American systems are influenced by U.K. The Philippines also employes U.K. style patterns (ROSTEJU 1954, 21-22). Japan, despite sophisticated systems, retains some LQ signals (see respective signal codes).

32A2 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 image: an image of a one/two/three-arm brightly painted blade in hues of red or yellow, punctuated by 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 model, 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 (the spectacle) are an integral unit (the tumble-arm or balanced-arm model is not fully integrated but the parts are integrated through linkage; see U.K. K&W 1963, 8-9).

Color is an important "ingredient" for the Anglo-American semaphore. It may be wondered if color is essential since is the practice of many railways to paint all blades (U.K.: arms) of the same shape a single color. For example, U.K. distant signals display a swallow-tail (U.S.: fish-tail) and painted yellow with black trim while home signals (with blunt ends) are red with white trim. The blades would be distinctive even if identified only by shape (and the reverse could be true: one shape but different colors). It is possible that this "double-

identification system" aids quick recognition of a signal. In the case of 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.

U.K. semaphores (and these are also found in EFEA, ENF, IR, PR, ROSTEJU [for Burma], SAR, etc.) have a "true" rectangle shape while the U.S. 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 U.K. and U.S. 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 is a second mark of origins since U.K. has left- hand models and the U.S. has right-hand versions. U.K. 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; U.K. K&W 1963, 14).

The previously mentioned tumble-arm (or balanced arm) signal is a U.K. 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 the movement of the other. Shape, color and position characteristics are those of UK practice. The signal, though minor now in UK, has remained a major signal for Western Australia and New Zealand (WAGR 1974; VR-A; NZR 1985).

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; see Chapter 29B2 for an illustration).

Dutch semaphores (seinpaals or armseins) bear a partial resemblance to Anglo-American and European models. All of the Dutch semaphores have the arm and spectacle joined together which parallels U.K. and U.S. practice (Op de Rails 1985a TIRSP). 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 U.S. and U.K. 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 arm and lens; this is true even of some signals that bear a visual resemblance to the U.K. and U.S. models (see RENFE 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 Finish 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 the remainder of the mechanism). The Yugoslav arm has two red stripes equidistant from the edges of the arm in contrast 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 formsignal tradition (SBB 10ff). Turkey and Indonesia employ form signals that stem from German and Netherlands practices respectively (TCDD among other sources; PNKA).

Belgium has a variety of semaphore forms of which most are of distinctive - and even singular - 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 1967, 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 lower 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).

32B Messages for Semaphore Signals

32B1 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). U.K.-U.S. semaphores though not identical share many similarities and can be regarded as an unit; significant 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: signals 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 LQLH or 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, U.K.), or 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 signalling. This indication occupies the mid-point of the signal apparatus (see Chapter 29B for illustrations). Caution indications are at a 45 degree angle whether UQ or LQ. Proceed indications are not the same for UQ and LQ. For UQ proceed is a vertical indication while for LQ the indication is about 45 degrees (LQ usuallly requires two arms so angle of blades is not contradictory, (GRS 1913, SP).

For most systems there is agreement on the significance of blade shapes. Square-end blades designates a home signal while fish-tail (or swallow-tail) indicates a distant signal. Pointed blades announce automatic signals. In some systems (for example, ANR 1947, 112, 118) square-end signals indicate absolute signals and pointed-end blades indicates 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 others especially in URO 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 1978, 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 U.S. and U.K. 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 (Op de Rails 1985a). Home signals are marked by a round oval (similar to the Germanic model), distant signals have an 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-U.K. South Africa, and also in Indonesia; that influence is clearly present in the latter system (PKNA 1971).

32B2 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 of signal 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. Lamps and blades are fully separated.

The USSR code book does not include semaphores (SZD 1979), but the 1984 German railway yearbook (EJ 1984, 152) lists semaphores for the 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. CZD also includes some blades with a yellow center stripe (see signal codes of JZ, MAV and signal information of AZDP; see also ER 1984).

CZD 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 arms and two yellow lamps. A lattice work semaphore is also included in CZD (see AZDP and EJB), 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 (MAV, 264). URO 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 (URO 1962). Belgium semaphores combine European and UK-US schools of signalling. Home signals consist of rectangular red blades with white stripes and square ends; the distant signal is yellow with an arrow-shaft shaped-end with black chevron. These signals emit standard messages (SNCB 1980).

32C Signal Boards

32C1 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 "Form Signal" is applied to all less-than-fully-lighted signals. But that fails to differ-

entiate 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" appears to have 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, 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 elctronic 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 board 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 revolves 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 Klappbarr, the German word for hinged). 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 usual two-

position signals and often one position is a "blind edge" indication. Chapter 32C2 reviews possibilities of the board.

The hinged or klappbarr variety of signal board are in use in DB, DR, OBB, PKP, TCDD, URO and possibily the 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 use of signal boards - and of the revolving 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 of Portugal are very similar in design and function.

Outside of Europe there are signal boards in the UAR system (UAR 1983), Vietnam (ROSTEJUS, 22-23) and Algeria (SNCA 1968, RGS). These are all largely of French vintage. Indonesia (PKNA 1971), employs a variety of signal boards. It might be too fanciful to see any relationship between the signal boards and the nineteenth century disc signal of the U.S.

32C2 Signal Board Messages

The three systems with a wide range of signal boards - as well as sharing many points of commonality - will be considered as a group. The UAR, with resemblances 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 of 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 over-lapping 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 meanings.

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 ROSTEJUS 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 separated by white lines. The meaning of this 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; ROSTEJUS 1954 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.

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

Spain provides an interesting two-part composite group of signals: one part combines signal boards and semapores, and the second brings together different kinds of signal boards (RENFE 1981, 1-13, TISRP). There are four elements within the composite signals. The first consists of the semaphore and signal board (blind-edge) for proceed; semaphore and downward pointing triangle for advising /announcing of precaution (semphore 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 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 precaution; 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 signal indications or shunting instructions. Three other board users will be attached to this category.

DB, DR, OBB and PKP and the URO have 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 distant signal for Hungary is a yellow disc for day and yellow lamp 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 URO system offers a square divided into small blue and white checks (URO 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 URO.

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 diamond is in use. This is replaced by a 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 edgethat 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 south-western European signal boards (NS 1978, 58).

32D Graphic and Geometric Signals

32D1 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 siganls 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 markings monographs, the first concern is the signal then the message and its context.

Since some shunting and point signals are also found in Chapter 31 it may be helpful if the reader reviews that material and also Chapter 31 wherein all-lighted forms of shunting and switch signals are considered.

Each of the 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. U.S. 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 signalling. 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 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 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 Manoeurvre (French), Maniobra (Spanish), Manouva (Italian), and Manobras (Portugal). Even several languages well removed from the Romance tongues employ similar terms: Manowrowa in Poland, Manevrisanje in Yugoslavia, and Mahebopobon in the USSR. German language codes employ Rangiersignal, and the Netherlands, a similar Rangeersein. Belgium speaks literally of petit mouvements. The English language has settled on shunting.

As has been noted, there are two terms for the juncture of tracks: switch, and points; thouugh they refer to the same function. This divergency 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 (IUR/UIC 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 relationship to switches.

32D2 Geometric Signals

Geometric signals are within the 532.52 and 533.54 and 533.60 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 lacks

internal signal lamps but is instead indirectly lighted by a flood lamp attached to the signal that acts as a substitute for daylight; this means that day and night messages are one and the same. 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 U.K. (U.K. K&W 1963, 22). 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 (just as some signal boards 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 U.K. 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 day 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 many more variations and therefore more difficult to briefly sum up. This signal is the open target previously mentioned and which is most commonly found in the U.S. 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 designs in use. This signal is definitely and visually different from switch and points indicators of U.K. and U.K.-influenced systems, and indicators in Europe.

The free-standing target is not covered by a central code. A U.S. railway engineering group provides a listing and illustrating of design shapes and at least one manufacturer provides a pictorial catalogue of shapes (Bethelehem Steel

1981). This is the case in the U.S. 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.

32D3 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 partly-unlighted. There is no problem in determining the character of those markings or of distinguishing between lighted and unlighted dimensions.

However, graphic signals have an uncertain character since 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 pattterns) 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 Kreusings Weichen, DB 1981, 55; DR 1971, 119), and are considered in Chapter 31.

This bifurcated view of graphic signals 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 decidely 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 32E2 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 very much obsolescent (possibly only the Southern Pacific in the U.S., and the Australian National Railway employ it to any extent; NZR has a variant form: see below). Even though it may be largely 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 (This coverage is an amalgamation of information from several references including Hall Signal 1913, 60-F-a & 60-H-a; US&S 1911 & 1929; Southern Pacific, 141, 142; Sante Fe 1909; Union Pacific [CCOR 1967, 130, 131]; Rock Island ["Electric Lights", 1936, 627, 628, 629]; and ANR 1947, 139).

It may be debated whether it is a graphic-shaped or a geometric-shaped signal. Since many of its forms display graphic designs it seems more reasonable to place it with graphic signals. Many of the track indicators are unlighted though some partially-lighted forms (and possibly fully-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-sized form; other forms are exclusively 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 of two messages contrary to position-light signals. The disc indicator is perhaps the only remaining version of the formerly important disc signal in the U.S. 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 (ANR 1947, 139; NZR 1979, 115).

32E 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 31.

32E1 Geometric Signals: Rotating and Revolving Discs and Panels

Many, perhaps all, of the revolving disc signals are U.K. and U.K.-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, WAGR, 486-487). The lamp is usually red though a limited number have purple (for example, VR-A, 28; ANR 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 U.S. 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 (both in Pakistan, PR GR.S. 5). Colors at night include red for stop indications and white or green for proceed indication. U.K. has one - now obsolete - solid red disc with an upright green rectangle (U.K. K&W 1963, 51).

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. Appendix I 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. ANR offers a rotating signal though no revolving models (ANR 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

flood-lights, 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 (ANR 1947, 113).

In the case of ANR, purple indicates stop for a "platform starting signal" (ANR 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 (U.K. K&W 1963, 23) is a points indicator; a second U.K. 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 U.K. and as a shunting signal in NSW (U.K. K&W 1963, 23; NSW, section 23).

32E2 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 U.S.) 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 not provide very much precision in summarizing meanings it can suggest meanings for such indications that will often hold true.

The shapes that these targets or open geometric signals may display runs the gamut of geometric shapes: arrows, prisms, ovals, circles, rectangles, squares, diamonds, lozenges, "masks." And many of these shapes can develop sub-patterns of their own. And target vary from a few inches in height to ten feet or more. Some U.S. 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 ANR 1947, 136, 137, 138; EFEA 1958, 145; FNC, Ch II, Art 33; FNM, 127-128; PNKA 1971, fold-out; ROSTEJUS 1954, 22; SBB 1981, 22; U.K. and U.K.-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 ANR is the "mask" shape. This term was coined from the resemblance of the target to face masks (such as Halloween masks). There are a variety of shapes of masks; most have "eyeholes" drilled into the metal though there are also some "eyeless" versions. Arrows represent a relatively common form; 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 lozenge-shaped was coined from the apparent resemblance of some targets to cough drops and similar medications. 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 have 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 postion of the mask vaguely suggests a stop message. This specific target is in use in the U.S. and ANR and bears these messages (Bethlehem 1981; ANR 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 (ANR for example; ANR 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 Philippines where white discs are employed for mainline though red lamps are in use at night (ROSTEJUS 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 ANR); 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 which 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.

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.

Basic messages for graphic 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 29B) 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 terms 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, ANR, 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. ANR has a variant form that partially resembles a semaphore arm but also bears resemblance to a check mark (ANR 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).

32F Non-sign Markings

32F1 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 transportation MARKINGS 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. Those symbols are the message; there is nothing super-imposed (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 it is a general 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 A.R.E.A. 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 (A.R.E.A. 1987, 1-7-2 and 1-7-3).

32F2 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 which are slender, or narrow, and either straight or tapered. They are employed by only a limited number of systems. Norway, Austria, and Poland are the larger users of pillars (NSB Sikkerton; OBB 1979, 86ff; PKP 1975, 138; TISRP). 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 crossings 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). URO includes boards and that organization included some non-European member systems (URO 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 (the Italian tavola can be translated as plank and that can sum up the general category). Supports frequently 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, 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 Sikkerhetan). 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 29B) 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 TISRP). 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 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).

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32G Railway Signs

32G1 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 was very much the case for partial code documents but it was also the case for some full-fledged signal codes. Signs were either not very important in many systems or they were left to local authorities to deal with. Even the AAR, which produces an exhaustive listing of signals and messages, has limited information on signs. And most of the information on signs in their files comes from individual railroads (AAR, Foley 1975). However, A.R.E.A. 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 (A.R.E.A. 1987, 1-7-2 and 1-7-3).

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, inscriptions 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, junctions, 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 types of signs which in turn provides a framework for 32G1 and 32G2.

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 29 and this segment divide 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 foci.

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 the 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 29C 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 (A.R.E.A. 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 a direct safety aid. These signs display letters and/or numbers for each signal installation. 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 tracks 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 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 are diverse but are nonetheless sharing in a relatively closely related function. Electric traction signs (5316) constitute the only international system 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 (Chapter 29A). 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 sign types exist for general purposes but they also include signs for special rail lines, or special categories of trains. For example, branch lines may have separate speeds, and separate speeds may be in force for passenger and freight trains. Many of the railway signs that are lighted are frequently speed control signs; this is especially true for Europe.

Only limited information exists on materials for railway signs. Again, A.R.E.A. provides an introduction to that topic. Posts can be of several materials including wood - if treated, concrete, and steel. A.R.E.A. recommends the use of aluminum (plates or of an extruded form) for

signs though fiberglass (GRP in Europe) is acceptable (A.R.E.A. 1987, 1-7-3).

32G2 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 can accept imprecision and some measure of indefinitiveness.

A.R.E.A. recommends "definite sign shapes" without giving particulars (A.R.E.A. 1987, 1-7-3, TIRSP). Sizes are not standardized though size of legend is a determining factor for sign size. A sharp contrast between symbol and background 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

inidicates 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 through 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 commonplace in North America, and triangles in Europe. Rectangles are common for UAR (horizontal emphasis) and in Japan (vertical emphasis, JAR 2-8). 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 symbol 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 signs sums up their functions and suggests their 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, permissable 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 though the Swiss rail system includes some lighted forms (SBB 1982, 27; see also DB 1981, 35). The illustrations in Chapter 29C include 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. Nontheless, most of these signs are very similar.

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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.

GLOSSARY

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 systems.

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

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 blocks 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 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 in

which 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 systems though some systems include significant numbers; in particular, URO. In some systems flashing signals display a single rate of flashing while in 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 interlocking 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 mainline uses; many others use one or other version for non-mainline 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 provides color for that light beam and thereby produces a pattern (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 semaphores display fully-integrated blade and lens units while others separate blades from lens and lamp apparatus.

Semiotics. This is the study of signs. It includes anything that serves as an representation of anything else. 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 multipart relationship involving the actual sign, what it refers to, who views the sign, etc. In this study the important parts of semiosis are 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 that are at least partially-lighted. Major forms include color-lighted, color-position, position, semaphores and signal board signals. The term can be 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.

Signalling. "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 system centralized traffic control, automatic train control, interlocking systems, etc. This study is concerned only 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 positions. 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 U.S. targets have lights but they can as easily have a day only indication. U.K. 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 which 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 approaching the location of that indicator. Indicators, which are found on only a few U.S. railways, and in Australia, are primarily for the benefit of train crews working 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 cars, accepting and disembarking of passengers and goods.

APPENDIX I

STAFFS, TABLETS, TICKETS & TOKENS

This study and its companion studies are concerned with human communication. However, the study is specifically concerned with indirect communication (via electro-magnetic devices, graphic symbols, electronic and acoustical devices, etc.) rather than direct human communication. Human communication in a direct mode (arm and hand signals, etc.), 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; 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 signalling 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 train 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 sharply at variance from wayside signals, and for that reason they are included in this appendix.

A variety of these systems are in use even late in the twentieth century. They 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 that object is in the possession of that crew. In many instances there are semaphore signals as well as the token or other object (UK 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" (UK 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 train 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 (UK K&W 1963, AAR 1953, Hammond 1964 among other sources, examines these practices).

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). K&W reviews many of the forms but excludes the tablet form that precedes the electric staff and token systems. The tablets in question 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 (Foster and Grant 1980). 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 that are one and three-fifth inch in diameter (United Nations 1954; Westinghouse Saxby Farmer, Neale's).

The U.S. did not make extensive usage of these various systems. Though some units of the Webb & Thompson electric were in use during the 1890s (AAR 1953, 11). Much more important were the time table and train order systems; the former is not part of this study. 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 (ANR 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).

Two electric token systems are currently available: Tyer (several models) of Tyer & Co. (within Foster & Grant, Ltd.) and Neale (Westinghouse Saxby Farmer, Ltd.). The former is a key token operation, the later is a ball token apparatus. The Tyer equipment is an up-dated version of much older systems while Neale appears to be a more traditional system.

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). 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 is 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.

An enjoyable and illuminating account of single-line signal forms is found in Brian Hollingsworth's **The Pleasure of Railways** centering on the spiritual home of tokens: the Scottish Highlands (Hollingsworth 1983, 43-45).

APPENDIX II

MAJOR RAILWAY SYSTEMS: SIGNAL TYPES & MESSAGES

Argentina

Two-aspect:

R Y
OR
G G

Four-aspect:

R
Y
G
Y

Three-aspect:

R
Y
G

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

Australia

(Australian National Railways employs former South Australian Railways signal code)

Signal patterns are very similar to those of Victoria Railways (see below). ANR 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 R/G "'Clear medium speed,' proceed at 25 mph, prepared to find next signal at proceed."
G R/Y "'Medium speed warning,' proceed at 25 mph prepared to stop at next signal."
Y Y/G "'Reduce to medium speed,' medium proceed at normal speed but pass the next signal at 25 mph."
R 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.

Brazil

All Searchlight (SL) G-Y-R G-Y-R
G-Y-R

G Proceed
GR Proceed
FLY Proceed-limited velocity
YG " " "
Y Proceed, be prepared to stop
YR " " " " "
RY " at restricted speed
FLR Permissive stop
FLR(2) Permissive stop
R Stop
RR Stop

Britain

3-Aspect:
G Clear
Y Caution
R Danger

4-Aspect:
Y Preliminary Caution
G Clear
Y Caution
R Danger

China

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

China (continued)

Home:
- G Passing with normal speed on main line, exit & route signal cleared.
- Y Entry into station main line & 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 Chapter 29B and 29C 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 red 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.

West Germany

Y G -- G

Y G R Y

Distant Signal:
- YY "Be prepared to stop at next signal"
- YG (Bottom Y, Top G), "Be prepared to proceed at low speed"
- GG "Proceed main signal ahead"

Home Signal:
- R Halt
- GY "Proceed at low speed"
- G Proceed

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/UIR 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 follow-material comes from UIC Code 1961, 732R.

IUR (Continued)

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 permissable 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 protected by it (1^{o} = 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).

IUR (Concluded)

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^{o}).

Ninth Principle:

a) If indications 1^{o} 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 elminates all other indications.
- -The warning indication (1') (warning to stop or speed restriction warning) eliminates all line clear indications (1^{o} m).
- -The indication to proceed (1^{o}) eliminates, in principle, the clear indication (1^{o} 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, 60 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

3-Aspect:

G	Proceed
Y	Caution
R	Stop

4-Aspect	I	II
	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)

Japan (Continued)

5-Aspect:

Y	
Y	Second Y & G: Reduced Signal
R	First & Third Y: Restricted Signal
Y	
G	

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

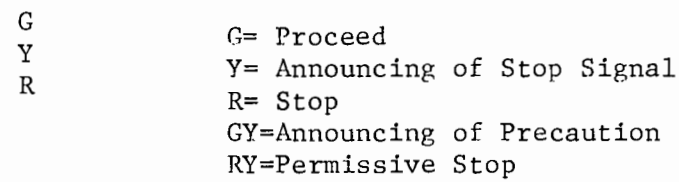
Y			Y
G	R	Stop	G
	G	Proceed	
R	Y	(upper) Caution	R
Y	FLY		
	GY		
	YY		

(See URO for at least partial elucidation of meanings)

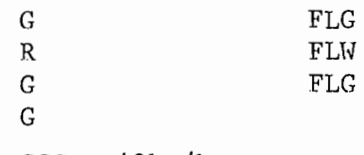
South Africa

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



Sweden



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

Union of African Railways

Absolute Stop Signal:	G	Clear
	Y	Caution
	R	Stop
Distant Signal:	G	Clear
	Y	Caution

United Railway Organization

	Vmax	120 km/h	90 km/h	60 km/h	40 km/h	0 km/h
Vmax	o G	o G FF	o G F	o Y FF	o Y F	o Y
120 km/h	o G o Y = G	oGFF oYY = G	oGF oYY = G	oYFF oYY = G	oYF oYY = G	o Y o Y = G
90 km/h	o G o Y - G	oGFF o Y - G	oGF o Y - G	oYFF o Y - G	oYF o Y - G	o Y o Y - G
60 km/h	o G o Y - Y	oGFF o Y - Y	oGF o Y - Y	oYFF o Y - Y	oYF o Y - Y	o Y o Y - Y
40 km/h	o G o Y	oGFF o Y	oGF o Y	oYFF o Y	oYF o Y	o Y o Y
0 km/h	o R	o R	o R	o R	o R	o R

Vmax = Maximum velocity
FF = F. flashing (100-110 flashes per minute)
F = Flashing (40-55 flashes per minute)

URO (Continued)

DDR and PKP follow the URO system but without all of the complexities. Both have eliminated FF lamps and double strifenindikators. Instead of 120 km/h and 90 km/h there is a single 100 km/h indicator employing the URO 90 km/h symbol aspects. Both systems conflate some of the 40 km/h and 60 km/h indications.

Czechoslovakian Railways does not release signal code information. Automatizace Zeleznicni Dopravy Praha, the nation's leading signal maker, has provided some information. The Czech version includes up to six colors (red, green, yellow, double yellow, white and blue). It also contains two stripe lights (contrary to DDR and PKP) and these can be green/yellow or green/green (URO are single or double green, or single yellow) The Czech system has vertical light indicators for short range needs. Shunting indications (blue lamps) are included with that signal. Three-aspect include G,Y,R with "additional white lights" for the fourth aspect. White and yellow indicates "caution, the distance to the next signal is shorter than the brake distance."

Other members of URO also employ portions or adaptations of the parent URO system.

USSR

G	"Established speed aspect, two or more block-sections ahead are free."
Y	"Restricted speed aspect, one block-section ahead is free";
R	YR: "Slow-approach aspect, the next section is occupied."
	R Halt

United States and Canada

1. The two-page chart is necessararily preceded by the following explanatory notes.
2. There are substantial overlaps in the numbering and message indications of the two systems. Railways of both belong to the AAR. However, the pattern of indications is published separately: the Canadian form from the Board of Transport Commissioners, and the U.S. version from the AAR.
3. The arrangement employed here does not follow the numerical schema. Instead an alternative approach in use on the CN (Rule Signal Instruction Aid) was adopted for this coverage. Since some numbers and contents for several rules are not included in the CN format, this compiler has supplemented that format with the necessary U.S. indications. This approach arranges signals by colors and color combinations.
4. CN includes only searchlight signals so that each signal representation contains three lenses (G, Y, R). AAR includes both searchlight and multiple-lenses so that a multiple unit would have three lamp units where Canada has one, and nine where Canada has three.
5. CN includes some signals that are staggered so that one lamp is to the left of the signal mast and one is to the right. The enclosed chart places these units in an off-center pattern though signal masts are not included.
6. In each block the U.S. version - if different from that of Canada - is on the left side; if Canada has a variant form it is to the right. When signals are in common they are placed in the middle third.
7. Abbreviations: A= Automatic; L= Limited; G= Grade; SPS= Station Protection Signal.

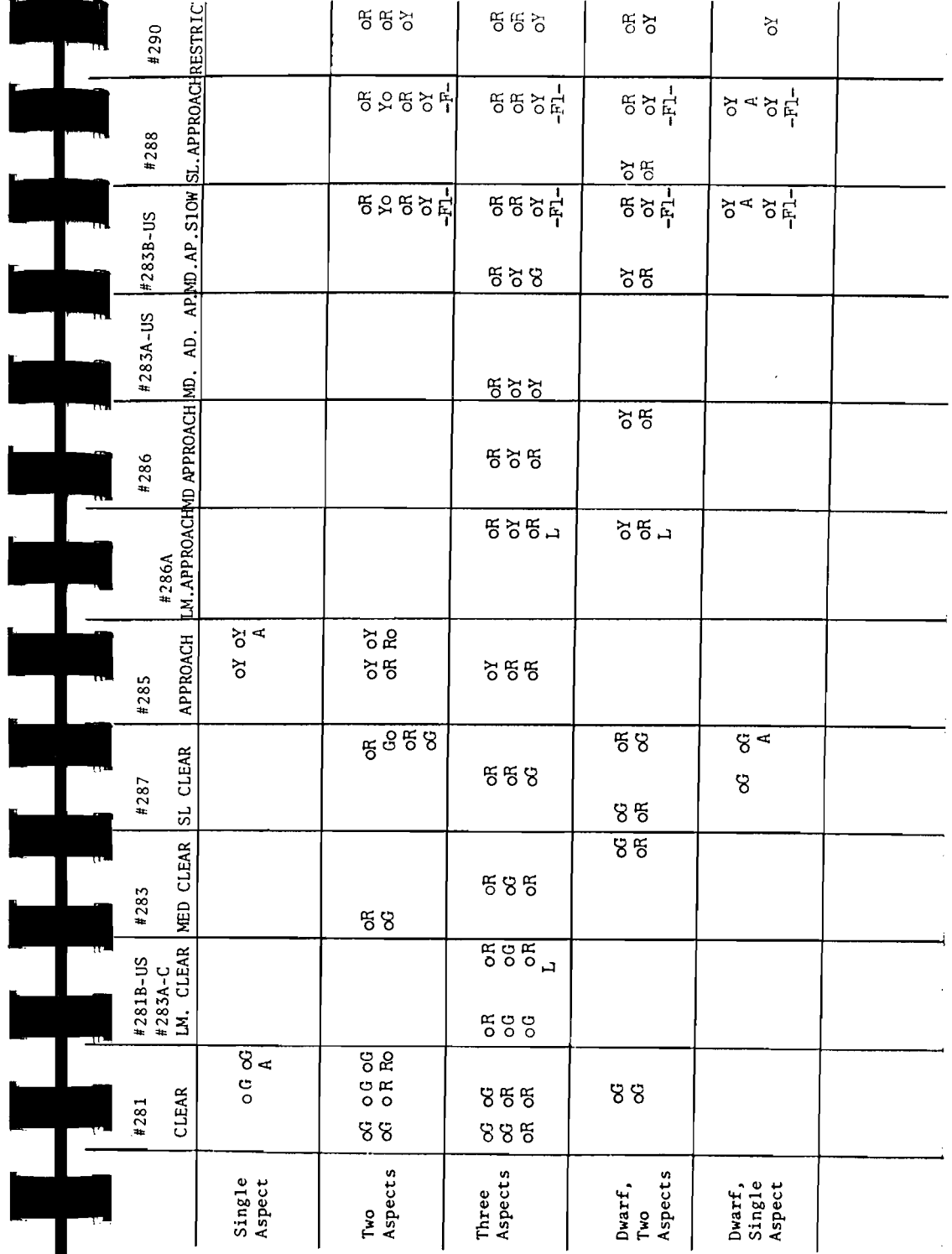
8. Full headings for signal indications are:

a) Clear Limited Clear Medium Clear Slow Clear

b) Approach Limited Approach Medium Approach Medium Advance Approach

c) Approach Limited Advance Approach Medium Advance Approach Approach Medium Approach Slow

d) Stop and Proceed Grade Signal Station Protection Stop



#281B-US #282A-C AP. LIMIT.	#281A-US AD.AP.MED.	#282A-US AD. APPR.	#282 AP. MED.	#284 AP. SLOW	#291-C S & PRO.	#291A-C GRADE	#291B-C ST.PROT.	#292 STOP		
					oR	oR (G)	oR S P S	oR oR A		
oY Go L oY L oG	oG oY	oY oY	oY oG	oY Yo oY oY	oR Ro	oR Ro (G)	oR Ro S P S	oR oR		
oY oG oG oY oG oR L	oG oY oR	oY oY oR	oY oG oR	oY oR oG oY oY oR				oR oR oR		
oY oG L	oG oY	oY oY	oY oG	oY oY				oR oR		
								oR oR A		

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ANR	Australia, Australian National Railways
BOTC	Canada, Board of Transport Commissioners
BR	Bangladesh, Bangladesh Railway
CFR	Rumania, Chemins de fer Roumains
CP	Portugal, Caminhos de Ferro Portugueses
CSD	Czechoslovakia, Automatizace železničí Dopray (for Československé Statni Drahy)
DB	German Federal Republic, Deutsche Bundesbahn
DR	German Democratic Republic, Deutsche Reichsbahn
CR	China, Guang, Hu Tong of Xi'an Railway Signal Factory (for Chinese Railways)
EFEA	Argentina, Empresa Ferrocarriles del Estado Argentino.
EFEC	Chile, Empresa Ferrocarriles del Estado de Chile
ET	Thailand, **Encyclopedia of Thailand**
DEV	German Empire, Deutscher Eisenbahn-Verwaltungen
ENF	Bolivia, Empresa Nacional de Ferrocrriles
FE	Uruguay, Ferrocarriles Estado
FNM	Mexico, Ferrocarriles Nacionales de México
FNC	Colombia, Ferrocarriles Nacionales de Colombia
FS	Italy, Ferrovie dello Stato
IR	India, Indian Railways
IUR	International Union of Railways/ Internationale des Chemins de fer

IRSE Institution of Railway Signals Engineers
JZ Yugoslavia, Zajednica Jugoslovenskih Zeleznici
JNR Japan, Japanese National Railways
KR Kenya, Kenya Railways
KNR Korea (South), Korean National Railways
MAV Hungary, Magyar Államvasutak
NS The Netherlands, Nederlandse Spoorwegan
NSB Norway, Norwegischen Staatsbahnen
NSW Australia, New South Wales Railway
NZR New Zealand, New Zealand Railways
OBB Austria, Österreichische Bundesbahnen
PNKA Indonesia, Perusahaan Negara Kereta Api
PKP Poland, Polskie Koleje Panstwowe
PR Pakistan, Pakistan Railways
RENFE Spain, Red Nacional de los Ferrocarriles Españoles
RAN Ivory Coast & Burkina-Faso, Régie des Chemins de fer Abijan-Niger
RFFSA Brazil, Rede Ferroviária Federal S.A.
SBB Switzerland, Schweizerische Bundesbahnen
SJ Sweden, Statens Järnvägar
SNCB Belgium, Societe Nationale des Chemins de fer Belges
SNCF France, Société Nationale des Chemins de Français
1934 Code des Signaux de 1934
1981 Principaux Signaux de la S.N.C.F.
1885 Rapport
SNCA Algeria, Société Nationale des Chemins de fer Algerians
SAR South Africa, South African Railways
SZD Soviet Railways
TRA Taiwan, Taiwan Railway Administration
QR Australia, Queensland Railways
TCDD Turkey, Türkiye Cumhuriyeti Devlet Demiryollari
UAR Union of African Railways

UK United Kingdom, Kitchenside & Williams
UN-TAAEC United Nations Technical Assistance Administration & Economic Commission for Asia and the Far East
URO United Railway Organization/Organisation für due Zusammenarbeit der Eisenbahnen
VR Finland, Valtionrautatiet
VR(A) Australia, Wooley, Victorian Railways
WA Australia, Western Australian Government Railways

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Addendum: Abbreviations

DB Danische Staatsbahnen

GENERAL INDEX

Note: This Index is concerned with the physical unit; messages are not the focus. However, categories combining messages and the physical into a recognized category are included. For example, electric traction signs.

COLOPHON

The book was prepared on an Apple III computer using Three Easy Pieces Software. Drafts and other materials were printed on an Apple Daisy Wheel Printer with Prestige 12 type.

Manuscript preparation was augmented by an IBM Selectric II typewriter with Adjutant 12 type.

The "printing masters" were prepared on an Apple Laserwriter II printer with Courier 12 type. This required the assistance of a Macintosh LC computer which incorporated the "brains" of an Apple IIe computer, and an updated version of Appleworks software (which is closely related to Three Easy Pieces). Br Justin Hertz, OSB, computer director of Mount Angel Seminary, strands of telephone cable, and an Appletalk network completed the printing process. The process was supplemented by IBM, and Panasonic (KX-E7000) typewriters utilizing a variety of type styles including Prestige Elite 12, Courier 12, Bookface Academic 10, and Proportional Spacing.

The copies were run on a Canon NP 6650 copier augmented by a Canon NP 7050 copier.

Paper: Hammermill Offset Opaque White, 70#.
Cover stock: Strathmore Bristol Writer Cover Oyster White, 80#

Cover designed and typeset by Barbara Phillipps at the Benedictine Press. Covers printed by Vince Zollner at the same establishment.

Bound by Br Simon Hepner, OSB at the bindery of Mount Angel Abbey Library.