ABSTRACT

Wayside rail signaling practice in the U.S. is a nightmarish web of operating rules, signal types, aspects, aspect names, and indications, differing between the different roads and even their individual divisions and locations. Much of the “vocabulary” involved is extremely curious and counter-intuitive, a result of the long historical evolution of this field and of the industry.

This article begins with a review of the evolution of the actual “signals” themselves. Then a consistent (if tortured) thread of syntax is identified for the mainstream of current practice, and its principles and most common application are discussed at length. An appendix illustrates, with extensive charts, the majority of the vocabulary with explanatory notes under two widely-used “dialects”. Other appendixes cover specialized related areas.

1 INTRODUCTION

Wayside rail signaling\(^1\) practice in the U.S. is a nightmarish web of operating rules, signal types, aspects, aspect names, and indications, differing between the different roads and even their individual divisions and locations. Much of the protocol involved is extremely curious and often counter-intuitive, a result of the long historical evolution of this field and of the industry.

Canadian practice, although for many years generally paralleling U.S. practice, currently follows a somewhat different (and more rational!) practice.

In this article, I begin with a discussion of the evolution of rail signaling and the various signal devices used in it.

Then, I describe some principles that run through most of the syntax used in the area. Next I give examples of the syntax used by an

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\(^1\) *Wayside signaling* operates through the use of visible signals placed alongside the track which give indications intended for observation by the locomotive engineman. It is distinguished from *cab signaling*, in which the indications appear inside the locomotive cab, and from various forms of *automatic train control*, in which the indications actually govern train operation (either through the engineman or directly).
illustrative signaling protocol. Then I discuss various “variations” we may encounter.

There are of course numerous subtleties to the various matters I present which are beyond the scope of this paper. And I must emphasize that often what I describe for each situation is only one of many possibilities—usually the most common, and hopefully the most illustrative.

An appendix gives, in “glossary” form, illustrated, a more extended definition of the syntax of two “standardized” signaling protocols,

Readers having need to further pursue the wide range of possibilities and the various subtleties of the field are referred to the section of the paper entitled “References”, where URLs to Web sites having an almost obscene amount of scope and detail may be found.

Finally, note that, consistent with our practice with respect to telephone signaling, we spell “signaling” that way, with one “L”. The spelling with two L’s is of course quite common and wholly proper.

2 OVERALL CONTEXT

This article (except where mentioned to the contrary) pertains to automatic block signaling practice and the associated interlocking signal practice, as widely used for many decades on most North American railroads. Nevertheless, prior doctrines, such as manual block signaling and even train order operation often used signals of essentially the same types discussed here.

Those two doctrines are briefly discussed in Appendix D (train order operation) and **** (manual block signal operation).

3 DEFINITIONS

These terms will be widely used in this paper. Words in bold here have their own entries.

Signal (wayside)—A head or array of heads placed alongside, or over, the track that shows, at any particular time, a single visual aspect to the train crew.

Head—A signal element that can exhibit any one of a small number of visual messages. Called “arm” if implemented by a semaphore, and often colloquially called “arm” even if implemented with lights (out of nostalgic respect for the earlier implementation).
Aspect—The visual appearance of a signal at a particular time, often described verbally. Examples: “Red”, “Yellow over green over red”.

[Aspect]Name—The formal name of the aspect. It is essentially a short form of the indication conveyed by the aspect. Example: for the aspect Green, the name is often Clear. An aspect may be given different names in the signal protocols of different railroads, and in a given protocol, there may be multiple alternative aspects that have the same name.

Indication—The operational mandate given by an aspect. Example, for the aspect Green, the name may be Clear, and the indication may be: “Proceed not exceeding Normal Speed”.

Rule—A numbered provision of a recognized set of operating rules (see section 4) that defines a particular aspect, its name, and the associated indication. Example: “NORAC Rule 282”.

4 STANDARDIZATION

4.1 Caveat

The information in this section was gathered for Issue 1 of this article, in 2002. It has not been generally updated, and so may well be out-of-date at this writing.

4.2 NORAC

Many northeastern U.S. railroads subscribe to a model set of operating rules promulgated by the Northeastern Operating Rules Advisory Committee (NORAC). The NORAC Operating Rules document covers many aspects of railway operation, including defining a set of signal aspects and indications.

4.3 GCOR

Many railroads in the western part of the United States adhere today to a set of rules known as the General Code of Operating Rules (GCOR), developed by an industry committee. Like the NORAC rules, it covers many facets of railway operation. In its initial edition (1985, substantially amended 1986), GCOR defined a set of signal aspects, names, and indications. However, as of the 1989 edition, GCOR no longer defines signal aspects, names, and indications, now leaving that up to the individual railroads.

Many railroads that follow GCOR as their overall operating rules continue to follow signal aspect and indication definitions very similar to those earlier prescribed by GCOR itself. Sometimes these are
spoken of as “GCOR aspects and indications”, but in light of the current scope of GCOR, that is not fully apt.

4.4 UCOR and CCOR

At one time, many railroads followed one of three sets of standard operating rules: The NORAC Operating Rules (already mentioned), the Uniform Code of Operating Rules (UCOR), or the Consolidated Code of Operating Rules (CCOR). GCOR in effect superseded both UCOR and CCOR, in an attempt to broaden the uniformity of practices.

Both UCOR and CCOR defined sets of signal aspects, names, and indications. Reference to UCOR and CCOR aspects, names, and indications are still encountered in the literature, but these references are essentially “nostalgic”.

4.5 CROR

In Canada, railroads are governed by the Canadian Rail Operating Rules (CROR). Among other things, It defines a set of signal aspects, names, and indications. This document is largely based on the UCOR rules.

4.6 Common western U.S. practice

Many western U.S. railroads have sets of aspects/names/indications drawn from, or evolved from, those once promulgated by GCOR. Each railroad may have a different subset of the entire GCOR repertoire, but when the same aspect appears in the list of two or more railroads, the names and indications are usually harmonious (if not identical).

I will refer to the joint collection of such aspect/indication definitions as “Common Western Practice” (CWP).

4.7 Rule numbers

In the various standard sets of operating rules that define sets of signal aspects and indications, the various aspects/indications are each usually identified as a numbered “rule”. Thus, it is common, in writing about one or more of these aspects, to refer to them by “rule number”, as: “In such an instance, the signal shall display the aspect of Rule xxx”, or even, more explicitly, “In such an instance, the signal shall display the aspect of NORAC Rule xxx”.

By way of reference, the rule numbers for aspects/indications prescribed by NORAC, UCOR, CCOR, and the first issue of GCOR are all typically in the “upper 200s” and/or “300s”.

In the current GCOR, Rule 9.1 states that the aspects and indications are to be found in the Special Instructions, a term used to refer to a
railroad-specific “addendum” to the railroad’s version of the GCOR. Accordingly, railroads adhering to the GCOR as their basic set of operating rules will often number their own signal aspects/indications as “Rule 9.1.x”.

In the current CROR, the aspects/Indications are denoted as rules 405 through 430.

5 SIGNAL CATEGORIES

In U.S. practice, most wayside signals may be classified as either automatic block signals or interlocking signals. Their respective roles are as follows.

5.1 Automatic block signals

Basically, the purpose of automatic block signals is to prevent a train from running into the train ahead. This is done by dividing the track into a series of blocks and controlling the entrance of a train into each. The presence of a train (or even a single errant car) in a block is usually detected by an electrical arrangement called a track circuit. When the track circuit determines that a block is occupied, a wayside signal at the beginning of the block gives an indication requiring the engineman to stop the train.

Stop indications given by an automatic block signal are usually permissive; that is, after the train has been brought to a stop, it may resume movement at a very low speed (often called the “restricted” speed), assuming that there is adequate visibility of the track ahead. The presumption is that the engineman would be able to see the train (or other obstruction) ahead in ample time to come to a stop before hitting it. Such an indication is sometimes called “Stop and proceed”. (See a further discussion of this matter in section 11)

5.2 Interlocking signals

An interlocking (more completely, interlocking plant) is a location in which a train encounters, for example, (a) switches (turnouts), which allow the train to move onto a siding, cross from one track to another, or follow either of two routes; (b) a crossing at grade over another track, essentially at right angles; (c) a drawbridge or other such potential disruption to the continuity of the track; or (d) a situation

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2 Often this information will actually appear in the System Timetable (which is not a timetable at all but rather a compendium of rules).
where the train could foul another train (such as where two separate tracks are unnaturally close together due to space limitations).

The term *interlocking* itself comes from the fact that the controls operating the signals are mechanically or electrically interlocked among themselves, with the controls for the switches, and with track circuits detecting the presence of a train (or car) in various locations, such that a signal cannot be made to give an indication that would authorize an unsafe or infeasible movement.

Today, a location of this type is most often called a “control point” (CP) rather than an “interlocking”. I will however in some cases use the term “interlocking” for continuity.

Interlocking signals are in modern times generally controlled within a concept known as Centralized Train Control (CTC). In this concept, signal operators working at control centers, which may be responsible for a rather large geographic area, control the movement of trains within that area by setting the various switches and signals, of course under the “interlocking” concept.

An *interlocking signal* is found at the entrance to an interlocking, but in fact usually also marks the beginning of, and governs, an entire block, often extending well beyond the far end of the interlocking proper. Thus it must also perform the duties of an *automatic block signal*. Forcing both these duties on a single signal has led to some of the more curious facets of syntax.

Stop indications given by interlocking signals are usually *absolute*: the train must stop and remain stopped until the signal changes to a more favorable indication. The reason is that the conflict might be a switch setting that the train could not possibly traverse, or the conflict might be “dynamic”, such as the rapid approach of another train on a crossing or conflicting track. Such an indication is sometimes called “Stop and stay”.

5.3 **Signals for switchyard and siding operation**

Special parts of the signal protocol described herein are often used to govern movements within switchyards or onto sidings elsewhere. They often utilize smaller signals, placed on or near the ground, known as “dwarf” signals. We will not cover this branch of signal protocol in this article.
5.4 **Distinguishing block and interlocking signals**

In many cases, the implications of a particular aspect will depend on whether the signal is in an automatic block or interlocking situation, and it is thus important that the two can be distinguished.

One convention widely followed is that automatic block signals all carry on the mast a plate with the block number; no such plate will appear on interlocking signals.

Another convention sometimes used with multiple-head signals (especially with color light signals, either searchlight or vertical three-lens) is that the heads are staggered on alternating sides of the mast for automatic block signals (typically right, left, right) but are placed on the same side for interlocking signals.

### 6 SPEED LIMIT CATEGORIES

In our discussion of signaling, we will often make reference to various speed limits. Many present signaling protocols involve the following named speeds, listed from the highest to the lowest:

<table>
<thead>
<tr>
<th>Speed</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Varies with road and location</td>
</tr>
<tr>
<td>Limited</td>
<td>Typically 40-45 mph</td>
</tr>
<tr>
<td>Medium</td>
<td>Typically 30 mph</td>
</tr>
<tr>
<td>Low</td>
<td>Typically 15 mph</td>
</tr>
<tr>
<td>Restricted</td>
<td>Speed such that train could stop in “half the visual range”, typically not over 15-20 mph in any case</td>
</tr>
<tr>
<td>[Stop]</td>
<td>[Listed as a speed to make certain syntax conventions work]</td>
</tr>
</tbody>
</table>

### 7 SIGNALS

#### 7.1 Introduction

In the next sections, I will describe the important physical types of signals, discussing for each the basic historical syntactic principles pertaining to its use. These syntactic principles are largely creatures of the physical implementation, and the overall syntax developed progressively (by accretion) in parallel with the introduction of new signal implementations.
7.2 Semaphore signals

7.2.1 Basic principle

Many different techniques were utilized during the earliest days of railway signaling. One which came into widespread use was the semaphore, a moving arm mounted on a mast, whose position conveyed information regarding the status of the track ahead.

A common arrangement was to have the semaphore arm hanging down (but not usually quite vertical) when the track ahead was clear, and to raise it to a horizontal position to indicate that the track ahead was not clear (and that therefore the train should stop). It has been suggested that this convention was evocative of a human “signalman” raising his arm to order the train to halt.

Typically the semaphore arm was square at the end, and carried a stripe of a contrasting color across its width near the end, to enhance visibility in different “sky background” situations. Figure 1 illustrates this arrangement in fanciful style.

![Figure 1. Early rail signal semaphore](image)

Typically the semaphore arm was lifted (to the Stop position) by an iron wire, pulled by a lever at the base of the semaphore mast or in the station.

A common early application of a signal like this was at a small station, where the signal (set by the stationmaster) would tell the engineman whether the train should stop, as there were passengers there (or freight, or mail), in case the train did not already plan to stop there to discharge passengers (or unload freight, or mail). It could also be used
to have the train stop because it was known (perhaps by telegraph communication) that another train was unexpectedly on the track ahead.

7.2.2 Illumination

Eventually, to allow the signal to be read at night, the “hub” of the semaphore arm was fitted with a frame\(^3\) carrying two glass lenses,\(^4\) behind which was placed a lamp (initially an oil lamp, later an electric lamp). The lamp was seen through a different lens for each of the two positions of the semaphore arm. Originally, the lens through which the lamp was seen with the arm down Clear) was clear (giving a white light), and the lens through which the lamp was seen with the arm horizontal (Stop) was red.

Figure 2 shows this arrangement.

![Figure 2. Early rail signal semaphore, with lights](image)

This color convention raised the risk that, were the red lens to crack and fall out of place, with the signal at Stop a white light would be seen, erroneously indicating Clear. To avert this, the standard color of the Clear aspect was eventually changed to green.

\(^3\) The frame was colloquially called a “spectacle”, a term which is still used, even though today the frame may carry three lenses.

\(^4\) Formally called, today, roundels (pronounced “ron-DELS”), but most frequently still called “lenses” in description of signal types.
Figure 3 shows this arrangement, now in a more “modern” (ca. 1990!) design. Here, I have shown the colors of all the roundels, the ones that are not lit being darker.

![Figure 3. Lower quadrant semaphore (red-green)](image)

7.2.3 The continuous light spectacle

A concern was that some obstruction might prevent the arm from being fully raised to the horizontal (Stop) position. To be sure that at night the signal could still be seen, but giving a “fail safe” message, often the spectacle was equipped with three roundels, the middle one also being red. Figure 4 shows this scheme, which is known as a “continuous light spectacle” arrangement.

![Figure 4. Lower quadrant semaphore—“continuous light” spectacle](image)

Still, if the wire that raised the semaphore arm If that wire were to become disconnected, or rusted in two, then when the arm was supposed to be raised (Stop) if might remain in the down position, again giving an erroneous indication of Clear.
To avert this, most railroads eventually converted to “upper-quadrant operation”. Here, the Stop aspect was still with the arm horizontal\(^5\), but the Proceed aspect had the arm raised to an upward (and in fact vertical) position. Figure 5 illustrates this.

![Figure 5. Upper quadrant signal semaphore](image)

The original mode, then called “lower-quadrant operation”, was retained for quite a while by some roads (notably Southern Pacific).

Sometimes in an upper quadrant semaphore of this type, the “continuous light spectacle” scheme was used.

### 7.2.4 The distant signal

Especially if the track were curved, the engineman might not be able to see a signal in time to bring the train to a halt at a signal that showed Stop. To deal with this, the practice was introduced of having a “distant” signal: another semaphore, following the position of the “main” semaphore but located some distance earlier in the track. The distant signal arm typically had a notched (“fishtail”) end, and the stripe across the arm was replaced with a chevron (matching the contour of the arm end), allowing the nature of the signal to be recognized.

With the adoption of the distant signal concept, the “regular” signal at the entrance to the block was given the name home signal.

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\(^5\) This choice was intended to make sure that an engineman would always properly recognize the stop aspect during a time of change of schemes.
With the “regular” semaphore arm for a block horizontal (Stop), the associated distant signal also had its arm horizontal, but the indication this conveyed there was not Stop but rather, “approach the upcoming signal at reduced speed, prepared to stop” (the modern indication name being just Approach).

As the blocks controlled by signals became shorter (to provide more efficient operation), it was often practical to have a single mast carry both a home signal for the block beginning there and (beneath it) the distant signal for the next block. The two signals could be distinguished both by their relative positions on the mast and by the difference in the shapes of the arm tips and the stripe/chevron across the arm.

In the initial practice, if the block immediately ahead were occupied (or otherwise unsuited for entry) but the next block were clear, the home signal would show Stop (red) and the distant signal for the next block (on the same mast) would show Proceed (green). There was concern that in this situation the engineman might act upon this inviting apparent Proceed aspect and continue at full speed into the current block (there to collide with its occupant).

To mitigate this concern, it became common to arrange the mechanism such that if the upper (home) arm showed Stop (horizontal, red) the lower (distant) arm would be forced to show Approach (horizontal, red) regardless of the position of the downline home signal that it nominally mimicked. This was called, as a result of the mechanical logic arrangement initially used to bring this about, “slotted operation”. We see this complete arrangement in figure 6.
7.2.5 Back to the lower quadrant

Often, in lower quadrant operation with two arms (home and distant), when the lower arm is horizontal (Approach), the light shown is yellow rather than red.

7.2.6 Three-aspect semaphore signals

With “slotted operation”, a set of two semaphore arms (one home, one distant) could only take on three states (as we saw in figure 6). It was realized that a single semaphore arm, with three positions (“aspects”), could convey this same repertoire. Figure 7 shows this arrangement.

![Figure 7. Three-aspect semaphore signal](image)

This of course resulted in cost saving, since even when there was “Approach” signaling the typical signal could now still have only one arm rather than two. In modern times, with upper quadrant operation is used, the use of two two-position arms for approach signaling was rare.

The light color yellow came to be associated with the “Approach” aspect.  

It was almost unheard of to have three-aspect semaphore signals with lower-quadrant operation. A major reason is that the lower arm position is normally not vertical but oblique (usually at 60° or 75° to the horizontal). Then an intermediate oblique position (for Approach) might be hard to distinguish from the lower position.

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6 At the time in which a white light meant Clear, green was often used for Approach.
7.2.7 Names for semaphore positions

It is common to speak of the various positions of a semaphore in terms of the corresponding light color: red, yellow, or green.

7.2.8 Slang

Because of the early history of the signal semaphore, in railroad slang a signal (even if given by a colored light only) is often called a “board” (“Yesterday Harry had an unexpected red board at Pistol Hill that made him late into Springfield by half an hour”).

7.2.9 Automatic block vs. interlocking semaphores

Sometimes “automatic block” and “interlocking” semaphores are distinguished by having the interlocking semaphore arms have a pointed end, rather than a square end (and a chevron, rather than a stripe, on the arm, oriented the same way as the pointed end.)

We won’t get to see that here, since as we get into interlocking signals, we will shift to examples using the more modern “light signals”.

7.3 Light signals

7.3.1 The color light signal

Semaphores, being overtly mechanical devices, required considerable maintenance, and were subject to problems from ice and snow. Over time, as electric lighting come into wider use, many railroads moved from the 3-aspect semaphore to a 3-aspect color light signal. In its classical form, this signal has an oval background plate (or “target”) having three lenses, each with a lamp, ordinarily arranged in a vertical column.

The arrangement of the lenses is normally, from top to bottom: green, yellow, red.\(^7\) This matches the sequence of arm positions in the upper-quadrant 3-aspect semaphore. Only one lens is illuminated at a time. The aspects and corresponding indications are the same as for the 3-aspect semaphore. Figure 8 shows the standard arrangement.

\(^7\) Note that this is the opposite order from that customarily used for road traffic signals. In addition, in road traffic signal work “yellow” is formally called “amber”.
When one signal carries multiple “heads” of this type, some or all may not follow this standard sequence of colors (see section 17.6).

Despite being thought of as “old-fashioned”, this is in fact probably still the most commonly-used signal head type in the U.S. today. In fact some railroads, having for some while use other types of signal heads, have converted to this type.

7.3.2 The triangular cluster light signal

In this variation of the three-lens theme, the three lenses are arranged in a triangular pattern on a (usually) circular background, usually with yellow and green at the top (usually in that order, left-to-right) and red centered below. We see a typical one in figure 9 (showing “green”).

“Triangular cluster light” is my name for this style—there is no consistent “official” name. It is sometimes called a “tri-light” signal (“tri” not for “three” but rather for “triangular”). It is sometimes called a “Type G” head, based on the nomenclature for a corresponding General Railway Signal product type.
7.3.3 The searchlight color light signal

A variation of the traditional 3-aspect color light signal, commonly called a “searchlight” signal, has only one lens and lamp, mounted at the center of a relatively-large circular background. Electromechanical apparatus in the signal head moves colored filters so that the light shown is either red, yellow, or green. An advantage is that it takes up less vertical space than a three-lens signal for a given lens diameter.

In its basic use, the aspects and indications of this type of signal are the same as for the three-lens color light signal. Some searchlight heads are also equipped to produce a “lunar white” aspect (produced by a diffusing white lens), typically used to explicitly indicate restricted speed.

7.3.4 The position light signal

The position light signal may be thought of as a semaphore without moving parts. It consists of a (usually) round background within which are set several lenses, all of the same color (usually yellow). For the Clear (or Proceed) aspect, three yellow lights in a vertical row are lit. For an Approach aspect, three yellow lights in a diagonal row, upward to the right, are lit. For a Stop aspect, three yellow lights in a horizontal row are lit. Often there is provision for a fourth aspect, used to indicate restricted speed: three lights in a diagonal row, downward to the right. A single light serves as the center of all three patterns. Figure 10 shows the arrangement.
For convenience, when speaking of position light signals, we often call the four visual aspects “green”, “yellow”, “red”, and “lunar white” (often just “lunar”), respectively, even though those colors are not actually involved. The figure is labeled this way.

7.3.5 The color-position signal

The color-position signal is similar to the position light signal, but the lights that are lit for the different aspects have different colors as well as being in different positions, generally the same colors as for the corresponding aspects of the basic three-lens signal. For the Clear (or Proceed) aspect, two green lights in a vertical row are lit (there is no center light\(^8\)). For an Approach aspect, two yellow lights in a diagonal row, upward to the right, are lit. For a Stop aspect, two red lights in a horizontal row are lit. To indicate restricted speed, two yellow lights in a diagonal row, downward to the right, are lit.

Figure 11 shows the arrangement.

As with the position light signal, when speaking of color position signals, we often call these visual aspects simply “green”, “yellow”,

\(^8\) The reason that there are two, rather than three, lamps lit for each aspect is that no single light could serve as the midpoint of all three patterns, as it would have to have a different color in each.
“red”, and “lunar white”, respectively. The figure is labeled in those terms.

8 SIGNAL PLACEMENT

In the basic situation of a single track (for a given direction of running), signals are commonly mounted on a mast at the side of the track—typically the right side (corresponding to the engineman’s side of the cab in usual U.S. practice).

When there is more than one track for a particular direction of running, rather than place signals for each on their own masts, there may be a column (usually again on the right of the track group) with a platform on the top from which arise separate short masts for each track, carrying the corresponding signals. (This is sometimes called a “bracket post” arrangement, the name coming from an earlier implementation, in which there was not a real “platform” but rather brackets extending to one or both sides of the mast itself to hold the additional signals.)

But for greater clarity in such cases, a short gantry extending from a column at the right side of the overall roadbed may be used (called a “cantilever bridge” or just “cantilever). The signals (on short masts arising from the gantry) are not centered over the tracks to which they pertain, but are slightly offset to the right side (as they would be if on trackside masts).

If there is no signal for one track (perhaps it is a siding), then commonly, to avoid any misunderstanding about which signal goes with which track (especially if the tracks are curved so as to distort the engineman’s view of which signal is “almost over” each track), there may be in its signal mast position a small mast with no signal on it (called a “doll arm”9)—a “mast placeholder”. Sometimes, for clarity of the situation at night, the doll arm will carry an unchanging blue or purple light.

In some cases, especially where there are several active tracks, a gantry (then called a “signal bridge”) may be built over the whole set of tracks, supported by a column at each side.

If there is only one signaled track and one unsignaled, and a bridge or cantilever is not used, the signal may be placed on a conventional

9 “Doll” is old British slang for a signal on a mast. The term “doll arm” for an empty mast is apparently a curious development from that. Sometimes “doll post” is used.
mast at the right of both tracks, with the short doll arm on a bracket off to its side (following the traditional concept of a “bracket post”).

9 APPROACH ASPECT NAMES

As maintained earlier, an aspect named just “Approach” means that the train should proceed (usually at some implied maximum speed), prepared to stop at the next signal.

If “Approach” is followed by a speed name (as “Approach Slow”) the train should prepare to approach the next signal at not over that stated speed, rather than being prepared to stop there.

Sometimes an aspect name will include “Approach” preceded by a speed name. That speed name pertains to the speed limit applicable to movement through the switch (if this is an interlocking signal) or through the block itself. If there is also a speed name after “Approach”, the implication described just above also comes into play.

10 ADVANCE APPROACH

Many railroads have adopted a protocol in which there are two types of Approach indication. The first indicates that the signal at the following block is at Stop; the second indicates that the signal at the block after the following block is at Stop. This protocol gives the engineman better information for controlling the train’s deceleration to meet the upcoming Stop signal.

Many sets of signal rules recognize this mode with the “advance Approach” indication. Its indication is typically to proceed at no more than limited speed, prepared to stop at the second signal ahead (the one currently known to be at Stop). The basic visual aspect used is flashing yellow (on the top head if a multi-head signal).

11 ABSOLUTE AND PERMISSIVE STOP INDICATIONS

As I mentioned at various places, a Stop indication at an automatic block signal is usually permissive, and a Stop indication at an interlocking signal is usually absolute, although the visual aspects are identical. Thus, an engineman arriving at a signal showing a Stop aspect must be able to determine the category of signal to properly determine the indication. A typical hint is that a block signal will have a block number plate, while an interlocking signal will not.

In some cases, unambiguous indication of this difference is provided. For a position light or color-position signal, a single lunar white light below the basic head (in Amtrak protocol; elsewhere, yellow or white above or below) indicates that the Stop indication is permissive.
Absence of such an auxiliary light indicates that the Stop indication is absolute.

12 SPEED LIMIT SIGNALING

12.1 Introduction

There are two basic situations in which it is appropriate to convey an explicit speed limit (or speed limits) with the signal.

- At an interlocking, the signal is often the signal for a block that begins with the interlocking but extends far beyond it. It is often necessary to impose a limit on the speed of the train while passing through the interlocking trackwork proper, especially when a diverging route has been set through a switch (which divergence the train may be unable to negotiate safely at normal speed).

And/or, it may be appropriate to impose a speed limit (different from that which would ordinarily apply) for movement through the black after the interlocking has been negotiated. Thus, the signal at the entrance to an interlocking may need to express either or both such speed limits.

- At a signal (automatic block or interlocking) just prior to a signal (of either category) that currently imposes an immediately-applicable speed limit, or is at Stop, it may be appropriate to impose a speed limit applicable to the approach to that following signal.10

The syntactic principles by which these limits are typically conveyed will be described later.

12.2 “Speed” vs. “route” signaling

Signal protocols, particularly for interlocking signals, generally follow one or both of two concepts regarding speed limits, which in their idealistic forms are:

- Speed signaling: in schemes of this type, speed limits are explicitly conveyed by conventions presented by multiple head signals. Interlocking signals do not explicitly indicate whether the route to be encountered is “diverging” or not—that is, the position of the switch (turnout) is not explicitly revealed, although it may be intimated by the speed limit indicated.

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10 The “approach” and “advance approach” indications, already discussed, are special cases of this; they carry inherent speed implications.
• Route signaling: in schemes of this type, at interlocking signals, the route that is set (through or diverging) is explicitly indicated. The applicable speed limit through the interlocking, for either the through or diverging route, is given for the particular interlocking by the employee timetable, and is not part of the signal indication.

In reality, most signaling protocols do not strictly exemplify either of these concepts, but follow different blends of the two.

The NORAC signaling protocol is strictly of the speed signaling variety. The signaling protocol formerly specified by GCOR is generally of the route signaling variety. The CROR (Canadian) signaling protocol is generally of the speed signaling variety.

13 BASIC ASPECTS AND INDICATIONS

13.1 Introduction

These aspects are given by a single-head signal, a situation most often found for a block signal. They are listed by visual aspect “description”. The customary aspect name is given underlined, followed by the indication.

13.2 Green

Clear—proceed at normal speed.

13.3 Yellow

Approach—reduce speed to medium and approach next signal preparing to stop.

13.4 Red

13.4.1 At an automatic block signal

Stop—stop, then proceed at restricted speed, prepared to stop (when a train or car is seen).\textsuperscript{11}

13.4.2 At an interlocking signal (although such are rarely single-head)

Stop—stop (and stay).

\[\textsuperscript{11}\text{ But a variation on that is found in some signal practices, as discussed in section 15.3.}\]
14 MULTIPLE-HEAD SIGNALS

14.1 Introduction

Signals providing for speed limit indication (whether block or interlocking) typically have two or three heads arranged vertically.

It is perhaps easiest when visualizing this type of signal to think of the heads being of the searchlight color light type, although most of the aspects can be presented equally well on other types (sometimes with some special considerations). When we illustrate the various aspects with figures, they will be based on the searchlight signal form.

14.2 The unique nature of red lights

Almost invariably, if all (lit) heads on a multi-head signal show red lights, the indication is Stop (Stop and stay or Stop and proceed, as appropriate to the type of signal).

If, however, some but not all of the lit heads show red lights, in most cases the red lights do not mean Stop, nor do they directly mean anything at all. They are merely placeholders.

A cute phrase used to remind us of this is, “If it isn’t all red, it isn’t red at all”.

14.3 Flashing lights

When a certain color light implies a speed limit, in general, if that light is flashing, the next higher speed limit applies (the indication is said to be “promoted” by the flashing of the light). If it does not imply a speed limit, when flashing it implies a “less restrictive” indication than otherwise.

15 A TYPICAL SIGNAL PROTOCOL

15.1 Introduction

Here I will describe the central themes of a hypothetical railroad’s signal protocol, which uses both “speed” and “route” signaling concepts.

15.2 Number of heads

The portion of the protocol I will discuss here can be performed by signals with two heads, and I will assume two-head signals in my

---

12 We will see one exception to that in section 15.4.
discussion. When a syntax with further aspects is used, three-head signals may be needed (see section 16). In that case, for the aspects discussed here, the lower head shows red (“not significant”).

15.3 Basic aspects

The basic aspects in the syntax are:

- Red on both (“all”) heads means Stop.
  - At an interlocking signal this means “stop and stay”
  - At a block signal, this means “stop and then proceed at Restricted speed” (so that the train could stop when the train or car in the block ahead is seen).
  - In some protocols, at a block signal this means “proceed at Restricted speed” (no stop first required), the proviso being that the train must already be at restricted speed before passing the signal. (It would have been alerted to this need by the prior signal, which would have shown Approach.)

- Green on the top head means Clear. The train may proceed at not over Normal speed without further qualification.
  - The second head will always show red (“no significance”)

- Yellow on the top head means the basic type of the aspect is Approach.
  - Red on the 2nd head means “no significance to this head”
  - Green on the 2nd head advises of a speed limitation different from that inherent in an Approach aspect. Why green? No significance to the color. It is just a different color from the yellow on the top head for ease of visual recognition of its role.
  - If the green is flashing, the speed limit implied is one step higher than otherwise.

15.4 When a diverging route is set

- Red on the top head only (this will only happen of the signal is at a switch) shows that the switch is set for the “diverging” route. Now the second head will show the basic type of the aspect, Clear or Approach.
If the second head shows green, the basic type of the aspect is Clear. The train may proceed at not over Normal speed without further qualification.

If the green is flashing, there is a speed limit through the switch (but none thereafter).

If the second head shows yellow, the basic type of the aspect is Approach. The train may proceed, prepared to stop at the next signal. In some cases a speed limit is imposed on top of that requirement.

If the yellow is flashing, this is an Advance Approach aspect: The train must prepare to stop at the second following signal.

15.5 Subtleties

In an actual protocol, often the formal indications include subtleties not discussed here.

15.6 Further aspects and indications

A complete signal protocol may have many more aspect/name/indication “rules” (the NORAC protocol has 24 altogether). Of the ones beyond what I describe above, many have “irregular constructions”, not formed from the basic syntactic principles.

16 WITH THREE HEADS

When three signal heads are used, for interlocking signals that, when a diverging route is set, show red on then top head, then the presence of green or yellow on either of the lower heads denotes the basic type of the aspect, Proceed or Approach, respectively, essentially the same as for the two-head protocol described above.

But here, the position of the green or yellow light, on the second vs. bottom head, conveys the speed limit. Then, also as we saw above, if the light is flashing, this denotes the next higher speed limit. Thus, four different speed limits can be conveyed.

This is one of the refinements allowed by the use of a three-head signal.
17 HEAD VARIATIONS

17.1 Approach lighting

In some cases, so as to conserve energy, at a block signal the entire signal is dark until an approaching train occupies the preceding block. The term “approach” used in this connection is not at all related to an Approach aspect.

17.2 Dark heads

If for a certain aspect on a two-head signal the lowest head (or the two lowest heads on a three-head) would show red (which would of itself be meaningless), those heads may actually be dark. (They contribute nothing to the aspect.)

Thus for example (in a typical syntax) a Clear aspect would appear to an approaching train as just a single green light (just as if the signal were of the single-head type).

This is done in the interest of saving energy and, to some extent, for visual clarity.

This does not contribute to any dangerous ambiguity in the even of a lamp failure in one or more heads; if the only thing showing on a signal is red, or if the entire signal is dark, this is to be interpreted as Stop.

Nevertheless, when the “dark head” plan is used, it is sometimes not followed for the Stop aspect, which then still shows red on all heads.

17.3 Hybrid position-family signals

In some protocols (including one flavor of the NORAC protocol) a two-head position-family signal may use one scheme on the top head and the other on the lower head. Quite common is to use the color position scheme on the top head and the position light scheme on the bottom head. I am not in a position to explain the rationale for this.

17.4 Narrow background heads

Very often, on a position-family signal with two heads, the background of the lower head is cut back on the sides, leaving a sort-of oval shape. This helps to visually distinguish the lower head from the upper one.

This is often done in combination with the “hybrid” scheme described just above.
We see this first in figure 12, which shows (in schematic form) three possible implementations of NORAC Rule 288. Slow Approach. The visual aspect for all of these implementations can be spoken of as “red over yellow”.\(^\text{13}\) The lower head in each case has a narrow background.

![Figure 12. Narrow background 2nd head—NORAC Rule 288](image)

- In the leftmost example, both heads use the position light scheme. The upper head visual aspect is “red” (horizontal); the lower head visual aspect is “yellow” (diagonal upward to the right).

- In the center example, the upper head uses the color-position scheme, and the lower head the position light scheme.

- In the rightmost example, both heads use the color-position scheme.

As we can imagine from these figures, a “narrow” lower head of either style cannot exhibit the “red” visual aspect (which would have the lights in a horizontal row). But red on the lower head would mean, of itself, “not significant” (see section 14.2), and so here in such cases the lower head is just dark.

We get further insight into how this works from Figure 13, which shows three implementations of NORAC Rule 283, Medium Clear, using “position family” heads.

\(^{13}\) Oddly enough, implementation of this rule with color light or searchlight signals usually uses three heads, the visual aspect being red over red over flashing yellow. Red on the top head, but not all does not here signify “diverging route”, a convention not used in the NORAC protocol.
In this case, the visual aspect for all of these implementations can be spoken of as “red over green”\textsuperscript{14}.

![Diagram of rail signals](image)

**Figure 13. Narrow background 2nd head—NORAC Rule 283**

For the top head, the leftmost example uses the position light scheme; the center and rightmost use the color position scheme. For the bottom head, the leftmost and center examples use the position light scheme; the rightmost uses the color position scheme.

As we can imagine from these figures, a “narrow” lower head of either style cannot exhibit the “red” visual aspect (which would have the lights in a horizontal row). But red on the lower head would mean, of itself, “not significant” (see section 14.2), and so here in such cases the lower head is just dark.

We see an example in figure, 14 for position light and color position signals showing NORAC Rule 281, “Proceed”. On a two head signal where the lower head can display “red” (such as a typical color light signal), that aspect would be “green over red”. But here, it is just “green”.

\textsuperscript{14} And in fact here, implementation with color light or searchlight signals can use two heads, the visual aspect being red over green.
17.5 Limited aspect heads

17.5.1 Semaphore signals

For a semaphore signal, if a head always exhibits one visual aspect, that arm will not even be equipped with a motor mechanism, and there will be only one lens in the spectacle.

17.5.2 Light signals

If the repertoire of aspects to be given does not ever utilize all possible colors on a certain head, that head may have only one or two (sets of) lenses. In some such cases, for a position light or color position signal, the background is usually cut back to a shape that only embraces the light pattern(s) that are used. This gives an additional visual cue to the state of that head.

Figure 15 shows a nice example of that on a color position signal on the former Norfolk and Western Railway (N&W).
Here, the lower head can only exhibit the color position aspect “yellow”. For overall signal aspects where, on other signal types, the lower head would show red for “not significant”, this head will be dark.

Note that the lower head has a center light, not needed for its (only) color position aspect (see figure 11). This is a red light, and it is the only light lit on the lower head in one of the more odd aspects in the N&W syntax: “red over little red” (Stop and Stay).

17.6 Implementation on vertical three-lens heads

In a two- or three-head signal using vertical three-lens color light heads, the position sequence of colors in the 2nd and 3rd heads is not necessarily the same as in the upper head, and the upper head may itself not follow the normal arrangement. Two arrangements used are (shown for three-head signals):
These arrangements are intended to improve the ability of an engineman to visually recognize certain aspects in the repertoire. I am not prepared to further discuss the rationale for this.

17.7 LED-based heads

Today, it is common for heads of various layouts to be implemented with LEDs rather than incandescent lamps. This of itself usually has no affect on the syntax that is employed, but might affect some of the details that are based on the conservation of energy or lamp life.

18 SOME SERIOUS CONTROL POINTS

I mentioned earlier that a control point (which might even comprise just a single switch) is often also the beginning of a signal block, perhaps of typical “enroute” length. But often, at a major “yard” or approaching a large terminal, we may have a series of control points immediately adjacent, such that the “blocks” are very short—comprising just the control point proper.

Figure 16 shows the Amtrak trackwork just south of Chicago Union Station (looking north, toward the terminal).15

15 Note that this photo is seemingly taken from a substantial distance and thus the apparent distances between objects is greatly “compressed”. For example, the nearby switchwork is not nearly as “acute” as it appears in the photo; the whole “ladder track” setup is actually about 800 feet long. What we see here actually represents about 0.30 miles along the trackwork.
Figure 16. Control points approaching Chicago Union Station

In the foreground we see most of CP (control point) Roosevelt. It comprises complex switchwork mainly devoted to allowing an inbound or outbound train to move from one track to another among the six main tracks.

At the nearest of the two signal bridges the next control point, CP Taylor, begins. Its switchwork allows movement of trains from certain of those six tracks to three other tracks off to both sides.

On that signal bridge we see the signals for the six main tracks that enter CP Taylor. As usual, they are placed slightly to the right of the tracks they govern.

What can we conclude from this picture?

• Most of the signal heads are of the “triangle cluster” type.

• The leftmost and rightmost signals also include a third head. It is believed that this is a searchlight head. (Why the different style for these? Who knows?)

• Why do the rightmost and leftmost signals have three head signals? Is there something about those tracks at this CP that is different from the other four main tracks? Yes—only those two tracks have the possibility of a diverging route here at this CP.

But the Amtrak signal chart for this subdivision provides for all aspects, including those denoting a diverging aspect, to be unambiguously presented on two-head signals. So I’m baffled.
19 APPENDIXES

Appendix A gives two tables showing principal signal aspects of two schemes in graphic form along with the corresponding aspect name, indication (not in the official form, but paraphrased for clarity) and perhaps an explanation of how the aspect is constructed and interpreted. The aspects illustrated are from the NORAC scheme and the scheme (based on the former GCOR definitions) followed by many western U.S. railroads.

Appendix B describes the unique B&O Railroad color-position light signaling scheme.

Appendix C describes a semaphore type that operates in both lower- and upper quadrants (the “Mozier scheme” semaphore).

Appendix D describes train order operation, a method of control of train movements largely used prior to the introduction of block signaling, but which has its own signaling practice.

Appendix E gives a brief introduction to manual block operation, a mode that was the precursor to automatic block operation.

20 ACKNOWLEDGEMENTS

The detailed information in this paper comes mostly from a collection of over 300 pages of wondrous, encyclopedic reference documents found on the Web. These documents reflect the great love of railway signaling and its history by the respective authors as well as their extraordinary patience, diligence, and attention to detail. Without in any way slighting the many other contributors to this body of work, I would like to particularly recognize the following:

Mark A. Bej, M.D., of the Department of Neurology, Cleveland Clinic, Cleveland, Ohio (one of the world’s finest hospitals, by the way). Mark’s special interest is the Pennsylvania Railroad, but his collection of works on signaling overall is wondrous.

Clive D. W. Feather of Thus, PLC in the UK. Clive’s oeuvre also extends to many other fascinating fields. He is the author of many papers and standards in the field of computer science.

James P. G. Sterbenz of GTE Laboratories, Waltham, Massachusetts, author of a large body of (large) Web pages covering signaling practice around the world. As you might expect, his range of interests is quite extensive, and covers many forms of transportation beyond rail.
Special thanks to Dave White, retired locomotive engineman with the Disneyland Railroad, for his insight into “Common Western Practice”, and to Dennis Yachechak of the Federal Railway Administration for his help on the evolution of the General Code of Operating Rules.

Thanks to Larry Evans for his nice photo used as figure 15.

21 REFERENCES

For those interested in a much larger and deeper look at the extensive landscape of railway signaling (and other railway technical matters as well), I suggest the following Web sites as starting points (the links are all seemingly operative as of February, 2018):

Railway Technical Web Pages—Home Page and Index
http://www.railway-technical.com

Railway Signalling and Operations FAQ (the starting point for access to Mark Bej’s monumental work in this field):

This link takes one to a wonderful interactive graphic signaling simulator (Java) developed by Henry J. Sundermeyer:
http://raildata.railfan.net/java/DivRte/NORAC.htm

It is predicated on the NORAC rules, and includes the use of the “Approach limited” aspect to provide the “advance approach” function.

His home page on matters related to New Jersey railroads can be reached at:
http://raildata.railfan.net

Click on any railroad logo at the left and you will go to a page listing many items about all these railroads, in many cases including detailed signaling information (often with Java-based interactive displays). The New York Central area has an especially nice graphic table of signal aspects and indications, directly accessible at:
http://raildata.railfan.net/nyc/signals/nyc_signals.html

A very nice resource on U.S. signaling practice is provided by, of all things, a Danish rail signal engineer, Carsten S. Lundsten, accessible here:
http://www.lundsten.dk/us_signaling

From the North East Rails site; includes a nice summary of signal aspects and indications:
http://www.northeast.railfan.net/pro_faq1.html
Joseph Hoevet has prepared very nice charts concisely showing the aspects, names, and indications for many railroad practices in a consistent format. They are indexed here:
http://signals.jovet.net/rules

22 ISSUE RECORD

Issue 8, February 1, 2019

(this issue). The material on a complex control point, deleted in issue 6, was restored (now in section 18). The material formerly in Appendix C was divided between Appendix C and Appendix D and substantially revised. Appendix E was added. Substantial additional material was added in the description of semaphore signals.


Issue 6, January 16, 2018. The detained description of the Union Pacific signal syntax is removed and the discussion of a generic syntax expanded. The signal chart for The Full Bucket line is removed. The photo of a complex control point and the ensuing discussion is removed Additional figures are added, especially in the section on narrow lower heads for position-family signals.

Issue 5. This issue primarily adds further information on absolute vs. permissive Stop aspects and some related matters. The signal chart for a imaginary/virtual railroad, the Full Bucket Line, is added in an Appendix. The photo of a complex control point is added, with some discussion. Figure captions have been added to conform to our editorial style. A number of editorial adjustments have been made.

Issue 4. This issue adds a number of figures, especially in the section on semaphore signaling. The description of multi-head signaling (in sections 14 and 15) has been completely rewritten, hopefully for greater clarity, now revolving around the example of the Union Pacific Railroad (UPRR) protocol. The list of external references has been updated. Many editorial adjustments have been made.

#
Appendix A
NORAC and CWP protocols—Selected Aspects and Indications

The tables that follow give illustrative aspects with their name and indication. Two protocols are represented:

- That defined by the NORAC Operating Rules. This generally follows the “speed signaling” protocol.

- What I call “Common Western Practice” (CWP). This is a joint collection of aspect/indication definitions from the sets of several western U.S. railroads, all drawn from, or evolved from, the definitions once included in GCOR. This generally follows the “route signaling” protocol.

Under any of the standards or railroad protocols, a given aspect name/indication may be attached to multiple visual aspects (even for the same type of signal, such as “searchlight”). In general, these are all obvious variants of one another (e.g., yellow vs. yellow over red vs. yellow over red over red). In this table, the visual aspects shown are usually the “most common” searchlight implementation. If the defined alternate visual aspects include ones that are not obvious variations of one another, two or more may be shown as the basis of separate items in the table.

For automatic block signals, I show schematically both a number plate and the convention of “staggered heads“, even though the latter is infrequently found in practice.

A cross across the lens symbol indicates that the light flashes.

The very light blue color indicates “lunar white”.

All aspects may appear on a signal with more heads than shown. In such a case, the additional (lower) heads generally show red (placeholder). In certain cases, such lower heads may be dark.

Aspects shown with red on the lower head(s) may appear on signals with fewer heads.

The NORAC indication descriptions are paraphrased (not necessarily verbatim). The CWP indication description is generic, and is only included if substantially different in its implications from the NORAC indication description.
### Table A-1—Automatic block signal aspects

<table>
<thead>
<tr>
<th>Aspect</th>
<th>NORAC aspect name</th>
<th>CWP aspect name</th>
<th>NORAC indication</th>
<th>CWP indication</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic indications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stop and proceed</td>
<td>Stop and proceed</td>
<td>Stop; then proceed if appropriate at restricted speed.</td>
<td>The stop is permissive since this is an automatic block signal (number plate present).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stop; then proceed at restricted speed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clear</td>
<td>Clear</td>
<td>Proceed at normal speed.</td>
<td>Basic clear indication.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Proceed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Approach</td>
<td>Approach</td>
<td>Reduce to medium speed and approach next signal at that speed, prepared to stop.</td>
<td>Basic approach indication.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>It is assumed that the next signal will be at “stop”.</td>
<td></td>
</tr>
<tr>
<td>Indications with approach speed limits</td>
<td>Advanced approach</td>
<td>Approach medium</td>
<td>Flashing yellow is an arbitrary “code” for this indication.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(In aspect name, speed limit stated after “approach”)</td>
<td><strong>Approach medium</strong></td>
<td>Reduce to limited speed. and proceed preparing to stop at second following signal. (It is assumed that the next signal will be at “approach”.)</td>
<td><strong>Approach medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach limited</strong></td>
<td>Proceed at normal speed, but approach the next signal at medium speed.</td>
<td><strong>Approach limited</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach limited</strong></td>
<td>Proceed at normal speed, but approach the next signal at limited speed.</td>
<td><strong>Approach limited</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach medium</strong></td>
<td>Proceed not exceeding prescribed speed, prepared to advance on diverging route at next signal at prescribed speed through turnout.</td>
<td><strong>Approach medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach limited</strong></td>
<td>Proceed prepared to pass next signal not exceeding 60 MPH.</td>
<td><strong>Approach limited</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach medium</strong></td>
<td>Yellow: approach Presence of green implies “but not prepared to stop”.</td>
<td><strong>Approach medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach limited</strong></td>
<td>Same as above, but flashing “promotes” the approach speed from medium to limited.</td>
<td><strong>Approach limited</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach medium</strong></td>
<td>Green on second head: approach speed medium.</td>
<td><strong>Approach medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Approach limited</strong></td>
<td>This is often used to implement the “advance approach” function.</td>
<td><strong>Approach limited</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Approach slow[1]

**Approach diverging**

Reduce to medium speed and approach the next signal at low speed.

Proceed prepared to advance on diverging route at the next signal at prescribed speed through turnout.

This is an arbitrary “code” to allow this indication to be displayed on a two-head signal. Following the “normal” pattern would require a three-head signal (see next aspect).

---

### Approach slow[2]

Reduce to medium speed and approach the next signal at low speed.

Here is the orthodox, three-head version.

Yellow present: approach

Presence of green implies “but not prepared to stop”.

Green on 3rd head: approach speed slow.

The fact that the approach speed is “slow” reduces the proceed speed.

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**Aspects used in CWP only**

### Advance approach

Proceed prepared to pass next signal not exceeding 50 MPH

CWP only

Yellow present: approach

Assumes next signal will be at “approach”.

Irregular construction.
<table>
<thead>
<tr>
<th>Diagram</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td>Approach restricting[1] Proceed prepared to pass next signal at restricted speed.</td>
<td>CWP only. Yellow present: approach Irregular construction. See alternate form below.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Diagram 2" /></td>
<td>Approach restricting[2] Proceed prepared to pass next signal at restricted speed.</td>
<td>CWP only. Alternate form. Yellow present: approach Lunar white present: restricted speed</td>
</tr>
<tr>
<td><img src="image3.png" alt="Diagram 3" /></td>
<td>Approach diverging Proceed prepared to advance on diverging route at the next signal at prescribed speed through turnout.</td>
<td>CWP only. Yellow present: approach Irregular construction.</td>
</tr>
</tbody>
</table>
Table A-2—Interlocking signals

Three head signal form shown (unless aspect not defined that way)
(Aspects shown with red on the 3rd head may be utilized on two-head signals.)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>NORAC aspect name</th>
<th>CWP aspect name</th>
<th>NORAC indication</th>
<th>CWP indication</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>Stop</td>
<td>Stop</td>
<td>Stop and stay</td>
<td></td>
<td>Basic stop indication—“It’s red because it’s all red”. The stop is absolute since this is an automatic block signal (heads in line, no number plate present).</td>
</tr>
<tr>
<td>Clear</td>
<td>Clear</td>
<td></td>
<td>Proceed at normal speed.</td>
<td></td>
<td>Green only: clear Since the signal is not “all red”, the red lights are only placeholders, and have no meaning.</td>
</tr>
<tr>
<td>Approach</td>
<td>Approach</td>
<td></td>
<td>Reduce to medium speed and approach next signal at that speed, prepared to stop.</td>
<td></td>
<td>Yellow only: approach (prepared to stop) The reduction to medium speed is inherent in the “approach prepared to stop” indication. The red lights are placeholders.</td>
</tr>
</tbody>
</table>
Indications with speed limits through the interlocking (in name, interlocking speed stated before “approach” or “clear”, approach speed stated after “approach”).

<table>
<thead>
<tr>
<th>Medium approach</th>
<th>Red on top head (but not all heads: diverging route set.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diverging approach</strong></td>
<td>Yellow present: approach.</td>
</tr>
<tr>
<td>Reduce to medium speed and approach next signal at that speed, prepared to stop.</td>
<td>Yellow on second head: medium speed through interlocking (also).</td>
</tr>
<tr>
<td><strong>Proceed on diverging route not exceeding prescribed speed through turnout prepared to stop at next signal.</strong></td>
<td>The bottom red light is placeholders.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slow approach</th>
<th>Red on top head (but not all heads: diverging route set.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diverging approach medium</strong></td>
<td>Yellow present: approach</td>
</tr>
<tr>
<td>Slow speed through interlocking [on diverging route], then medium speed and approach next signal at that speed, prepared to stop.</td>
<td>Yellow on 3rd head: slow speed through interlocking. [Yellow on the 3rd head would indicate “restricted”, but is promoted to “slow” by flashing.]</td>
</tr>
<tr>
<td><strong>Proceed on diverging route not exceeding prescribed speed through turnout prepared to stop at second signal unless signal is clear.</strong></td>
<td></td>
</tr>
</tbody>
</table>

- The table above outlines different signal indications with speed limits through the interlocking system. The indications include both medium and slow approaches, with corresponding actions for each.
- The top red light signifies the approach, with yellow lights indicating the need for caution or specific speeds.
- The bottom red light is used as a placeholder for any additional instructions.

- In the case of medium approaches, the diverging route must be followed, with a reduction in speed to medium and proceeding to the next signal prepared to stop.
- For slow approaches, the diverging route is also followed, with the addition of slow speed through the interlocking and proceeding to the next signal prepared to stop unless it is clear.

- Each indication is accompanied by clear, step-by-step instructions to ensure safe and controlled movement through the interlocking system.
<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
<th>Action</th>
<th>Notes</th>
</tr>
</thead>
</table>
| **Limited clear**<br>**Diverging clear limited**<br>Limited speed through interlocking [on diverging route], then proceed at normal speed.<br><br>Proceed on diverging route not exceeding 40 MPH through turnout. | Red on top head (but not all heads: diverging route set.)(Green present, no yellow: clear)<br><br>Green on second head, flashing: limited speed through interlocking. [Green on the 3rd head would indicate “medium”, but is promoted to “limited” by flashing.]
| **Medium clear**<br>**Diverging clear[1]**<br>Medium speed through interlocking, then proceed at normal speed.<br><br>Proceed on diverging route not exceeding prescribed speed through turnout. | Red on top head (but not all heads: diverging route set.)(Green present: clear)<br><br>No yellow, green on second head: medium speed through interlocking
| **Slow clear**<br>**Diverging clear[2]**<br>Slow speed through interlocking (on diverging route), then proceed at normal speed.<br><br>Proceed on diverging route not exceeding prescribed speed through turnout. | Red on top head (but not all heads: diverging route set.)(Green present, no yellow: clear)
<p>|   | Green on 3rd head: slow speed through interlocking |</p>
<table>
<thead>
<tr>
<th>Aspect Description</th>
<th>Medium approach medium</th>
<th>Red on top head (but not all heads: diverging route set.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium speed through interlocking, then approach next signal at that speed.</td>
<td>Yellow present: approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yellow on second head: medium speed through interlocking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green on 3rd head: approach next signal at medium speed. [Special construction].</td>
</tr>
<tr>
<td>Restricting</td>
<td>Restricting</td>
<td>Lunar white: proceed at restricted speed.</td>
</tr>
<tr>
<td></td>
<td>Proceed at restricted speed until a more favorable signal.</td>
<td>[Arbitrary: doesn’t really fit any pattern.]</td>
</tr>
<tr>
<td></td>
<td>(There are several alternative aspects.)</td>
<td>The red lights are placeholders.</td>
</tr>
</tbody>
</table>

Aspects used in CWP only

<table>
<thead>
<tr>
<th>Aspect Description</th>
<th>Approach limited</th>
<th>CWP only.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proceed prepared to pass next signal not exceeding 60 MPH.</td>
<td>Yellow present: approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flashing green on second head: approach next signal at “limited” speed (traditional syntax).</td>
</tr>
<tr>
<td>Signal Aspects</td>
<td>Description</td>
<td>CWP Only</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Advance approach</strong></td>
<td>Proceed prepared to pass next signal not exceeding 50 MPH</td>
<td>Green over yellow: next signal yellow. Yellow on second head: “medium” speed through interlocking (traditional syntax).</td>
</tr>
<tr>
<td><strong>Approach medium</strong></td>
<td>Proceed past next signal not exceeding prescribed speed, prepared to advance on diverging route at next signal at prescribed speed through turnout.</td>
<td>Yellow present: approach Arbitrary construction.</td>
</tr>
<tr>
<td><strong>Diverging clear limited</strong></td>
<td>Proceed on diverging route not exceeding 40 MPH through turnout.</td>
<td>Red on top head: diverging route set Green present, no yellow: proceed Flashing green on second head: through interlocking at “limited” speed (traditional syntax).</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Proceed prepared to pass next signal at restricted speed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approach diverging</th>
<th>CWP only.</th>
<th>Yellow present: approach</th>
<th>Irregular construction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proceed prepared to advance on diverging route at the next signal at prescribed speed through turnout.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Proceed prepared to pass next signal at restricted speed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diverging approach diverging</td>
<td>CWP only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proceed on diverging route not exceeding prescribed speed through turnouts, prepared to advance on diverging route at next signal.</td>
<td>Irregular construction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approach thirty</th>
<th>CWP only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proceed; approach next signal not exceeding 30 MPH, prepared to enter diverging route at prescribed speed.</td>
<td>Irregular construction.</td>
</tr>
</tbody>
</table>
Appendix B
B&O Color-position signal conventions

Introduction

The former B&O railroad widely utilized an interesting convention based on a single color-position head accompanied by auxiliary lights (on individual circular backgrounds) above and/or below the head proper. Although this practice has largely been superseded, it is fascinating, and so I describe it here.

The syntax is quite direct. The signal layout and the basics of the syntax are shown in this chart:

With green base aspect

Proceed, approach next signal at medium speed. *
(If flashing, limited speed.)

Proceed at medium speed through interlocking.
(If flashing, limited speed.)

Proceed through interlocking at medium speed, approach next signal at medium speed. *

* But not “prepared to stop”.

No auxiliary light: Proceed through interlocking at slow speed, approach next signal at slow speed (not “prepared to stop”).

With yellow base aspect

Proceed, approach next signal at slow speed. *

Proceed at medium speed, approach next signal at medium speed, prepared to stop.

Proceed at medium speed through interlocking, approach next signal prepared to stop.
(If flashing, limited speed.)

No auxiliary light: Proceed at medium speed, approach next signal prepared to stop.

Auxiliary light syntax

There are three auxiliary light positions above the color-position head proper and three below. Only one auxiliary light is illuminated for any aspect (a few involve no auxiliary light).

An auxiliary light above denotes a signal of the automatic block type (or one that is functionally equivalent); one below denotes an interlocking signal.

The center lights in either group essentially denote the “basic” form of the indication given by the aspect of the head proper. The left and
right lights, used mainly in connection with a green base aspect, indicate that the indication is of the speed-limited approach type (that is, not “prepared to stop” at the next signal), and indicate the speed limit for approach.

**Green base aspect**

With a green base aspect:

An auxiliary light **above** indicates that this is an automatic block signal, and

- A left light indicates proceed and approach to the next signal be at *medium* speed.
- A flashing left light indicates proceed and approach the next signal at *limited* speed.
- A right light (yellow) indicates proceed and approach the next signal at *slow* speed.
- A center light indicates proceed.

An auxiliary light **below** indicates that this is an interlocking signal signal, and

- A left light indicates proceed at *medium* speed and approach the next signal at *medium* speed.
- A right light (yellow) indicates proceed at *medium* speed and approach the next signal at *slow* speed.
- A center light indicates proceed through the interlocking at medium speed and proceed at normal speed.
- A flashing center light indicates proceed through the interlocking at *limited* speed and the proceed at *normal* speed.

**Yellow base aspect**

With a yellow base aspect:

- A light **above** at the center indicates that this is an automatic block signal: proceed at *medium* speed and approach the next signal prepared to stop.
- A light **below** at the center indicates that this is an interlocking signal: proceed through the interlocking at *medium* speed and approach the next signal prepared to stop.
• A light below at the center indicates that this is an interlocking signal: is proceed through the interlocking at limited speed and approach the next signal prepared to stop.

Red base aspect

A red base aspect indicates Stop ("and stay), unless one of the following conditions obtains, in which case it indicates Stop and Proceed:

• There is a block number plate on the mast (denoting an automatic block signal)

• The center auxiliary light, above or below, is illuminated.

Lunar white aspect

A lunar white aspect (there will be no auxiliary light) indicates proceed at restricted speed.

Alternative to flashing

For any of the aspects that involve a flashing auxiliary light, an alternative is to have the light steady and a triangular yellow plate in the lower right auxiliary light position. (The plate essentially indicates, "limited speed").

Flashing green aspect

A flashing green base aspect (there will be no auxiliary light) indicates slow speed through the interlocking, then proceed at normal speed. (This is an irregular construction.)

No auxiliary light

With no auxiliary light, the indication is highly restrictive (a "fail-safe default" situation). With a green base aspect, the indication calls for slow speed through the interlocking (if applicable) and approach to the next signal at slow speed. With a yellow base aspect, the indication calls for slow speed through the interlocking (if applicable) and approach to the next signal prepared to stop.

As already mentioned, with a red base aspect and no auxiliary light, the Stop indication is absolute ("Stop and Stay") unless a number plate is present (denoting that the signal is of the automatic block type), in which case the indication is Stop and Proceed.
Appendix C
The “three-phase” (“Mozier”) semaphore scheme

C.1 Introduction

When lower quadrant operation of semaphore signals was common, a single semaphore blade could usually only give two aspects: one (“Clear”) with the blade downward, perhaps at an angle of 45°-75° to the horizontal, and one (“Stop”) with the blade horizontal (see figure 1).

In a few cases, a third aspect (“Caution” or “Approach”, the latter typically meaning that a further signal was at Stop) was provided with the blade at an intermediate angle. But the fairly similar positions for the three aspects meant that the signal could readily be misunderstood. Thus the three-position, lower quadrant semaphore never came into wide use.

Of course, after upper quadrant semaphore operation came into use, it became common to have three different aspects by way of three easily-distinguished blade positions (see figure 7).

But, in the general context of lower quadrant semaphore signaling, A. M. Mozier of the Erie Railroad developed a semaphore in which the blade operates in both lower and upper quadrants. The scheme was also used in the “Style D” semaphore made by Union Switch & Signal Company (US&S), which they described as a “three-phase” semaphore.

![Figure 17. “Mozier” semaphore scheme](image-url)
Figure 17 shows the scheme, which, regardless of the mechanism design used, is often called the “Mozier” scheme.

The drawing is evocative of the design of the US&S Style D signal.

It is essentially an extension of the classical lower-quadrant scheme, with a third position added, having the blade above the horizontal at an angle of typically 60° (the lower position then being at an angle of 60° below the horizontal). In the modern signal light color scheme, a yellow roundel is illuminated in this position.

C.2 Spectacle and lamp arrangement

In the US&S Style D semaphore the spectacle was arranged for the lamp to be atop the post (rather than on a bracket to the side, as was common for other semaphore designs). This way, when there were two semaphores on the same post, one facing each direction (common for train order signals), the same lamp (with a lens on both sides) could work for both.

C.3 Example

A lovely example of a US&S Style D Mosier scheme semaphore signal is seen in figure 18 in Appendix D.

C.4 Earlier color system

At one time, a white light on a lower quadrant semaphore meant Clear and a red one meant Stop. Then, in “Mozier-scheme” semaphores, for the “arm up” aspect (Caution/Approach), a green light was often used.

C.5 “Fail safe” operation

Both the actual Mozier design and the US&S Style D design used (different) ingenious counterweight schemes to assure that the signal arm went to horizontal (the Stop indication) in case the chain(s) or pipe operating the signal arm were to break or become disconnected.

The operation of this scheme for the US&S Style D signal is described in connection with figure 20 in Appendix D.
Appendix D
Train order operation

D.1 Train order operation

D.1.1 Introduction

Early railroad operation depended on “timetable” operation. There, the movement of trains was governed by a timetable (not the kind used by patrons to choose a train for their travel) that prescribed when a train is permitted to leave each station (or perhaps a way point where the train was required to wait). This system, when it worked properly, avoided (or at least reduced) the possibility that train movements could conflict.

After the use of the telegraph became widespread, timetable operation was augmented by a system of reports of train movement, carried by telegraph, the results of which were to give a train instructions (by way of “train orders”) as to departure from stations and in other respects (perhaps, with two-directional single-track running, it might direct the train, at a certain upcoming point, to enter the siding there and wait for a train in the other direction to pass. This led to improved efficiency and reduced chance for inadvertence. The protocols for doing this were of course very elaborate, intended to avert any misunderstandings that could have tragic consequences (and to assure accountability by all persons in the loop).

Certain types of train order had to be signed for by both the engineman and the conductor (who, rather than the engineman, is actually the “captain” of the train). Drawing upon the terminology used by the practices of one of the early railroads to adopt this scheme, these were often described as “Form 31” train orders.

D.1.2 Pick up of orders “on the fly”

Another type of train order (“Form 19”) did not require a signature by the train crew. To minimize the delay at an intermediate station for the pickup of an order of that type, the practice came into effect of passing these kinds of orders to the train crew “on the fly”.

Typically, then the order was placed in a clip on a cane or bamboo hoop (usually with a straight “handle”), which was then held up by the station agent, or placed in a clip on a post. The engineman was alerted to the need to pick up a train order in that fashion in various ways, sometimes by what was a “yellow” indication of a signal at the station.
The train would slow down but continue through the station. The engineman or fireman would snag the hoop with his arm, promptly pull the train order out of the clip, and toss the hoop onto the ground, from where it would later be recovered by the station agent or one of his subordinates.

Later, a fork on a long handle was used to hold (in a triangular pattern) a loop of twine into which the rolled-up train order was tied. The trainman would put his arm through the loop, which came out of the fork. The trainman would then untie the twine from the train order and discard the twine.

The protocol here often required delivery of the “Form 19” train order to both the engineman and the conductor. There would be separate hoops (or forks) for the two copies.

D.1.3 Signaling

An attractive mode of operation at a station where train orders were issued involved three position wayside signals (typically a separate one for each direction of operation, usually mounted on the same mast). These were often semaphore signals.

The aspect that indicated Proceed (we can think of this as the green aspect) meant that the train should proceed through the station in the normal way. The aspect that indicated Stop (red) meant that the train should stop, perhaps to pick up a “Form 31” train order (which had to be signed for), or perhaps (for a passenger train) to pick up passengers.

The aspect that usually indicates Caution or Approach (yellow) meant that the train should slow down and prepare to pick up a “Form 19” train order “on the fly”.

Often, when lower quadrant signaling was the norm for block signaling on the railroad, a Mozier scheme semaphore (see Appendix C) was used as the train order signal.

D.1.4 Fail-safe operation

Typically, the protocol prescribed at the signal at a station be normally kept at Stop. When the station agent (or signalman) saw an approaching train, and there were no train orders for it, he would put the signal to Clear until the train had passed, then put it back to Stop.
D.2 Example

D.2.1 Introduction

Figure 18 shows a lovely example of a manually-operated two-directional US&S Style D “Mozier scheme” semaphore used as a train order signal, at the restored depot at Columbus, N.M., three miles north of the border with Mexico. The depot went out of use in 1959, when the railroad line was dismantled. The building, originally built in 1902 (some authorities say 1906), now houses the town historical museum.

![Figure 18. Columbus, N.M. restored railway depot](image)

At the far left of the picture we see the train order mast, with clips at various heights to hold the train order hoops. (There is a small stairway for access.)

D.2.2 Personal inspection of the signal

In January, 2019, my wife Carla and I visited Columbus (it was the take-off point for a weekend trip into Mexico—Columbus is only three miles from the border with Mexico), and we had a chance to examine this signal. From our examination, it appears that this signal had originally been a classical Mozier-scheme signal, with three positions.
But subsequently it has been converted to a two-position lower-quadrant signal.

We found that the third spectacle position (which would have been for the arm up position and would normally carry a yellow roundel) now actually has a blank metal plate. Additionally, the semaphore operating levers inside the station, which appear to originally have had three positions, had each been fitted with a piece that blocked their motion to the third position (which again would have corresponded to the arm up position).

D.2.3 Evolution

This signal was probably originally installed when this line was operated by the El Paso and Southwestern Railroad, the original builder of the line. Very likely that line used a three-position train order signaling plan. The line was eventually leased and later bought by Southern Pacific. That line used two-position lower-quadrant semaphore signals, including for train order signaling. We presume that the conversion of the signals at Columbus from three-position to two-position was done when the line was under Southern Pacific control.

With only two signal arm positions, how would it be indicated that the train should slow and prepare to receive a Form 19 train order? Noted rail signal expert J. B. Calvert describes one scheme used by Southern Pacific. As the train approached, the station agent would twice briefly put the arm to Clear (described as a “wink”). That signified that the train could proceed but must slow and prepare to receive a Form 19 train order.

Figure 19 shows Carla at the base of the train order signal mast, with her hand on the end of the bellcrank that, through a vertical “pipe”, operated the blade of the westbound signal. (The pipes from the levers in the station to the two bellcranks have been removed in to allow visitors to traverse the sidewalk we see to our right to reach the building entrance.)
D.2.4 Counterweight fail-safe mechanism

Figure 20 shows the signal heads. The lamp (bidirectional) is atop the post, behind the red roundel we see in the picture.

We can see the metal disk in the third (now unused) spectacle position. To the left we see the large (and heavy) counterweight which will pull the blade up to horizontal if the operating pipe breaks or becomes disconnected when the blade is below horizontal.\footnote{The weight of the counterweight is sufficient to also lift the weight of the vertical operating pipe if the break or disconnection is at the bottom (or in the horizontal rod leading to the operating lever).} If the operating pipe breaks or become becomes disconnected when the arm
is above horizontal, the arm descends to horizontal by its own weight\textsuperscript{17}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image1.png}
\caption{Train order signal heads}
\end{figure}

\section*{D.3 Possible alternate use}

It is very possible that at some point in the history of this signal, it was used for manual block operation (see Appendix E) rather than as a train order signal.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image2.png}
\caption{Columbus, N.M. rail depot (perhaps ca. 1914)}
\end{figure}

\textsuperscript{17} Assisted by the weight of the vertical operating pipe if the break or disconnection is at the bottom (or in the horizontal rod leading to the operating lever)
D.4 Many years earlier

Figure 21 is a photo of the Columbus depot and surrounding facilities, likely taken in about 1914. Here we are looking east.

There were two tracks passing this station, with a substantial separation between them. We see the second track passing a water tower and coaling station. We assume that this track was a siding, used for watering and coaling, and probably was well to allow the passing of opposing trains.

We note that the train order signal is apparently of a different type that we have discussed earlier. It may in fact have not been illuminated.

D.5 A curiosity

We recently encountered another photograph (figure 22), taken in 1962, after the train line had gone out of use but before the rails were taken up. Here we are looking west.

![Figure 22. Columbus, N.M. depot, line abandoned, 1962](image)

It shows a train order post with access stairs (almost certainly the very one we see in figure 18) located on the far side of the second track. This was perhaps intended for use by westbound trains using the siding.

Note that no similar post is shown on the near side (as we see in figure 18).
That would mean that at the time, for trains using the “near” track, the train orders would have been handed up with a hoop or fork held by the station agent.

#
Appendix E

Manual block operation

Manual block operation was in a way a refinement of train order operation and was often intertwined with it for a period. It was an important step along the path to automatic block signal operation.

In this scheme the route was divided into blocks, often quite lengthy and always having a station (or an intermediate signal cabin) at the boundary between blocks. At each such point there were wayside signals (often using semaphore signals). The signals were operated by signalmen (of course at a small station, the station agent might also be the signalman).

The signal control points were interconnected by telegraph (or later by telephone). (The signalman was often the telegraph operator, especially at smaller stations, and certainly at signal huts).

Following an elaborate and strict protocol, in the simplest case our signalman would set the signal to Stop after a train had passed (and was thus in the block). When the train has completely exited the block (at the following station or signal hut), that fact was reported by the signalman there to our signalman, who would then put the signal to Clear, allowing a subsequent train to enter the block.

But because of the great length of the block, the ideal result (a train never entering a block where there was already a train with which it might collide) would seriously limit the traffic capacity of the line.

Thus, compromises were built into the scheme. Simplistically, even if there was a train still in the block ahead, a following train would be permitted to enter the block after a certain time period. This of course did not protect against the possibility that the first train might unexpectedly stop in the block due to mechanical trouble, and that the following train might collide with it.

Often, this concept was more liberally applied to freight trains than passenger trains. I suppose it was considered that a collision involving only freight trains was more “acceptable” than one involving a passenger train.

A common situation was that the signals at a station used for train order operation were then repurposed for manual block operation (and again, sometimes the mode was a very complex hybrid of the two).