PRIMER ON AMERICAN RAILROAD SIGNALS

RAILROAD SIGNALS of the U.S.

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From article in the Railfan Guide to the US Web Site – with active hot Links
https://railroadsignals.us/ written by Todd Sestero toddgp30@yahoo.com

PRIMER ON AMERICAN RAILROAD SIGNALS
Chapter 1 - Introduction

So what are signals? We know what they are when we see one sitting alongside the tracks (commonly referred to as a *wayside signal*), but how many of us think of a flag as a signal? There are also hand signals, whistles and horns, and crossing gates in addition to the familiar wayside signal. We also consider signs as a type of signal. Each has its own specific purpose and method of communicating information. Signals came about because there was a need - because there was no other way to get the desired information to the engineer. This website concentrates mostly on wayside signals you can find in the United States today.

If you go cruising around the internet, you will find a lot of information on railroad signaling. Some sites are better at explaining the principles than others. The website for the Railway-Technical Web Pages is one of the better sites around for explaining things in an easy to understand format, along with some really good graphics to accompany the discussion. You will hopefully consider this site as one of the better ones.

Volumes can be written on early signals. As such, there is a separate section that deals with them on this website. Another good reference is (2) – JB Calvert goes into detail with numerous illustrations, and includes many references to many American signs and signals.

Outside of the basic three aspect color light signal, most railroad signals are confusing to the uninitiated, and it makes no matter which type of signal you are looking at, what railroad you are on, or what country you are in. Fortunately for the world, every country in the world has decided to use the same three colors in their traffic lights, and those colors dominate the railroad industry as well.

The simple three color light signal can be roughly interpreted the same as a standard auto traffic light: Green -- go, yellow -- slow down, and red -- stop. It's the definition of railroad signals that sets them apart from the above interpretation. Most railroads would name those aspects clear, approach, and stop.

In the United States, most signal systems relay either speed information (predominate in the east) or routes (prevails in the west) to the engineer. In Britain, signals indicate the condition of the track ahead, and it is left up to the engineer to adjust his speed accordingly. This generalization does not preclude the signals from also displaying the status of the blocks ahead with the American systems, as we will see later.

The signal systems of today are becoming increasingly all electronic, replacing a cabinet full of vital and non-vital relays with redundant computers. Even though computers still need some sort of output device (like a relay) to isolate and handle the bulb current, we are finding these jobs handled more and more by solid state relays. The reasoning behind this effort to update and replace is simple -- cost.

Rulebooks, most of which contain signal aspects for the territory they cover, are interesting reading. In addition to wayside signals, they also provide the reader with hand signals, whistle signals, and the rules that govern the operation of the railroad. In looking over various rulebooks, many of the east coast railroads adopted a similar structure to their rulebooks. For most, the signal rules were numbered 281 (clear) through 292 (stop) for defining the regular wayside signal indications. For some reason, western railroads seem to organize their rulebooks with the signal aspects covered under one numerical section, and the different aspects used different letters. For instance: the UP has all of their wayside signal aspects in rule 245, using rule 245A for clear, to rule 245Q for stop….. their cab signals are in rules 246 thru 246C.

Here's a link to the rulebooks in my rulebook section.

If you are looking for a good all-around explanation of model railroad signaling, I recently came across this PDF by Richard Johannes:
http://www.hubdiv.org/articles/signalsClinic.pdf

Scientific American had a great article on the electro-pneumatic block signal in the April 5th, 1890 issue if you can locate it.

Sidebar - In talking about inventing things, the U.S. Patent Office is responsible in the United States for issuing patents on inventions. They had their start in 1790, but formally became the Patent Office as we know it today in July of 1836. They also had "the great fire of 1836" (3), in December, which destroyed about 10,000 of the early patents - 2845 of which could be "reconstructed" and re-issued in a "X" format, where the "X" preceded the patent number. What the Patent Office now considers patent No.1 goes to J. Ruggles, for the design of a traction wheel for locomotive engines. (4) The Patent Office has TIFF pictures of the patents issued prior to 1976, after that, you can get both a text synopses and TIFF pictures of the patents. It's a most interesting way to spend time on the internet. The only problem is that you can't do a text search on the old (pre 76) patents since they exist only as images.

In looking thru some of the patents issued in modern times, it seems that inventors are still coming up with interesting ideas that never make it into the real world. Take for instance, patent No. 4,073, 453 from Feb 1978. Marion Thomas of Baton Rouge LA came up with an idea for grade crossing protection that overcame the inherent disadvantage of having only a bulb that flashes when the train was coming. It was a mechanical nightmare that involved motors and gears to make two discs spin around the blinking light. Another invention that never hit the big-time was No. 4.067,522 from Jan 1978. Orie Williams of Evansville IN came up with a foot pedal to activate the bell and whistle of a locomotive at the same time. One "recent" patent from Oct 1989 that may have been used was No. DES. 304,039 by two guys from Louisville KY – it is a warning sign that attaches to the rail head. I've seen blue flag type signs that attach this way to the railhead, so I wonder if these flags use this patent.

PRIMER ON AMERICAN RAILROAD SIGNALS
Chapter 2 - Signals Common in the United States Today

Prior to 1900, signal styles were a lot more individualistic, and could vary widely from railroad to railroad. More and more today, the American signal scene is finding color light signals, where there was once a wide array of styles to feast on. You could still find semaphores everywhere into the 70's, now they are rare. The B&O CPL's and Pennsylvania PL's were plentiful east of Chicago, however, their numbers today are rapidly dwindling. There was even a lone ball type signal that made it into the 1990's in New Hampshire. Operating wig-wag crossing signals can still be found, and to even a lesser extent, rotating banner signals (although I am not aware that any of them still have the stop sign in place). You could even find smashboards and tilting targets being used into the 90's. The same goes for switch lanterns - they used to be common place, but try to find one these days - they have almost all been replaced with reflectorized stands.

According to Alstom, signaling on American railroads was introduced as early as 1857, but extensive installations were not made until 1900 when railroad management realized the benefit signaling could provide to expedite traffic movement.

As already stated, the general trend of late has been towards the use of color light signals. One notable exception is the Northeast Corridor between Washington D.C. and New York City, where Amtrak has kept the Pennsy PL's, but colorized them. This is probably for the same reason that the Pennsy developed the PL's in the first place – limited room to mount signals so they could be seen between the mess of overhead wires and support structures. The Norfolk Southern, in former N&W territory, has also been slow in replacing their CPL's.

Many of the older signals were complicated mechanical mechanisms or assemblies such as semaphores, B&O CPL's and Pennsy PL's. Semaphores taken down during the 40's, 50's and 60's were replaced by searchlight signals or color light signals, and many of those searchlight signals are today being replaced with color light signals. Why replace when the old signals work fine? My guess would be high maintenance cost, although rusting equipment and hardware could be another. And if you are going to replace something, (logic dictates) you might as well do it with something new. Although rare, a fully loaded B&O CPL uses 14 bulbs, in as many individual housings, in contrast to three stacked color light heads (housings) using a total of eight or nine bulbs in the three heads. It's a matter of simple economics in an industry where they can tell you how much it costs to blow the horn at a grade crossing. Railroads, like any other profit making business, try to contain costs (especially on overhead items such as signals), otherwise, steam engines would still be common place.

Learning the difference between the styles is not difficult, but trying to figure out if a searchlight is a GRS or US&S head, is a little more difficult. Hopefully, this primer will answer some of the questions you may have. To differentiate the signals I am talking about here, from other signals on the railroad, we often refer to these as wayside signals.

The majority of signals in the United States today are of the following types:

Semaphores
Searchlights
Colorlights (includes "Tri-lights")
Position light (PL)
Color position light (CPL) and Position Color light (PCL)
(semaphores just barely make it onto this list)

The major manufacturer of American signals are:

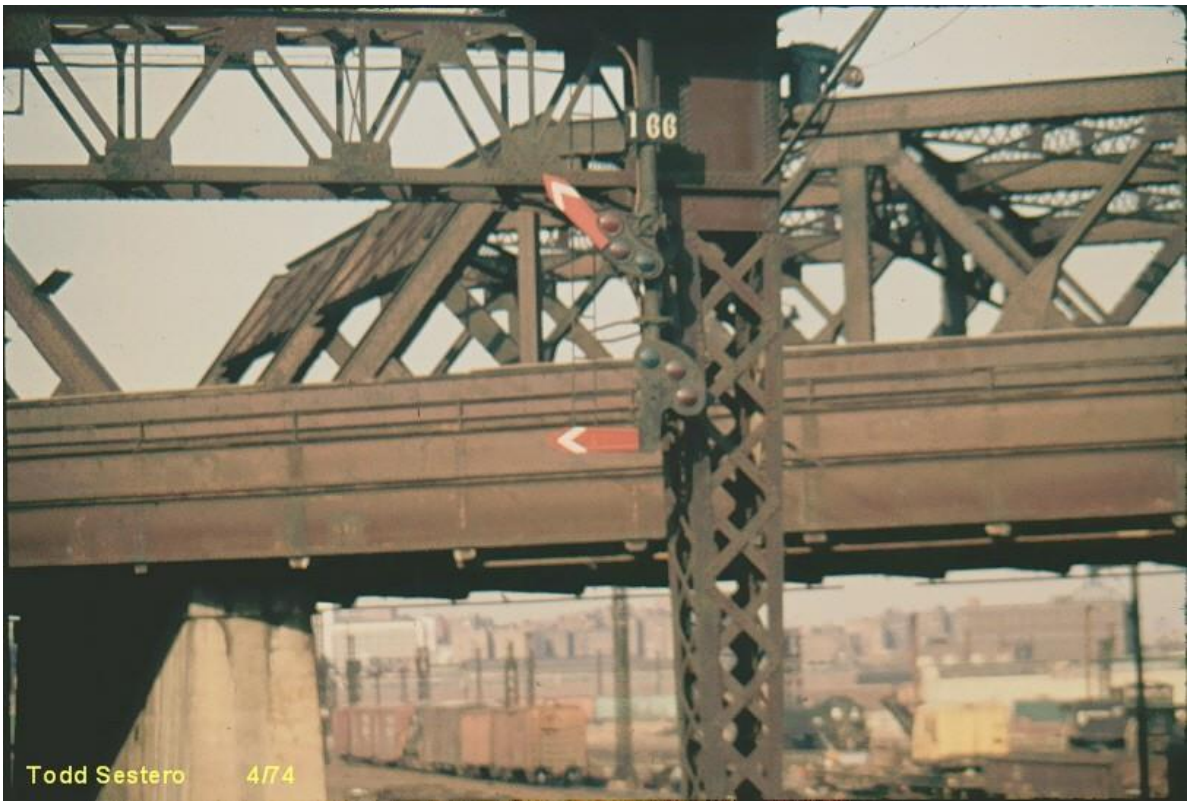
GRS (General Railroad Signal – now Alstom)
Safetran
US&S (Union Switch & Signal)
Harmon (GE)
Western Cullen Hayes
WRRS (Western Railroad Signal).

Semaphore Signals

Semaphore signals were once the mainstay of American railroading, but are becoming increasingly rare. http://www.semaphores.com does a pretty good job of keeping you up to date of where the last survivors are.

Semaphores used a combination of two technologies to convey information to the engineer. During the day, a board approximately three feet long was put into different positions by some sort of actuating mechanism, be it "armstrong" (purely hand operated mechanical), pneumatic, or electrical, or a combination of those technologies.

During the night, the same part of the signal that the board mounted to, the spectacle, contained anywhere from one to four colored lenses, which would rotate in front of a stationary light source. …..Semaphores, we all love them, but due to their mechanical complexity, they gave way to simpler devices such as the *searchlight signal* or *color light signal*.



Semaphore signals on the New Haven, in the Bronx, judging from the apartment buildings in the background.

Searchlight Signals

Searchlight signals are a form of color light signal where all of its aspects radiate from one set of lenses. Placed inside the housing, is a miniature semaphore like mechanism which places a small, roughly 1 inch diameter colored filter in the light path in order to change the displayed color. The filters are placed on a small vane which is similar to the spectacle used with semaphore signals.

Searchlight signals were used by many railroads, with the big exceptions being the Pennsy and the B&O. The current mainstays of this type are the Alstom (GRS) SA-1 and SA-5, and the US&S H-2 and H-5 (6).

Searchlight signals today are facing the same demise as most other signal types, being phased out in favor of the color light signal because they are simpler to maintain.


Todd Sestero
2/8/06

A couple of classic searchlight signal installations at the same location in suburban Atlanta, these are of the US&S variety. The easiest way to tell is by the hoods.

A couple of dwarf searchlight signals in Buffalo NY, on the former New York Central (now CSX). These are GRS units, the giveaway being the hoods - notice the difference in their shape from the US&S hoods above.

Color Light Signals

This type of signal is quickly becoming the most prevalent type in the United States today. They are simple in design, being nothing more than a housing with a separate chamber, lens, and light bulb for each aspect to be displayed. Railroads like them because they are simple to maintain - no moving parts.

Older models were a single housing with a separate compartment for each bulb. Many newer designs are taking the modular approach, and can be customized with any number of aspects on one head. Another trend is towards the use of aluminum and plastic, where steel was once the only choice (FYI - you can't find a traffic light made today that isn't plastic).

Three color light signal installations -- On the left is a newer installation on CSX's RF&P division in Lorton VA, just south of the Amtrak Autotrain terminal..... In the middle is a

CSX two head color light signal in New Castle PA, replacing a CPL on this former B&O line..... On the right is a two head signal on the NS in Cleveland OH.

"Tri-light" Signals

Let me first say that professional signal maintainers do not use this term, hence the use of quotes around the term. Quite simply, these lights are color light signals. Maintainers usually refer to them by the model, such as TR-2 (US&S) or type G (GRS). As already seen above, a standard color light signal puts the three lenses in a straight row, whether vertical or horizontal. This style of signal places the lenses in a triangular pattern, giving the signal a maximum of three aspects per head.

"Tri-light" signals in Berea OH, slightly to the west of Cleveland. Both CSX and Norfolk Southern use tri-lights at this location, which is kind of unusual. NS has, so far, kept the old support structures for their signals, making for interesting signal shots compared to the dull and boring aluminum structures common in installations today. The CSX tracks are on this side of the tower. This is great railfan spot where the NS and CSX come together for some good action, and is a favorite spot with the locals.

Position Light Signals

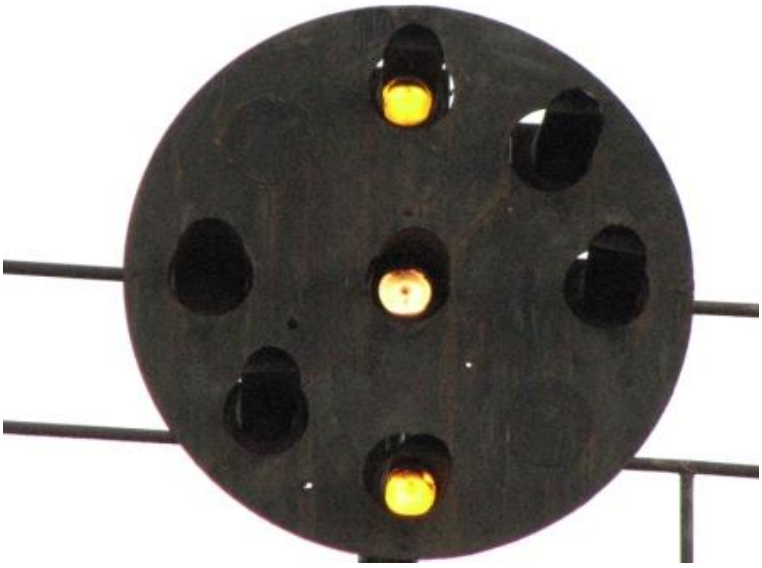
Position Light Signals were developed by the Pennsylvania Railroad. They were developed to overcome what was seen as an inherit disadvantage of the semaphore, visibility.

PL signals were used by the Pennsylvania Railroad and associated railroads, such as the Long Island RR and the Norfolk and Western.

The Pennsy also came up with two associated signals, the PL dwarf signal and the Pedestal signal. The dwarf can only display four aspects, all low speed signals. The Pedestal signal can display almost everything except for the circle and “X”.

During the 60’s, the N&W “colorized” their PL’s, so they look similar to the B&O CPL’s from a distance.

The Norfolk Southern, since it's acquisition of 60% of Conrail's trackage, has been busy replacing the PL’s with color light signals. They have also been replacing many of the N&W's version of the PL, the CPL, with color light signals. Several factors contribute to these signals being replaced: Age and the now held philosophy that the aspects are sometimes confusing from a distance which may lead to the engineer misinterpreting the indication.



This PL signal is located in Mapleton PA on signal bridge 1932.

***Color Position Light*, or *Position Color Light*?**

With the next two categories of Position Light signals, there exists some confusion in the industry as to what to call the colorized version of the Pennsy Position Light signals. The B&O CPL's have always been called CPL's. However, the signals used today on Amtrak signals on the corridor between DC and NYC (as well as the signals on the Norfolk and Southern in former N&W territory (directly below), are adapted Position Light signals. Amtrak maintainers call theirs *Position Color Light* signals. Another term that is applicable is *Colorized Position Light* signal.

The effectiveness battle between position type signals such as the Pennsy PL's and the B&O CPL's continues till today, although it is a moot point since they are all being replaced in favor of color light signals. The Pennsy went with all yellow signals because they said the signals could be seen through most forms of inclement weather better than anything else. The main difficulty with an all yellow signal is viewing it from a distance and not being able to discern the aspect it is displaying, and therefore, making the engineer wait until he was closer to the signal in order to see what it was telling him. Many people consider the B&O CPL the better choice, even with the odd form of marker lights used to modify the meaning of the aspect displayed on the main head. From a distance tho, you could readily tell the difference between the colors on the B&O 's lights.

This photo, taken in downtown Roanoke VA, illustrates the N&W's adaptation of the Pennsy PL signals into colorized versions, including the dwarf version. The N&W kept the center light in the lower head, so it could be used to display their stop aspect. The nice thing about these signals, is that even with a bulb out, as with the right most signal, you still have two red lamps lit. Notice the dwarf's have also been colorized.

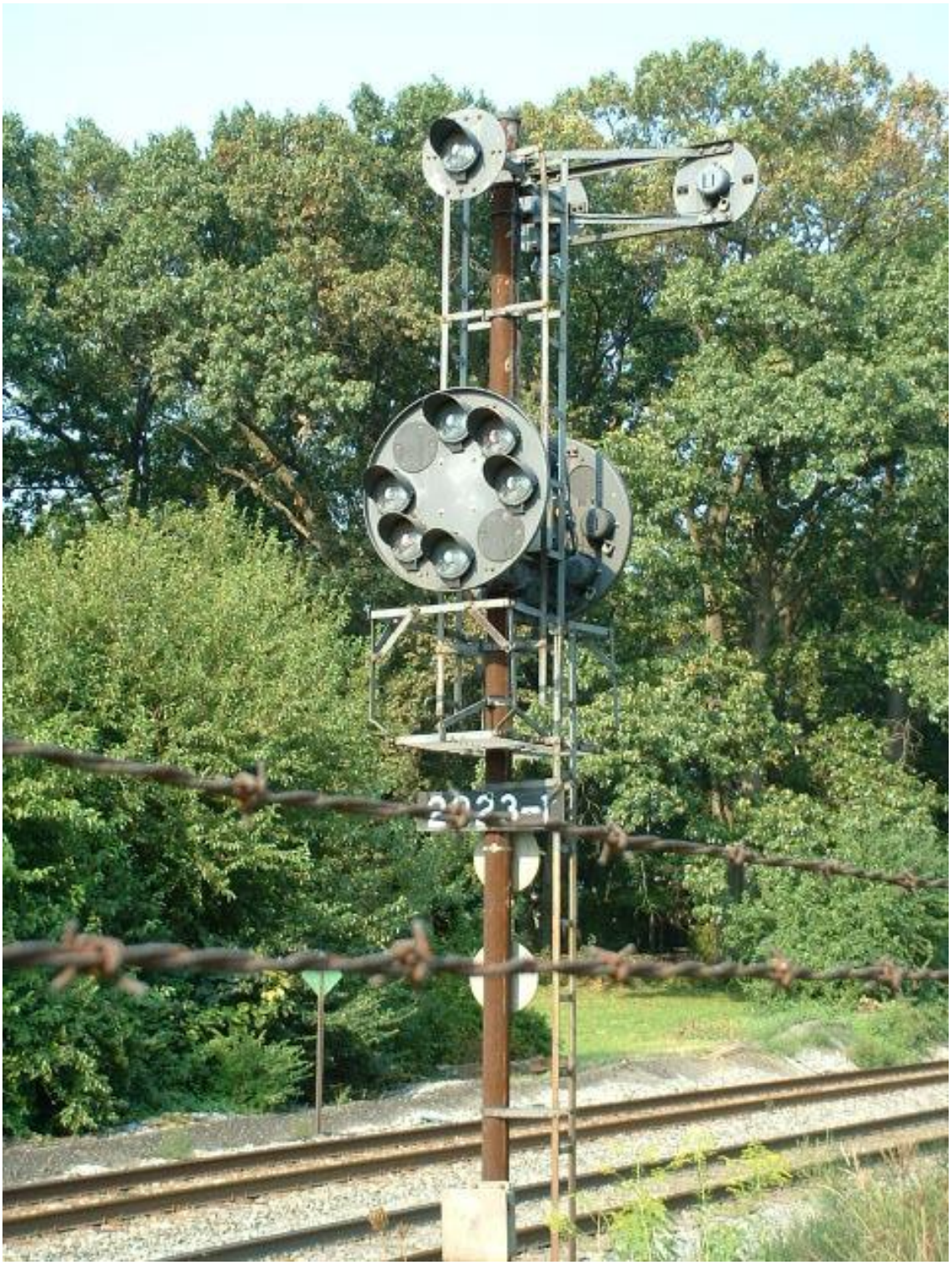
Color Position Light Signals

CPL signals were developed by the B&O Railroad. They went off in a slightly different direction from the Pennsy, but they still wanted to visually duplicate the semaphore action of using position to relay information to the engineer.

Keep in mind that these efforts were in the "good-ole-days" when the railroads had real engineering departments that actually designed and made things. So they decided on using a series of colored lamp pairs for each aspect, arranged in the same horizontal to vertical fashion that semaphores used.

Interestingly enough, B&O CPL's were chosen to be used on the joint trackage into Washington DC Union Station. The dwarf version , if so fitted, *could* display ALL of the aspects of its full size brother, and they are the only dwarfs that can claim this.

The B&O Railroad museum in Baltimore, and the Brunswick RR museum, are the only places I have seen a "full" dwarf. Over the past few years, CSX has stepped up its efforts to replace the CPL's :-(. SIRT announced in 2005 that it would be replacing its remaining CPL's, but has not to date. Get pictures of them while you can!



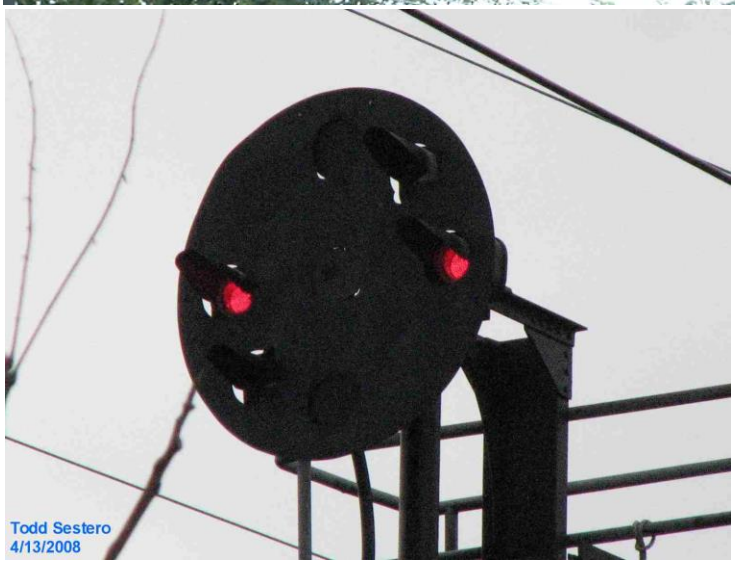
Both sides of the same CPL location at the Gaithersburg fairgrounds in suburban Washington DC. Both tracks are signaled thru here for bi-directional operation.

These eastbound CPL signals are for northbound traffic at ROSSVILLE in the Rosedale section of Baltimore County, NE of Baltimore. On the other side of these signals, the track goes to a single line for it's trip up to Wilmington DE. According to the B&O map, they are absolute signals at this location, as well as the one for facing traffic adjacent to the train.

A couple of dwarf CPL signals at Bailey's wye in Baltimore MD, just south of Camden Station.

Position Color Light Signals

PCL signals are an adaptation of the Pennsy PL signals, where they have been "colorized". So far, Amtrak has been content with keeping them around, altho they have been experimenting with LED's south of the Susquehanna River bridge. To accomplish the change from PL to PCL, they had to eliminate the center head. They had to do this, because the Pennsy PL signal only displays one color, yellow. So what to do with the center lamp when displaying the red or green aspects? I guess, since the N&W colorized their PL's, we *could* call them PCL's to, but there is no general agreement on whether they should be called CPL's or PCL's, although most do call them CPL's.



Amtrak PCL's at the south end of the Halethorpe MARC station (SW suburban Baltimore), and a pair in Wilmington with LED's.

PRIMER ON AMERICAN RAILROAD SIGNALS
Chapter 3 - Glossary of Signal Terminology

Unless noted, the definitions used in this section come from a C&O/B&O rulebook, dated April 27, 1969.

Other rulebooks quoted are:

- Baltimore and Ohio Railroad -- April 26, 1953 (B&O/53)
- CCOR Consolidated Code of Operating Rules - October 1, 1980 (see below)
- CSX Transportation -- January 1, 1987 (CSX)
- New York Central System -- January 1, 1951 (NYC)
- Pennsylvania Railroad - April 26, 1925
- Uniform Code of Operating Rules -- 1962 (UCOR)

While various rulebooks choose to group definitions of similar topics together, instead of alphabetically, I have chosen to alphabetize my list, placing *Manual Block System* way far away from *Automatic Block System*.

It's interesting to note the change in some definitions from the "same" railroad thru the years, for instance: B&O/53, C&O/B&O/69, and CSX/87.

Also, without the benefit of being able to read thru many different rulebooks, you wonder why one railroad defines CTC, and another does not, or why they all don't fully describe the terms relating to interlocking. Curious.

Terms used in a description that are in *italics* are defined elsewhere.

While some may feel that it is tedious having multiple definitions for the same term, it may also help to squelch disagreements between two people when they can't agree on a definition because they learned the rule from a different book. I hope this helps.

A quick speed look-up (this is a guide as given speeds are not absolute, and may vary by railroad):

- 45 mph - Limited
- 30 mph - Medium
- 15/20 mph - Slow
- 15/20 mph - Restricted (most RR's used 15 up till the mid 70's, and then changed it to 20 to save fuel)

Some Definitions:

Absolute Block -- A section of track which may be occupied by only one *train* or *engine* at a time.

Absolute Block Section -- The section of track between opposing *absolute block signals*, at least one *block* in length, on a track signaled in both directions.

Absolute Permissive Block (APB) System -- An *automatic block signal system* for a track signaled in both directions on which a *train* or *engine* causes a STOP indication to be displayed on the next opposing *absolute block signal* and STOP or STOP AND PROCEED on signal in rear of the *train*. Signal indications do not supersede the superiority of trains, therefore, *Timetable* or *Train Order* authority is required. *Todd Sestero*

Absolute Signal -- A *block or interlocking signal* without a number plate, the most restrictive indication of which is STOP. also see *Block signal, Dwarf signal, Interlocking signal, CPL signal, Fixed signal*

Absolute Signal (CCOR) -- A *block or interlocking signal* designated by an "A" marker, or by the absence of a number plate.

Approach Signal (CCOR) -- A *fixed signal* used to govern the approach to another signal.

Approach Signal (UCOR) -- A *fixed signal* used in connection with one or more signals to govern the approach thereto.

Aspect -- see *Signal Aspect*

Automatic Block Signal (ABS) System -- A series of consecutive *blocks* governed by *block signals* (UCOR and CCOR add *"cab signals*, or both"), actuated by a *train*, *engine*, or by certain conditions affecting the use of a *block*.

Automatic Block Signal (ABS) System (CSX) -- A series of consecutive *blocks* whose use is governed either by *block signals* actuated by a *train* or by certain conditions affecting the use of a *block*. Unless so specified, such signals do not authorize the movement of *trains*.

Automatic Cab Signal System (ACS) (CCOR) -- A system which provides for the automatic operation of the *cab signal* and cab warning whistle.

Automatic Interlocking (CCOR) -- An *interlocking* actuated automatically by the approach of a *train* or *engine*.

Automatic Railroad Crossing System -- An arrangement of *fixed signals* and signal appliances so interconnected that the movement of *trains* or *engines* over the crossing are automatically controlled.

Block (CCOR) -- A length of defined limits, the use of which by *trains* and *engines* is governed by *block signals*, *cab signals*, or both.

Block -- In *Automatic Block Signal Territory*, the length of track between two signals in the same direction, the use of which by *trains* or *engines*, is governed by an *automatic block or interlocking signal*.

Block -- In *Manual Block Territory*, the length of track between designated points or between open *train order* offices, the condition of which will be given as prescribed by the rules.

Block (CSX) -- A length of track of defined limits. In signaled territory, a block is the length of track either between two consecutive *block signals* governing movements in the same direction or from a *block signal* to the end of signaled territory.

Block Indicator (UCOR) -- A device located at hand operated or *spring switches* to indicate track occupancy in the *block* or blocks to which it refers.

Block Signal -- A *fixed signal* at the entrance of a *block* to govern *trains* and *engines* entering and using that *block.* also see *Absolute signal, Dwarf signal, Interlocking signal, CPL signal, Fixed signal Todd Sestero*

Cab Signal (UCOR/CCOR is close) -- A signal located in engineman's compartment or cab, indicating a condition affecting the movement of a train or engine and used in conjunction with interlocking or block signals, or in lieu of block signals. Note: Special instructions will be used to govern the operation of cab signals where in use.

Centralized Traffic Control (CTC) (CCOR) -- A block signal system under which *train* or *engine* movements are authorized by *block signals* whose indications supercede the superiority of *trains* for both opposing and following movements on the same track.

Centralized Traffic Control (CTC) (UCOR) -- A system in *ABS* territory under which *train* or *engine* movements are authorized by *block signals*, whose indications supercede the superiority of *trains* for both opposing and following movements on the same track.

Color Position Light (CPL) Signal -- A *fixed signal* in which the *indications* are given by color and the position of two or more lights. It consists of a cluster of lights normally displayed in pairs. For some indications, marker lights are displayed above or below the main cluster to qualify its meaning. also see *Absolute signal, Block signal, Dwarf signal, Interlocking signal, Fixed signal*

Communicating Station (NYC) -- A station where an operator or signalman is on duty or where a trainman may communicate by telephone with a train dispatcher, signalman or operator.

Control Operator (CCOR) -- An employee assigned to operate a CTC or interlocking control machine.

Control Siding (CCOR) -- A siding, the entrance to which is governed by signal indication.

Current of Traffic -- The movement of trains on a *main track*, in one direction, specified by the rules.

Distant Signal (PRR/25) -- A *fixed signal* used in connection with one or more signals to govern the approach thereto.

Division -- A portion of a railway or railroad designated by *timetable*. also see *Subdivision* *Todd Sestero*

Division (or Area) (UCOR/CCOR//PRR/25) -- That portion of a railway assigned to the supervision of a Superintendent or other designated officer.

Driver (PRR/25) -- The employee in charge of and responsible for the operation of a *track car* as prescribed by the rules.

Double Track (CCOR//PRR/25) -- Two *main tracks*, upon one of which the *current of traffic* is in a specified direction, and upon the other in the opposite direction.

Dual - Control Switch -- A power-operated switch which is also equipped with a hand-throw lever for hand operation.

Dual Control Switch (CCOR) -- A power-operated switch which, by use of a selector lever and a hand throw lever, may be hand operated.

Dwarf Signal (B&O/53//PRR/25) -- A low home signal. Also see *Absolute signal, Block signal, CPL signal, Interlocking signal, Fixed signal*

Electric Switch Lock (UCOR) -- An electric lock connected with a hand operated switch to prevent its operation until the lock is released.

Electrically Locked Switch -- A hand-operated switch with an electrically-operated locking appliance.

Engine -- A unit propelled by any form of energy, or a combination of such units operated from a single control, used in train or yard service.

Engine (NYC) -- A machine propelled by any form of energy and used in train or yard service.

Engine (PRR/25) -- Any self-propelled unit used for the movement of trains.

Engineman (UCOR) -- The employee in charge of and responsible for the operation of an engine.

Engineman (PPR/25) -- The employee in charge of and responsible for the operation of an engine as prescribed by the rules.

Extra Train -- A *train* not authorized by a *timetable schedule*. It may be designated as, EXTRA or WORK EXTRA. see *Train*

Extra Train (UCOR) -- A *train* not authorized by a *timetable schedule*. see *Train* *Todd Sestero*

Extra Train (PRR/25) -- A *train* not authorized by a *timetable schedule*. It must be designated as:

- Extra - for any extra train except passenger train extra or work train extra;
- Passenger Extra - for passenger train extra;
- Work Extra - for work train extra.

Extra Train (NYC) -- A *train* not authorized by a *timetable schedule*. It may be designated as:

- Extra - for any extra train, except work extra;
- Work Extra - for work train extra.

Extra Train (CCOR) -- A *train* not authorized by a *timetable schedule*. It may be designated as:

- Extra - for any extra train except work extra;
- Work Extra - for an extra train authorized by Form H train order.

Facing Point Lock, Spring Switch (CCOR) -- A locking device for a spring switch which automatically locks the points in normal position.

Fixed Signal -- A signal of fixed location indicating a condition affecting the movement of a *train* or *engine*. also see *Absolute signal, Block signal, Dwarf signal, Interlocking signal, CPL signal*

Fixed Signal (NYC/CCOR) -- A signal of fixed location indicating a condition affecting the movement of a *train.* Note to definition of Fixed Signal: The definition of a "Fixed Signal" covers such signals as switch, train order, block, interlocking, semaphore, disc, ball, stop boards, yard limit boards, speed boards or other means for displaying indications that govern the movement of a train. *CCOR's note to the above description is:* Note.-The definition of a "Fixed Signal" as switch, train order, block, interlocking, such signs as stop signs, yard limit signs, reduce speed and resume speed signs, and other other means for displaying indications that govern the movement of a train.

Grade Signal (UCOR) -- A stop and proceed signal equipped with a marker displaying the letter "G".

Home Signal (B&O/53//PRR/25) -- A fixed signal at the entrance of a route or block to govern trains or engines entering and using that route or block.

Interlocking -- An arrangement of *fixed signals* and signal appliances so interconnected that their movements must succeed each other in proper sequence and for which interlocking rules are in effect. *CCOR adds:* It may be operated manually or automatically.

Interlocking Limits (CCOR) -- The tracks between the outer opposing *absolute signals* of an *interlocking*.

Interlocking Limits (UCOR) -- The tracks between the extreme or outer opposing interlocking signals of an *interlocking*.

Interlocking Signal (UCOR) -- A *fixed signal* at the entrance to or within *interlocking limits* to govern the use of the *routes*.

Interlocking Signals (CCOR) -- The *fixed signals* of an *interlocking*.

Interlocking Station (UCOR) -- A place from which an interlocking is operated *(aka: tower - Todd)*.

Intermediate Signal (B&O/53) -- An automatic block signal equipped with a number board. *Todd Sestero*

Indication -- see *Signal Indication*

Interlocking Limits -- The tracks between the opposing absolute signals governing entrance to an *interlocking*.

Initial Station (UCOR) -- The station at which a schedule is first timed on any subdivision is the initial station for that schedule, and for an extra train it is the station at which such train is created.

Limited Speed -- A speed not exceeding 45 MPH also see *Maximum Authorized speed, Medium speed, Slow speed, Restricted speed*

Main Track -- One or more than one track designated by special instructions extending through yards and between stations, upon which *trains* are operated by *timetable, train orders, block signals, interlocking signals,* rules or special instructions, and under the supervision of the Train Dispatcher unless otherwise provided. also see *Single track, Two or More tracks*

Main Track (CCOR//PRR/25) -- A track, other than an auxiliary track, extending through yards and between stations, upon which trains are operated by time table or train order, or both, or the use of which is governed by block signals.

Main Track (UCOR) -- A track extending through yards and between stations, upon which trains are operated by time table or train order, or both, or the use of which is governed by block signals, interlocking signals, or other method of control.

Manual Block System -- A system used for the blocking of trains moving in the same direction and for which *manual block system* rules are in effect.

Manual Interlocking (CCOR) -- An interlocking operated by an employee by means of an interlocking machine.

Maximum Authorized Speed -- The maximum speed authorized by special instructions, for a *subdivision* or portion of a *subdivision*. also see *Limited speed, Medium speed, Slow speed, Restricted speed*

Medium Speed -- One half maximum authorized speed, but not exceeding 30 MPH. also see *Limited speed, Maximum Authorized speed, Slow speed, Restricted speed*

Motor Car (NYC) -- A car propelled by any form of energy and used in *train* or yard service. *Todd Sestero*

Passing Siding -- A track auxiliary to the main track designated by special instructions for meeting or passing *trains*.

Pilot -- Am employee assigned to a *train* when the Engineer or Conductor, or both, are not fully acquainted with the physical characteristics or rules of the railroad, or portion of the railroad, over which the *train* is to be moved.

Reduced Speed (CCOR) -- Proceed prepared to stop short of *train, engine*, obstruction

Register Station (CCOR/UCOR) -- A station at which a train register is located.

Regular Train -- A train authorized by a timetable schedule. also see *Train, Extra train, Superior train, Train of Superior Right, Train of Superior Class, Train of Superior Direction*

Remote Control (B&O/53) -- A term applied to a method of operating outlying switch and signal appliances from a stated point.

Restricted Speed -- Proceed preparing to stop short of *train*, obstruction, or anything that may require the speed to be reduced, but not exceeding 15 MPH also see *Limited Speed, Maximum Authorized speed, Medium speed, Slow speed*

Restricted Speed (B&O/53) -- Proceed, prepared to stop short of: train, obstruction, improperly lined switch, or broken rail.

Restricted Speed (CCOR) -- Proceed prepared to stop short of *train, engine*, obstruction, or switch not properly lined, looking out for broken rail or anything that may require speed of a *train* or *engine* to be reduced, but not exceeding 20MPH.

Route (UCOR) -- The tracks a *train* or *engine* may use in passing from one point to another. *Todd Sestero*

Schedule (UCOR) -- That part of a *time table* which prescribes class, direction, number and movement for a *regular train*.

Section (CCOR/NYC) -- One of two or more trains running on the same schedule displaying signals or for which signals are displayed.

Semi-Automatic Signal (B&O/53) -- A signal having both manual and track circuit control.

Siding (NYC//PRR/25) -- A track auxiliary to the *main track* for meeting or passing *trains*. *CCOR adds:* The timetable will indicate stations at which sidings are located.

Siding (UCOR) -- A track auxiliary to the *main track* for meeting and passing *trains*. Sidings and their capacities will be designated in the *time table* or special instructions.

Signal Aspect -- The appearance of a *fixed signal* conveying an indication, as seen from the direction of the approaching *train* or *engine*.

Signal Aspect (CCOR) -- The appearance of a *fixed signal* conveying an indication, as viewed from the direction of the approaching *train,* or the appearance of a cab signal conveying an indication as viewed by the observer in the cab.

Single Track (NYC) -- A *main track* upon which trains are operated in both directions. also see *Two or More tracks, Main track*

Schedule -- That part of a *timetable* which prescribes class, direction, number and movement for a *regular train*.

Signal Indication -- The information conveyed by the *aspect* of the signal.

Signal Indication (UCOR) -- The information conveyed by a *fixed signal* or cab signal. *Todd Sestero*

Single Direction Signal System (SDSS) -- An *automatic block signal system* under which *trains* or *engines* are operated with the *current of traffic* under Rule D-251.

Slow Speed -- One half *maximum authorized speed*, but not exceeding 15 MPH also see *Limited Speed, Maximum Authorized speed, Medium speed, Restricted speed*

Slow Speed (B&O/53) -- A speed not exceeding 15 MPH.

Spring Switch -- A switch equipped with a spring mechanism arranged to restore the switch points to normal position after having been trailed through.

Station -- A place designated by name on the *timetable*, or by special instruction, or a designated place at which a *train* may stop for traffic, or to enter or leave the *main track*.

Station (CCOR) -- A place designated in the *timetable* by name.

Station (NYC//PRR/25) -- A place designated on the *timetable* by name, at which a *train* may stop for traffic; or to enter or leave the *main track*; or from which *fixed signals* are operated.

Station Protection Signal (UCOR) -- A stop and proceed signal equipped with a marker displaying the letters "SPS", used to protect trains or engines occupying the main track in yards or at stations in the block protected by the signal.

Subdivision -- A portion of a *Division* designated by *timetable*. also see *Division*

Superior Train -- A *train* having precedence over another *train*. also see *Train, Extra train, Regular train, Train of Superior Right, Train of Superior Class, Train of Superior Direction*

Terminating Station (UCOR) -- The station at which a schedule is last timed on any *subdivision* is the terminating station for that schedule, and for an *extra train* (except work extras) it is the station to which such *train* is authorized.

Three or More Tracks (CCOR) -- Three or more tracks upon any of which the *current of traffic* may be in either specified direction.

Timetable -- The authority for the movement of *trains* subject to the rules. It may contain classified *schedules* with special instructions relating to the movement of *trains*, *engines*, equipment, and other essential information.

Timetable (NYC) -- The authority for the movement of regular *trains* subject to the rules. It contains the classified *schedules* of *trains*, with special instructions relating thereto.

Traffic Control System (TCS) -- An *automatic block signaling system* under which *trains* or *engines* are operated in either direction on one or more tracks under Rule 271.

Track Car (PRR/25) -- A self-propelled car or truck which may be manually moved to or from the tracks.

Train -- An *engine* or more than one *engine* coupled, with or without cars, displaying markers. also see *Extra train, Regular train, Superior train, Train of Superior Right, Train of Superior Class, Train of Superior Direction* *Todd Sestero*

Train (NYC) -- An *engine* or motor car or more than one *engine* or motor car coupled, with or without cars, displaying markers. also see *Extra train, Regular train, Superior train, Train of Superior Right, Train of Superior Class, Train of Superior Direction*

Train of Superior Right -- *A train given precedence by train orde*r. also see *Train, Extra train, Regular train, Superior train, Train of Superior Class, Train of Superior Direction*

Train of Superior Class -- A *train* given precedence by *timetabl*e. also see *Train, Extra train, Regular train, Superior train, Train of Superior Right, Train of Superior Direction*

Train of Superior Direction -- A *train* given precedence in the direction specified by *timetable* as between opposing *trains* of the same class. also see *Train, Extra train, Regular train, Superior train, Train of Superior Class, Train of Superior Right*

Train Order Signal (UCOR) -- A fixed signal provided at train order offices used in conjunction with the delivery of train orders and as prescribed by Rule 91A.

Train Order Signal (PRR/25) -- A signal displayed in the place provided therefore, in addition to a fixed signal, when there are orders either to hold or to be delivered to a train.

Train Register -- A book or form which may be used at designated *stations* for the registering the time of arrival and departure of *trains* and such other information as may be prescribed.

Train Register (NYC) -- A book or form which may be used at designated *stations* for registering signals displayed, the time of arrival and departure of *trains* and such other information as may be prescribed.

Two or More Tracks (NYC) -- Two or more main tracks upon which any of the *current traffic* may be in either specified direction. also see *Single track, Main track*

Yard (CCOR) -- A system of tracks within defined limits over which movements not authorized by *timetable*, or by *train order*, may be made, subject to prescribed signals and rules, or special instructions.

Yard (NYC//PRR/25) -- A system of tracks within defined limits provided for the making up of *trains*, storing of cars and other purposes, over which movements not authorized by *timetable*, or by *train order*, may be made, subject to prescribed signals and rules, or special instructions.

Yard Engine (CCOR) -- An *engine* assigned to yard service.

Yard Engine (NYC//PRR/25) -- An *engine* assigned to yard service and working within yard limits. *Todd Sestero*

PRIMER ON AMERICAN RAILROAD SIGNALS

Chapter 4 - Reading and Interpreting Railroad Signals 1

Name, Aspect, Indication - How do we properly refer to signals.

Signal Colors and Their Meaning - Every color tells you something, do you know what they all are?

Flashing Aspects - The meaning of a signal changes if the signal is flashing, we'll tell you why.

Speeds - Besides telling the engineer whether he needs to stop or go, we also need to tell him how fast he can go.

Route vs. Speed Signaling - Railroads have a choice when defining the signal indications.

Rulebooks and the Signal Rules - Every indication of a signal corresponds to a rule somewhere....

Signal Head - What exactly is a signal head?

High vs. Low (or Dwarf) signal - The same signal might mean something different if mounted low, if it even looks like the high version!

Format - Is the red on the bottom or the top?

This section will also deal with the signals, modification of them, and how it affects the signal indication.

Multiple Heads - Why do we need more than one signal head, and what do they all mean?

Red as Place Holder - A Simple Concept.

Darkened Heads - Why the railroads would selectively turn off a signal head.

Stop vs. Stop & Proceed - Why the railroads came up with this indication and it's impact on operations.

Stop Signals vs. Grade Signs - Another way a railroad can help to control costs.

Blanking out unused positions - A simple way to control your inventory.

Signal Spacing - How it changes the meaning of a signals indication.

Signal Bridges - When you have more than one track to signal.

Doll Posts - A placeholder for un-signaled tracks.

Backgrounds - Helping with the visibility of a signal.

For a very nice interactive signal display of the NORAC rules, check out this page

Name, Aspect, Indication???

Hope I don't bore you, for I will be repeating some of the stuff I already mentioned in sections one and two.....

I guess the first thing you need to know about a signal is: *what is the signal telling you?*.... what information is the signal trying to convey to the engineer (railroads) or operator (transit). To intelligently discuss a signal, you need to be able to differentiate between a signals aspect, indication, and name (and maybe the rule it is associated with).

Name - The *name* of a signal is just that, what the signal is called when you look in a rule book or talk about it to others. The above signal is called "stop signal", and the one to the left is "restricting".

Aspect - The *aspect* of a signal is the visual appearance of a lit signal, for instance, in the above photo, the signal is displaying a red. As shown to the left in a two head signal, you have a lunar over a red.

Indication - The *indication* of a signal is the meaning of a signal. The red signal above tells the light rail operator he needs to stop before passing the signal. The signal to the left tells the engineer that he can not pass the signal at more than (usually) 15MPH - if he is exceeding that speed, he needs to slow down to that speed before getting to that signal.

Signal Colors and Their Meaning

The colors used in today's signals are green, yellow, red, lunar, and white (remember, we're talking about signals in North America).

- The color of a signal tells the engineer what he has to do,
- The location of that color, determines the speed at which he is allowed to "do it".

We will get to the speed thing in a minute.

We are familiar with red, yellow, and green, for those colors are used in the traffic lights that govern our every move on the roads around us. On the railroads, these colors are used to display stop, approach, and clear, respectively. Lunar is a relative newcomer to most signals, and probably saw its first widespread use in B&O CPL signals for the restrict indication. White today is used in CPL marker lamps, as well as Pennsy dwarf and pedestal signals.

Up until the early 1900's, white was commonly used instead of green for clear, and purple was common in addition to red for stop and/or restrict, but mostly in dwarf signals. My signal timeline has more details of signal development and progress.

In general, the four main colors and their indications are:

Green / Clear: The train may proceed at the maximum allowable speed in the rulebook for that stretch of track, until it reaches the next signal. The use of green in signals had to wait for several developments back in the early 1900's. One was the development of a suitable coloring agent for glass to give it the color, and secondly, the railroads needed a push to stop using white for clear, since it was not failsafe... in other words, if a yellow or red lens was broken, and fell out, it would display white, and the engineer would interpret that as *clear*.

Yellow / Approach: The train must proceed at an intermediate speed, usually medium speed, until it reaches the next signal. Not all railroads employed yellow for the approach indication. The CNW back in the early days used a combination of red and green to indicate approach, as shown in the CNW rulebook section. The use of green and red wasn't limited to railroad use, as many municipalities did the same with traffic lights, and I can remember traffic lights in New York City into the early 60's using red and green lit together to warn of the signal getting ready to change to red.

Lunar /Restricting: The train must proceed at the restricting speed until it reaches the next signal. Lunar is a very slightly bluish white, and it compared to a "regular" white, has a distinct difference in it's appearance. The lens itself is a pale blue, and if used to filter natural sunlight, it would give off a bluish color. What makes the resultant color in a signal look white is the fact the an incandescent bulb gives off a lot of red, and little blue, so the filtering effect of the lens *corrects* the light passing through to give it its *cool white* look. Restricting was a solution to a situation for the railroads, where they were trying to get around the practice of having to stop a train, which costs them a lot of

money. Proceeding at a restricted speed allowed the train to creep along while keeping a look out for anything that may cause an accident. Railroads also came up with a *stop and proceed* indication, which at least allowed the train to keep moving after coming to a complete stop, and probably saving a little bit of time. Restricting speeds are usually around 15MPH, but can be anything from 10 to 20MPH, depending on the railroad.

Red / Stop: Trains must stop for a red signal. Some railroads employ both "stop and stay" and "stop" indications, the latter of which allows the train to proceed at restricting speed after the engineer has stopped his train at the signal. On multiple head signals, red is also used as a placeholder.

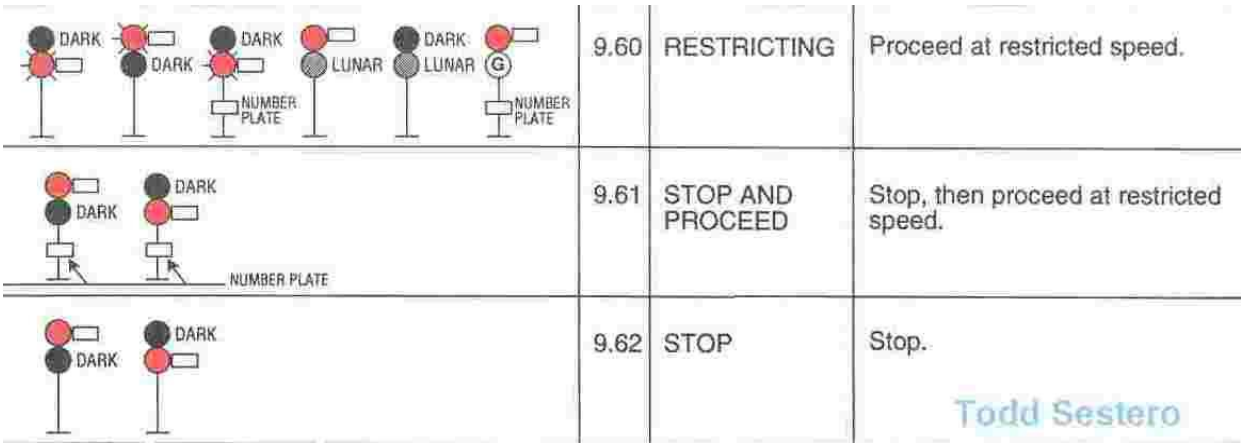
The pictures below illustrate these four aspects. Not many signal heads contain all four aspects as this one does in Doswell VA.

All four of these aspects can be displayed on color light, position light (PRR), color position light (B&O), and position color light (Amtrak) signals. Searchlight signals and "tri-light" signals can only display three of the aspects by nature of their design.

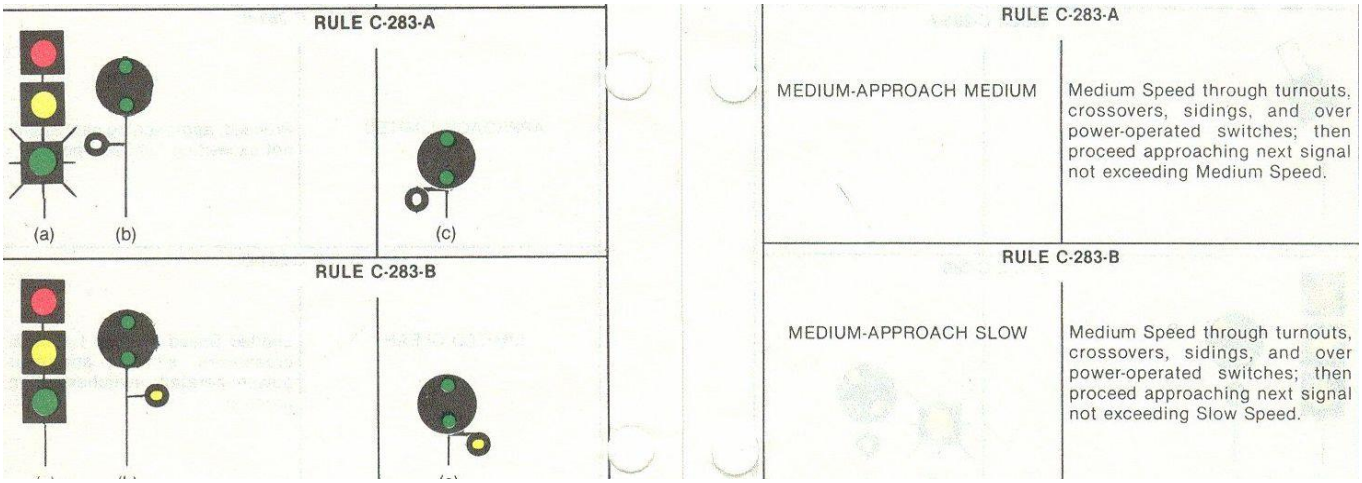
Flashing Aspects

Because of the definition of aspect (it's visual appearance), we can gain an additional aspect from any of the four above by flashing the lamp on and off. In most cases, this upgrades, or loosens the control the signal has over the train movement. In the picture below, from the ATSF section, one can see that if we flash the red lamp, it changes a stop signal to a restricting signal, and allows the train to proceed at that speed without stopping. Many railroads would accomplish the same thing by using a number plate.

In the second example, CSX uses a flashing aspect to upgrade a medium-approach-slow (R/Y/G), to a medium-approach-medium by flashing the green aspect. The yellow in the middle gives us the medium approach, using medium speed through the turnout, and the flashing upgrades the slow speed to medium speed on the approach to the next signal. While it may sound complicated, it is actually pretty simple and follows the rules.



9.60	RESTRICTING	Proceed at restricted speed.
9.61	STOP AND PROCEED	Stop, then proceed at restricted speed.
9.62	STOP	Stop.



Speeds

There are a number of "speed" terms associated with signals and the rules. Some speed terms are associated with just signals, and others are used in instructions by the dispatcher

The following terms are taken from a Southern Rwy rulebook and a Conrail signal card. There may be additional differences on other railroads.

1) **Normal Speed:** The maximum authorized speed.

2) **Limited Speed:** A speed not exceeding 45 miles per hour. Some railroads, such as the New York Central (aka: CR) specified 45MPH for passenger trains, and 40MPH for freight trains.

3) **Medium Speed:** A speed not exceeding 30 miles per hour.

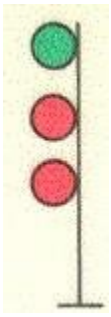
4) **Reduced Speed:** Proceed prepared to comply with flagging signals and stop short of train or obstruction.

5) **Restricted Speed:** Proceed prepared to stop short of another train, obstruction, or switch not properly lined and look out for broken rail, but at a speed not exceeding 15 miles per hour. Conrail specified 20MPH outside interlocking limits, and 15MPH inside.

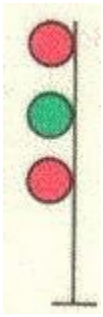
6) **Slow Speed:** A speed not exceeding 15 miles per hour. Some railroads have pushed this up to 20MPH, such as CSX.

7) **Yard Speed:** A speed that will permit stopping within one-half the range of vision.

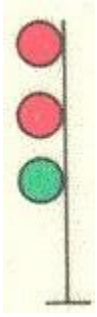
Of the above speeds, several have associations with signal indications.



Normal speed is associated with a clear indication, whether it be a lone Green on a high signal, a G/R, or G/R/R.



Medium speed is associated with a green indication in the middle position, medium clear, as in a signal displaying R/G/R.



Move the green down to the bottom position of a three head signal, R/R/G, and we have slow speed, as in slow clear.

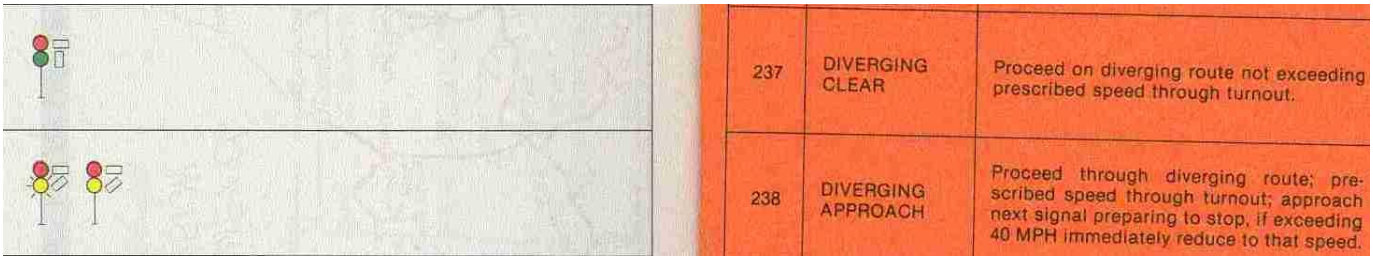
Maximum track speeds are usually specified in the employee timetable.

In most rulebooks, they will state that a train passing a signal has to maintain the speed indicated by that signal until the rear of the train has passed that signal. The same generally applies for moves through turnouts (switches).

Route vs. Speed Signaling

Not all railroads use their signals to indicate the speed of the train. Generally, the western roads following Route Signaling, and the eastern railroads use speed signaling... It's sort of like the divide between radio using "K's" in the west, and "W's" in the east, except KDKA in Pittsburgh (there's always an exception!)(see the bottom of the page).

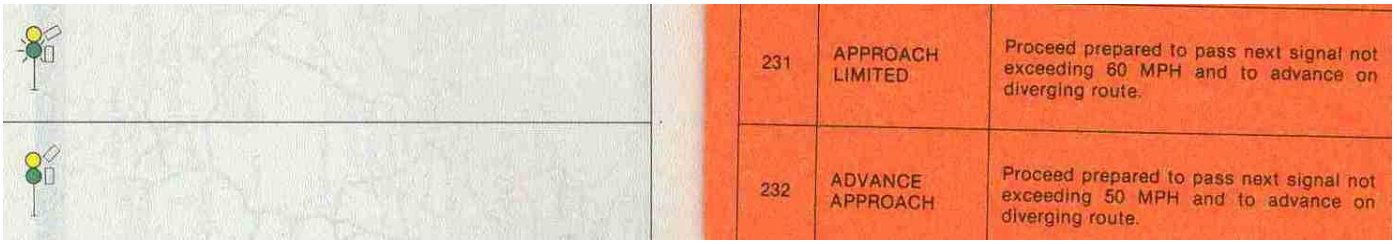
The first example below is from an ATSF rulebook, and illustrates the use of routing information instead of speed information for the indications. Rule 237, *diverging clear*, would be a *medium clear* on the east coast, and the *diverging approach* in the east would be either a *slow approach* or *restricting*.



237	DIVERGING CLEAR	Proceed on diverging route not exceeding prescribed speed through turnout.
238	DIVERGING APPROACH	Proceed through diverging route; prescribed speed through turnout; approach next signal preparing to stop, if exceeding 40 MPH immediately reduce to that speed.

Exceptions abound. One is the NS timetable for the Kentucky region which appears to use route signaling instead of speed signaling, another is the Southern.

But even with railroads that do use route signaling, sometimes the indications can give speed info as seen in an excerpt from the same ATSF rulebook:



231	APPROACH LIMITED	Proceed prepared to pass next signal not exceeding 60 MPH and to advance on diverging route.
232	ADVANCE APPROACH	Proceed prepared to pass next signal not exceeding 50 MPH and to advance on diverging route.

In the ATSF rulebook, it does not show any three head signals. There has been much discussion on the Yahoo Railway Signaling group about the differences in speed and route signaling, and some roads do employ three heads. In this case, they would use the middle head to indicate a diverging route one way, and the lower head would be for an alternate or immediately following diverging route.

Rulebooks and the Signal Rules

Every signal aspect nowadays has a rulebook number associated with it.

For instance, The Baltimore Light Rail system operators manual shows us that a stop signal is rule number 4.4.1.

If the restricting signal above was on the Santa Fe (which this one is not), it would be rule number 240 in one book (SF's restricting is red over lunar). Many west coast railroads number their signal rules in the 9.1.x section of their rulebooks, but the numbers are not standardized as the east coast rules are for some reason... for instance, CNW "stop" = 9.1.1, CC&P "stop" = 9.1.9, BN's "stop" is 9.1.15, and another ATSF Rulebook has "stop" = 9.62.

Note that on most east coast railroads, they number their rules 281 (for "clear"), to 292, for "stop".

My rulebook section is here, and if you have one available you can scan that I don't have, it would be greatly appreciated. Most of the western roads I do not have, so roads like the UP, SP, WP, etc, would be nice. Credit is always given.

Signal Head

The term *head* has been used a number of times, so what is a *head*? Loosely defined, a signal *head* is a single housing that contains one or more signal elements in it. Newer signal heads are modularized, allowing the railroads to configure a signal with as many or as few aspects in it that they want. Older signal heads were a single piece affair, with partitions separating each section (they are also really, really heavy!). In the above photo, the lunar over red (L/R) signal is a two-head signal, while the red over red over red (R/R/R) signal to the right is a three head signal. The left signal head below is a three aspect, modularized "high" signal manufactured by Safetran. Next is a two aspect single housing dwarf signal made by US&S. Third is a two aspect modularized dwarf signal manufactured by Safetran. Lastly is a four aspect modularized signal. All four of these are vertical single head color light signals.




High vs. Low (or Dwarf) Signals

The picture below on the left shows a typical "high" signal installation, this one being in Mason City IA on the UP where it crosses the Iowa Traction. High signals typically can give authorization for the train to proceed at the maximum allowable speed as given on the timetable or in the rulebooks.

In the middle is a two color, color light dwarf in Doswell VA. Dwarf signals are usually limited to medium or slow movements. There are exceptions to this though, since B&O dwarf CPL's can display ALL signal aspects. In another instance, in Toronto, they utilize three searchlight dwarfs in one housing coming out of Union Station as seen in the second set, which means a G/R/R allows the engineer to "hammer down" coming out of the station. This is unusual, because in most terminal areas, speeds are limited.

According to one source, a high signal is one which is presented above the level of the locomotive cab window, and a dwarf signal is one presented below the cab window. This was explained to him by a manager of signals for a class one railroad.

There are some instances where a dwarf signal has been used as a high signal, the only ones I am aware of currently is coming into and out of DC's Union Station, where they employ B&O dwarf CPL's on a signal bridge. FYI - The B&O color position light signal system is the only system devised that can display all of the high signals aspects in a dwarf signal (the only dwarf signal with that distinction).

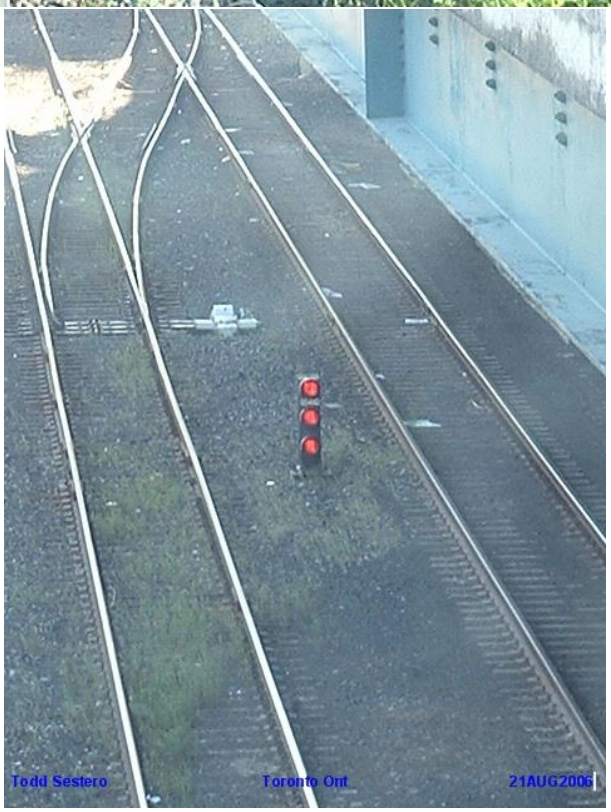
The signal to the right (in Perryville MD), as far as I know, is in its own category, since it is neither a high or dwarf signal. Most Pennsy pedestal signals are about head height as one walks next to the signal.


1912
BEGIN
ABS


Todd Sestero 5APR2007 Roswell VA


4N


Todd Sestero
Toronto Ont
21AUG2006


Todd Sestero
Toronto Ont
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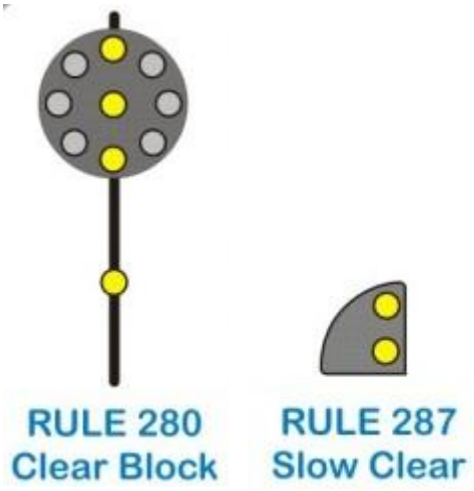
These are guidelines, as there are almost always exceptions. For instance, in Houston at Pierce Junction, the UP mounted a searchlight signal (left photo above) on top of (about) a 6 or 7 foot tall pole. It is still probably considered a dwarf signal since it is not "way" up.

The picture in the middle is of a Pennsy dwarf PL on a pole in Perryville, and it is mounted on the pole to give the engineer a better sight line, as there is quite a curve on the wye, with a lot of "stuff" in the way.

On the right are the pedestal signals in Wilmington, mounted on a signal bridge over the mainline. High or not? After a discussion on the Yahoo Railway Signaling group, most people agreed that it is a medium speed signal since it is almost at the north edge of the platform, in interlocking, so trains would be restricted to medium speed moves anyway. Notice how some lamps have been replaced by LED's and appear lunar white.



These two excerpts from my Pennsy signal chart illustrates that the same aspect can have two different meanings. If the dwarf was a high signal, it would be a *clear block* instead of the *slow clear* that it is.

Below are pictures of another example, where, back in the early 60's, the B&O tried to implement radio control of the signals on a manual block section after a fatal accident occurred. They put dwarf CPL's up on the top of 10 or 12 foot tall poles, and re-lensed the signal so all of the aspects were yellow, like the Pennsy PL's are all single colored white. If you have the July 2004 issue of Trains, you can look for the story by Harold E. Meeker starting on page 50. Photos are used with the kind permission of Mr. Meeker, who is a most interesting fellow to talk to and has a rich railroad history and background, and if you are into coincidences, he lived about 5 miles away from me when we first moved into the Towson area of Baltimore back in 1966 while he was working for the B&O!! If you go looking for these signals, forget it, as they were removed shortly after the experiment ended. A bonus photo he sent me, and not in the article, is the one to the right of the equipment used in the test, an application using what we call today "COTS", or, Commercial Off The Shelf.






Format

I've never seen anyone reference a term for what I call the signal *format*, where a standard vertical color light signal places the red at the bottom of the signal, and I'll probably get cards and letters from scores of people for creating and using the term. Having the red on the bottom, instead of on the top as we are accustomed to with automobile traffic lights is a carryover from the old semaphore days, where the blade of an upper quadrant semaphore would "drop" from green to red as a failsafe/safety function in the event of a problem, equipment failure, or other mal-function. Below is a typical four color progression from red/"stop" to green/"clear" after a train has passed in Doswell VA. I guess one could call this the *standard or normal format* (additional photos and a railfan guide to Doswell is here), and having red on top like the light rail signal at the top of the page, would be *reverse format*.




When it comes to transit systems, they are less standardized than the railroads, as shown at the top of the page (in what I call the reverse format).

Transit system signal designers seem to take more liberty when designing systems, and there appears to be more variety in transit signals then there exists with railroad signals. Many heavy rail systems use a two aspect, three lens red and lunar signal, showing a red over red for stop, and a lunar for clear (the lunar is in the middle, and the top and bottom lenses are red).... Baltimore and Washington DC are two systems that use them. In addition, they both use a flashing lunar to indicate a diversion from the main route, in which case, it's still really a "three" aspect signal (confusing, isn't it?). The Minneapolis L/R system started out with signals in the Baltimore format, then decided to switch over to the standard railroad format with red at the bottom.... what difference does it make, and to spend all of that money just because some signal guy came from the railroads and wants to see them look like RR signals.... what a waste of money!

The CNW, at one time, used color light signals horizontally, as shown in their 1929 rulebook: Chicago and North Western Rwy 1929
Even within the rulebook, they show (on two head signals), the lower head with red on the both the right and the left, with rule 501AA showing the red on the left - all others show it to the right.

Another form of color light signal, which many call "tri-lights" (professional signal maintainers do not use this term) for the triangular arrangement of the lenses, generally has the red lens placed at the bottom location, and green to the right. The signal to the left is at Pierce Junction in Houston, and uses a red LED, and is typical of most tri-light signals in use today. The signal to the right is the rear view of an older GRS signal (without a background) at the Gaithersburg MD train show.

Immediate speed / Occupancy / Next signal rules - Speeds determined by frog angles Cab signal require acknowledging more restrictive signal or brakes apply. Semaphore-Blade shape and color have no effect on aspect.

For a complete glossary of railroad and signal terms, taken from a half dozen or so rulebooks, check out the previous chapter: Glossary of Terms

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A Couple Of Other Well Written References:

Signal Basics by AA Krug: http://www.alkrug.vcn.com/rrfacts/signals/signals.htm

Signal Basics by Carsten S. Lundsten: http://www.lundsten.dk/us_signaling/

Railway Technical Web Pages Signal Basics: http://www.railway-technical.com/sigind.shtml

A Wikipedia page: http://en.m.wikipedia.org/wiki/North_American_railroad_signals

http://earlyradiohistory.us/kwtrivia.htm

PRIMER ON AMERICAN RAILROAD SIGNALS

Chapter 5 - Reading and Interpreting Railroad Signals 2

Multiple Heads - Why do we need more than one signal head, and what do they all mean?

Red as Place Holder - A Simple Concept.

Darkened Heads - Why the railroads would selectively turn off a signal head.

Staggered Heads and Absolute vs Permissive **-** Why the railroads came up with this indication and it's impact on operations.

Stop Signals vs Grade Signs - Another way a railroad can help to control costs.

Blanking out unused positions - A simple way to control your inventory.

Signal Spacing **-** How it changes the meaning of a signals indication.

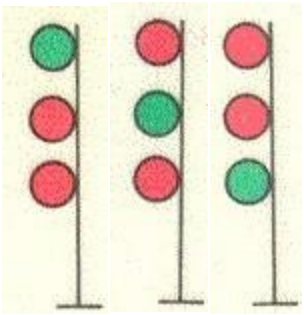
Signal Bridges - When you have more than one track to signal.

Doll Posts - A placeholder for un-signaled tracks.

Backgrounds - Helping with the visibility of a signal.

Multiple Heads

Railroads can normally use a single head signal for wayside signals, if the only purpose is to tell the engineer the condition of the track ahead of him. If the signal designer wishes to tell the engineer more, they add additional heads. A single head is usually a high speed signal, meaning the the engineer is allowed to go the maximum speed authorized by his handbook or timetable for that particular section of track if he has a clear. The picture to the left is on the south side of Pigs Eye yard in St Paul MN, and shows a pair of three head searchlight signals.



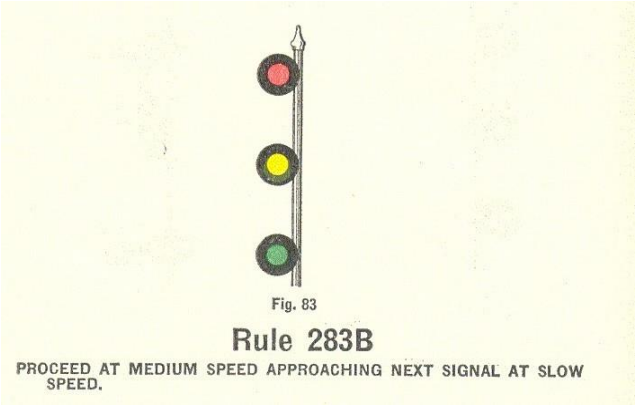
These excerpts are from a Conrail signal card dated 1988.

With the addition of more heads, the top head is the high speed head, the middle head is for medium speed moves, and the bottom head is for slow speed moves.

With a green on top, or G/R/R, as it is usually referred to, it authorizes the engineer to proceed at the maximum allowable speed for that section. Move the green down to the middle position, R/G/R, however, and the meaning changes. Now the indication is "medium clear", and the maximum allowable speed is (usually) around 30MPH. Bumping the green down to the bottom head, R/R/G, and the indication is now a "slow clear", and limits the trains speed to 15MPH.

So why do they want to control the speed of a train? For a variety of reasons: a move thru a set of crossovers, a move onto a siding, going onto a diverging route, bad track, workers present on the right-of-way, etc. Most, if not all rulebooks, state the the entire train has to pass through the switches, or pass the signal, before the train can resume a higher speed.

In addition to the colors of a signal, the meaning can also be modified by having the aspect flash. In almost all circumstances on railroads, a flashing aspect makes the signal more restrictive.



To further complicate the interpretation of a signals meaning, railroads employed multiple non-red aspects, such as Y/Y/R, which on many railroads would be an "advance approach", sort of like having a distant semaphore giving you an indication of the signal two signals away, allowing the engineer more time to prepare for speed

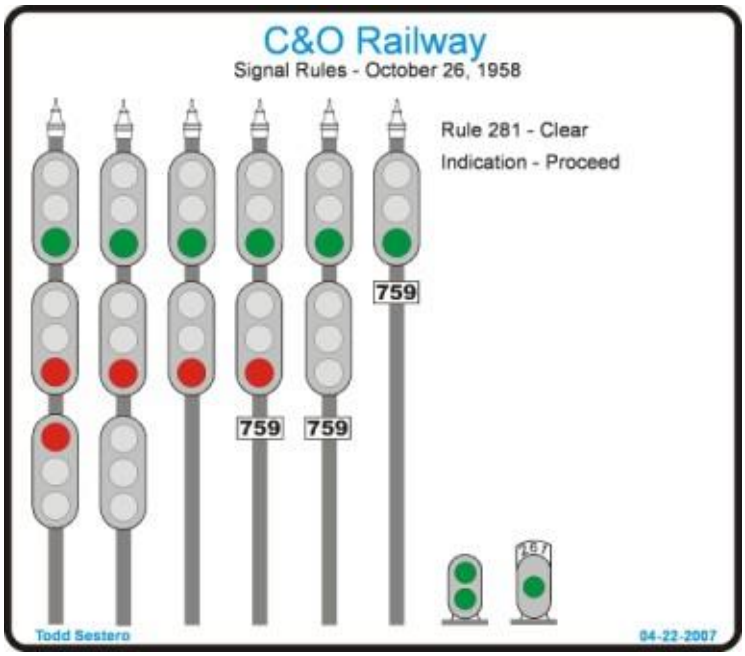
changes. The New York Central, for instance, employed a R/Y/G signal, which stated the engineer had to proceed at medium speed, approaching the next signal at slow speed, in other words, he could pass this signal at medium speed, but had to reduce the speed of the train right away so he wouldn't be going faster than 15MPH when he came upon the next signal - it still really follows the medium and slow speed guide for the meaning of the position of the heads.

An excerpt from my New York Central aspect page.

The indication also has different meanings on whether the railroad employs route or speed signaling. In the SR example, a green in the middle would indicate a "diverging route clear", where the train can proceed thru the diverging route observing the authorized speed thru the crossover or turnout (which would be specified in the rulebook). On the old New York Central routes, a green in the middle would be a limited clear, limiting speed to 40 or 45MPH, not necessarily thru turnouts.

Old railroaders use the phrase "if it ain't all red, it ain't red at all", meaning any colors displayed in the signal other than red make the signal less restrictive than stop.

Red as place holder



On multiple head signals, regardless of the type of signal used (color light, searchlight, etc), red is used as a placeholder. Take, for instance, a three head signal showing green over red over red (G/R/R). I can't think of a railroad that doesn't have this in their

books as a clear signal. The plate to the left illustrates the concept as practiced on many railroads.

All of the signals pictured display the same indication, clear, regardless if there are 1, 2, or 3 heads.

This discussion also brings us around to the rule on most railroads that an improperly displayed signal is considered the most restricting aspect, mainly, stop.

Darkened Heads

The above example also illustrates another common practice of "darkening" the bottom signal, if it's not needed for the indication. With 2 or 3 head signal installations, they could choose not to light up the bottom head, where red is used just as a placeholder anyway.

This practice has fallen out of favor with the FRA, so its use it not as widespread as it used to be. This is because, on non-color light installations, as with searchlight signals, a bulb could be out, and the bottom head would then NOT be able to display a green or yellow. A lamp out in a signal is considered a red, so, with a three head searchlight location like the one at Pigs Eye at the left, the signal would not be able to display a R/R/G or R/R/Y indication if the bottom bulb was out, and the engineer would have to interpret the signal as a stop signal. There would be no way for the engineer to know from looking at the signal if the bottom head was a red, or the bulb was out and was supposed to be yellow or green, and would have to bring the train to a stop if he only saw a R/R.

Staggering Signals: Absolute vs Permissive.

AKA Stop vs Stop and Proceed

Under normal circumstances, an engineer approaching a *Stop Signal* would have to completely stop his train and wait until the signal became more favorable before proceeding. This is called an *Absolute Signal*. Some railroads call this "*Stop and Stay*" as opposed to just a Stop Signal.

In some places, the railroads decided they could have the train stop, and then proceed at a restricted speed, looking for anything that might cause an accident. This is called a *Permissive Signal*. Railroads came up with the idea to place a number plate below the signal to denote a Permissive Signal, but in the old days before reflector type signs, and good headlights, this posed a problem at night.

So how could the engineer tell at night if the signal he was approaching was a stop and proceed signal? The New York Central and New Haven, among others, staggered, or offset the lights, so at night, there was a visible difference in the appearance of the signal.

The left photo below is of a New Haven semaphore in the Bronx from back in the early 70's, and demonstrates how the upper signal is to the left of the mount, and the lower semaphore is to the right (Going back to a discussion in the semaphore section, each semaphore is its own signal, in contrast to other forms of signals where multiple heads still are considered as "one signal").

The photo in the middle is an example of this practice on the ex-NYC mainline between New York City and Buffalo, in Corfu NY. Notice that both signals also have a number plate displayed. The number plates and staggering of the signals only modified the meaning of the stop aspect, all other indications remained unaffected. The NYC shot also illustrates what AA Krug refers to in his discussion about the need for safety, where they didn't really need two heads, but used the extra head anyway. (look at he track ahead and you'll see there are no diverging routes, so one signal could have sufficed here). BTW, A little further down the track (westbound), where there are some crossovers, they do used three searchlight heads.

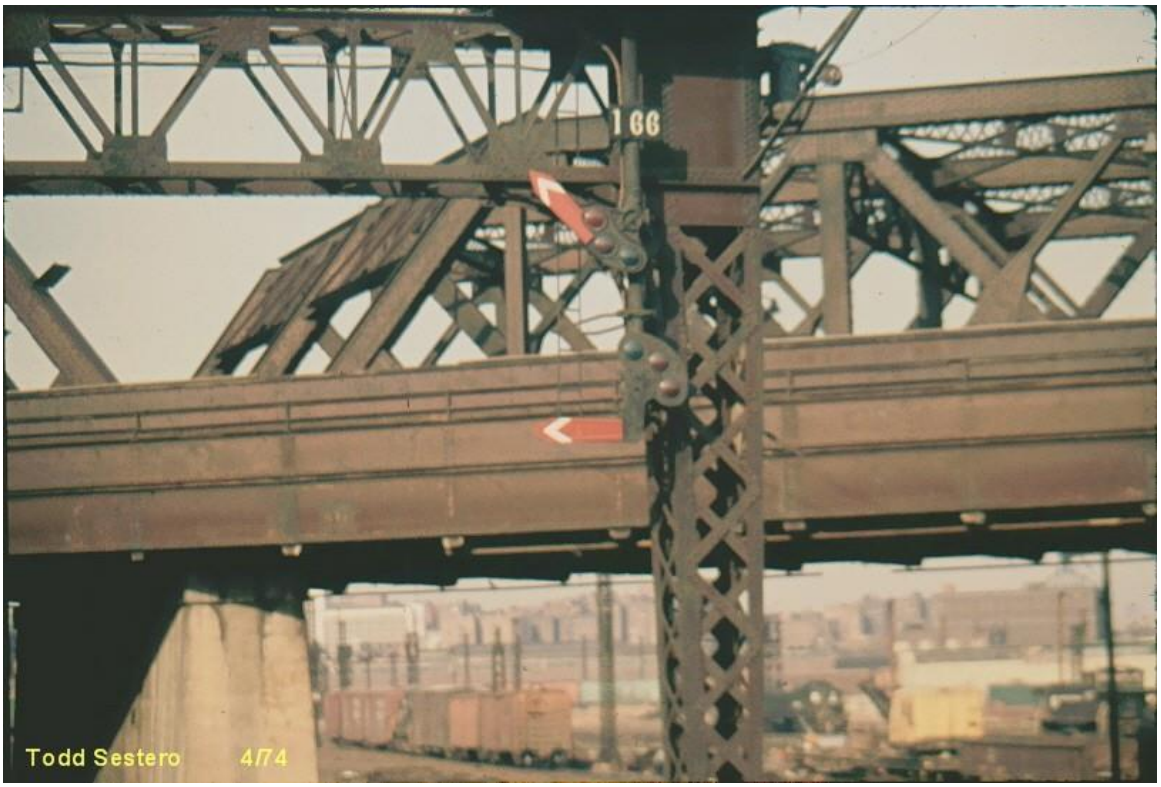
The right photo illustrates this practice in Gastonia NC on the former Southern Rwy.

Notice that the NYC and New Haven had the upper head offset to the left, and the Southern had it to the right.

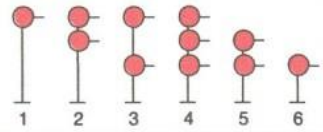
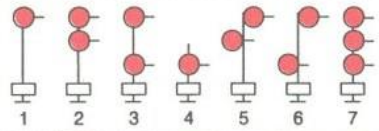
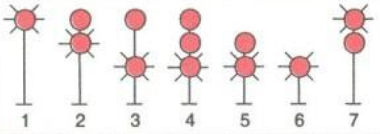
Note that all three have number plates! It is fairly universal for numbered signals to be permissive. One exception was the Rio Grande, who numbered all of their signals. The DRGW called Absolute Signals *Positive Signals*, and used the letter "P" just above the number plate (Thanks to Mike McLaughlin on the Yahoo Signaling group for this tidbit of information in December of 2010).

As a recap, signals above one another in a straight line are absolute, signals that are staggered are permissive. Some railroads would also employ an "A Plate" to signify an absolute signal.

Below the photos is an excerpt from a CNW rule sheet out of a CORA manual. It shows a couple of things pertinent to our discussions.


166
Todd Sestero 4/74


Todd Sestero ex NYC Corfu NY - Colby Rd 19AUG2006
4131E
4132E

RULE	ASPECTS	NAME	INDICATION
9.1.1		STOP	Stop.
9.1.2		STOP AND PROCEED	Stop, then proceed at restricted speed to the next signal or to the end of block system.
9.1.3		FLASHING STOP & PROCEED	Stop. Block occupied. Proceed at restricted speed.

Stop Signals and Grade Signs.

Railroads, in their ever clever ways to save even more money, came up with a modification to the stop rule for heavy tonnage trains on a grade, that would require a severe penalty in time and fuel to get the train moving again once given a more favorable indication, or braking distance if on a down grade. This was the grade sign. Heavy tonnage trains can roll by a stop signal at restricted speed if the signal has a grade sign displayed, usually as shown below in the two examples. The left and middle photos are of a CSX/ex-B&O grade sign on a CPL signal in Gaithersburg MD, and the one on the right is at the south end of Pigs Eye yard in St Paul MN, easily viewable from US10.

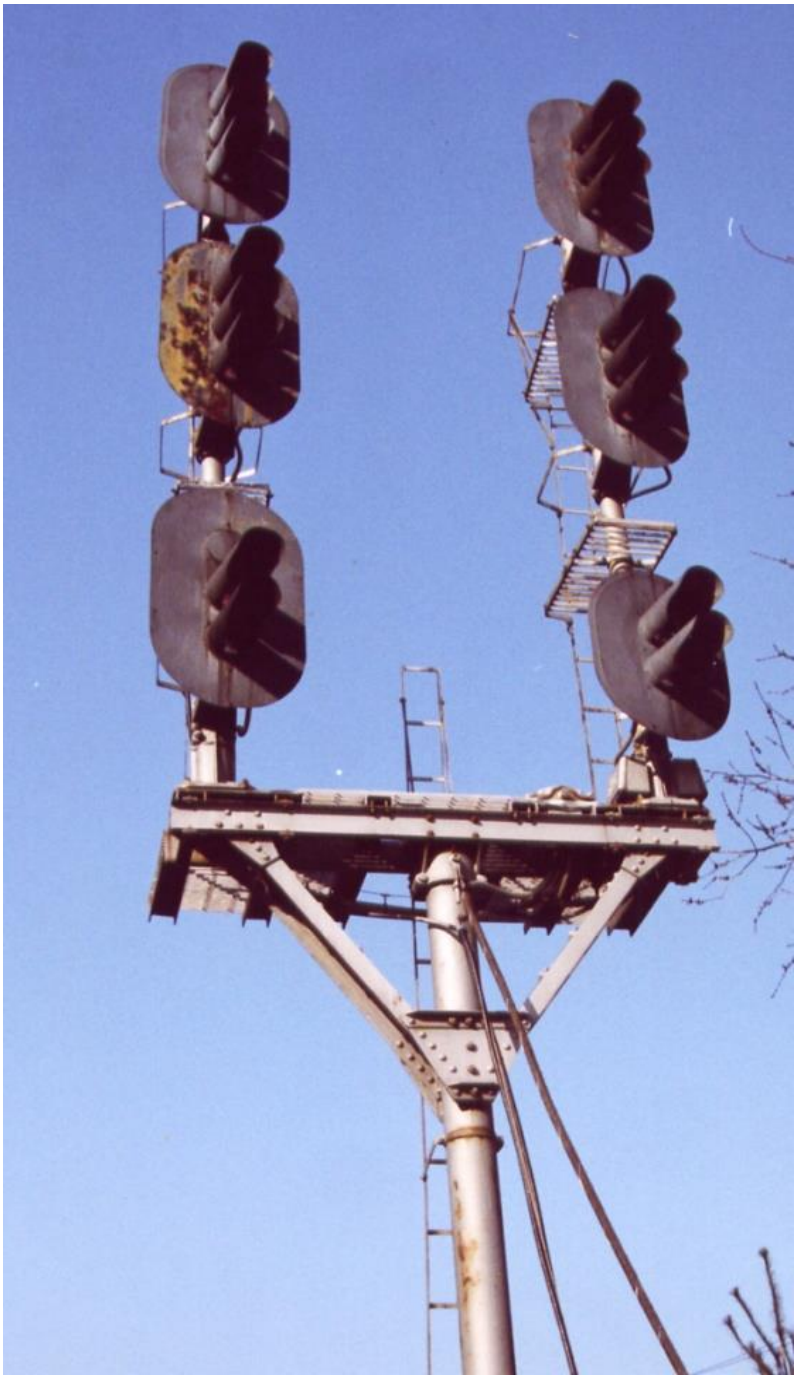

G
D


G
D
Todd Sestero Gaithersburg MD 11/2/2008


4244
G
Todd Sestero St Paul MN south ofPigs Eye Yard 29SEP2006

Blanking out unused positions

This practice is used when a signal head does not need all of the available aspects the head is capable of displaying



On most railroads, they would use an appropriately sized head, out of consideration for cost. If they only needed one or two aspects in a particular position, they would use a one or two position signal head, as shown to the left on the old RF&P line at Doswell VA. The right signal is only capable of displaying medium or slow speed indication since the top head is always red.

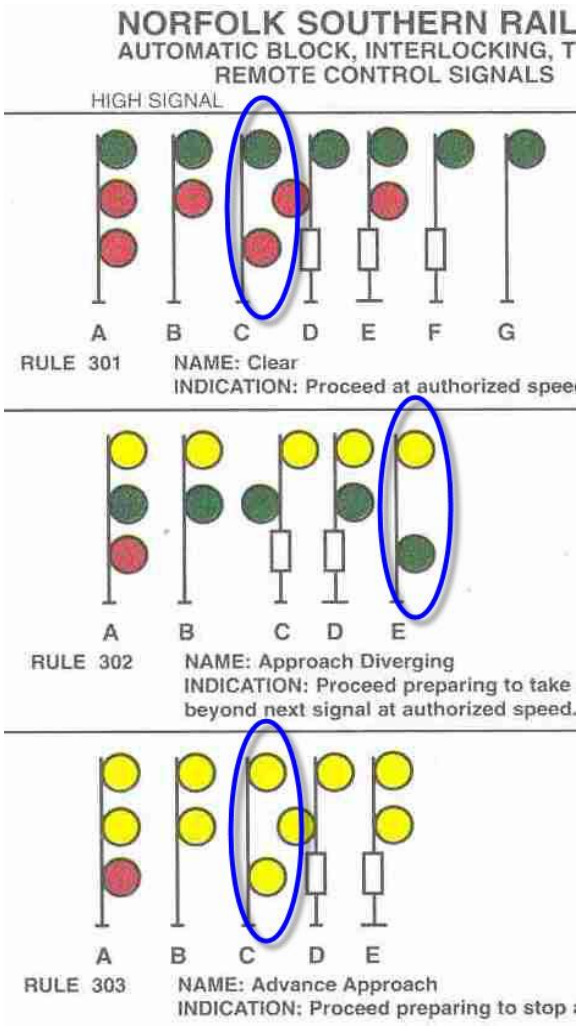
On the right, it shows the bottom head on the left having the green aspect being blanked out, but on the right, they use a two aspect head. Why? Maybe they downgraded the slow speed head so it could only give us a slow approach, and not a slow clear. Or maybe they ran out of two aspect heads.... Don't know from looking at the signal, but those are two possibilities. Notice that the bottom head on the left shows red in the middle position. Photo by Jim Mihalek.

In other instances, such as many transit companies, they want to contain costs in a different way, so to keep different signal heads in stock, would cost more than the occasional use of blanking an aspect, as shown in the photos below at the Gilroy station on the Baltimore light rail, where the tracks goes from two to one for it's ride through the Hunt Valley Industrial Park.

Then there are the Pennsy PL and B&O CPL signal heads. The B&O did not have a "shortened" version of its signal head like the Pennsy did for its lower head. This meant they had to blank out all of the unused positions. The “restrict only” B&O signal (in S Baltimore) below shows this. The picture to the right shows a B&O signal (also in S Baltimore) with just the restrict aspect blanked out.

The middle picture shows a Pennsy PL head with just a stop aspect, with all of the other possibilities blanked out. The other two Pennsy signals other variations of blanking out unused positions. From left to right of the Pennsy pix, Columbia PA, Northumberland PA, and the west bank of the Rockville Bridge in Marysville PA.

Signal Spacing



Another way the railroads saved money is illustrated to the left. This was to leave out the "middle" signal if they had no medium speed moves at a particular location. An engineer could tell that the lower head was a slow speed signal, by the larger than normal spacing of the two sets of signals, although, since engineers have to qualify on particular sections of track, the signals should not come as any great surpise.

Signal C for Clear, signal E for Approach Diverging, and signal C for Advance Approach are the signals of interest.

The scan on the left is from the Norfolk Southern rulebook for the Kentucky region.

The photo below illustrates this practice. Compare the two signals in the picture, and you will notice the larger than normal spacing between signal heads, compared with the three head signal in the background. A train approaching the restrict signal would have just come through Tower 87 in Houston TX, headed into Settegast Yard. Depending on

the indication the engineer receives next at the stop signal, he could get cleared to proceed into the yard, or take a diverging move to the left and head up to the Gulf Coast Junction.

Signal Bridges

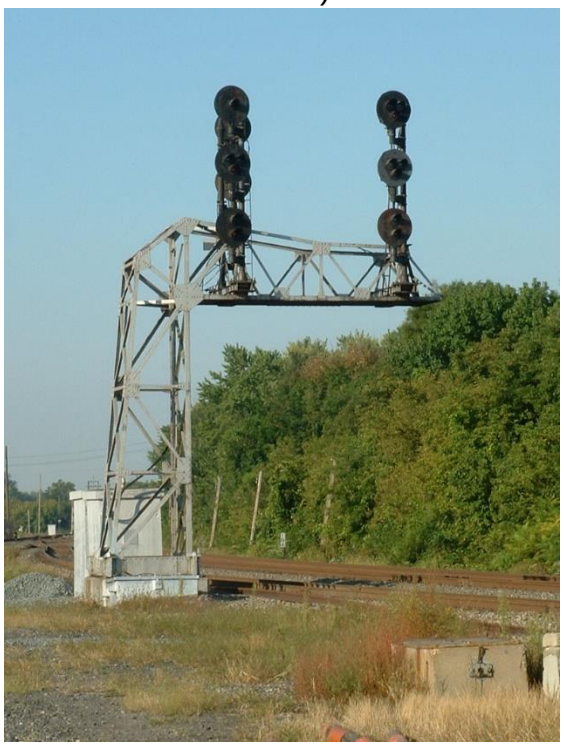
If you have more than a single track, and need to signal them, what are your options?

You can put a full signal bridge over them....

ex Southern Rwy, Gastonia NC

ex B&O, Ridgeley St, Baltimore MD

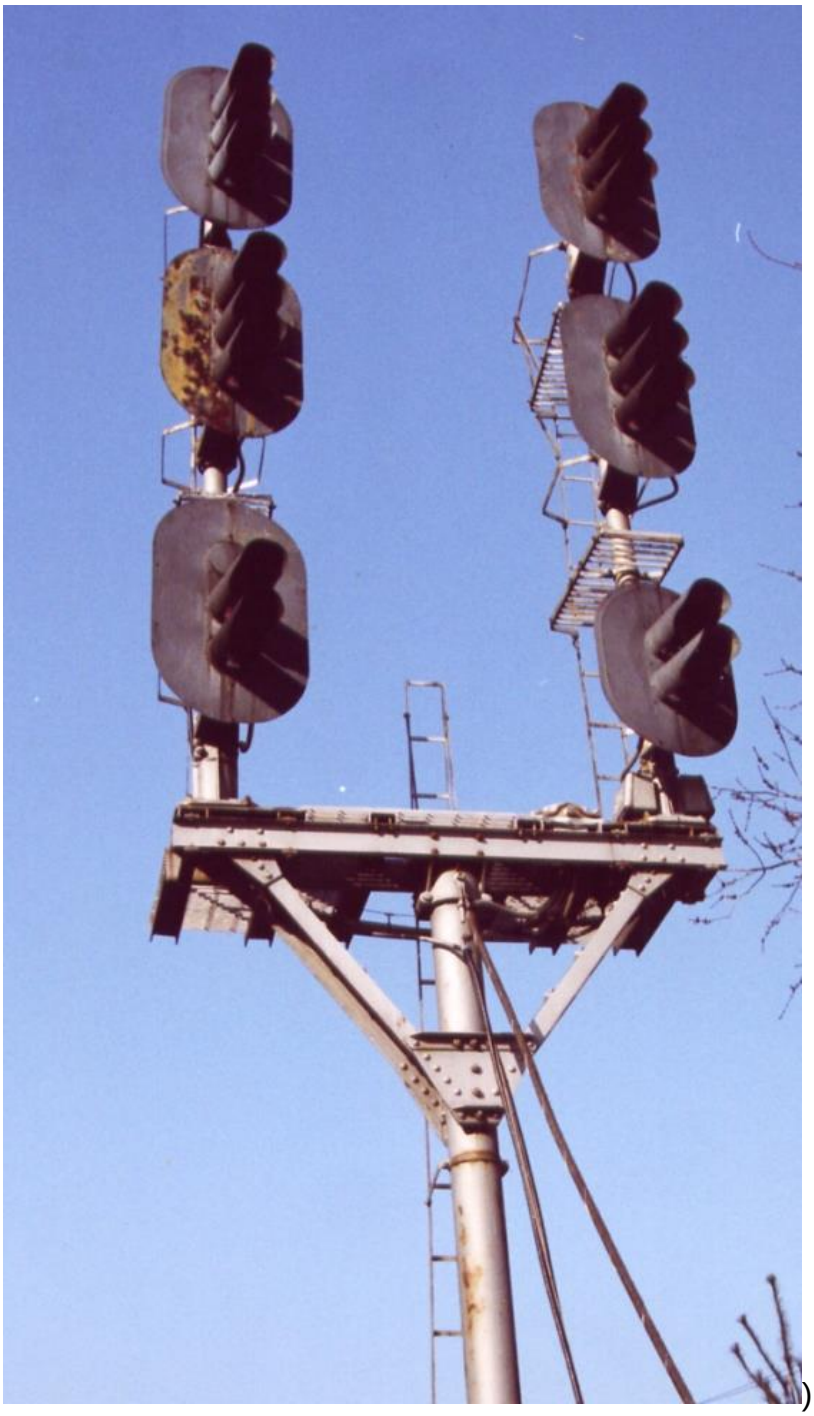
You can put a cantilever type signal bridge over them (almost always limited to two tracks)...



(L) ex NYC, Berea OH, and (R) ex C&O, Richmond VA behind the airport. The one in Berea has disappeared, replaced by color lights sometime in 2010.

You can put them on a bracket post..... again, almost always limited to two tracks. See the Doll Posts section for an unusual exception.

(L) ex B&O, South Baltimore MD... (M) ex RF&P, Doswel VA... (R) Color Signal in Ohio (by Jim Mihalek



)

Notice the RF&P signal has a siding between it and the tracks it governs. BTW, the B&O CPL's are now gone, replaced in late 2012 by color lights.

Or, in a non-bridge application, you can put signals on both tracks:

Baltimore Light Rail, Timonium MD

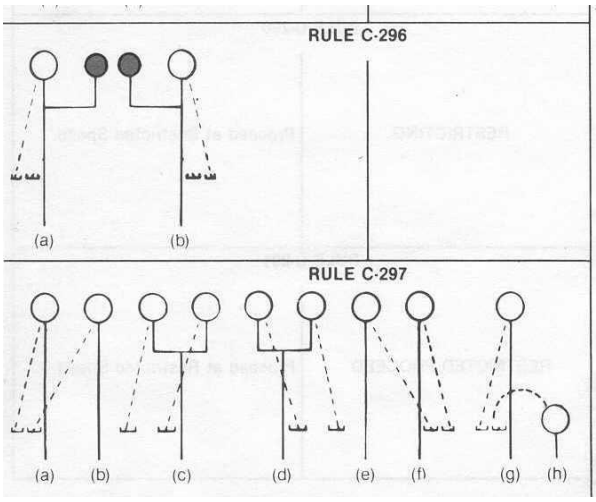
Doll Posts

Now, what happens if you only need the left track (of two) signaled, but the only place you can put the signal is to the right of them? Enter the place holder, or *Doll Post* (some railroads refer to it as a *Doll Arm*). The picture below shows how the B&O did it with their CPL signals, this one is north on Baltimore at the end of a siding (hence the dwarf mounted to the bottom of the pole). The post, or arm to the right of the signal tells the engineer that there is a track to the right of the one that the signal is intended for.

The second set of pictures of a US&S Searchlight signal with a doll post in Lineville AL on an ex-SCL line, As with many other railroads, they use a high signal for the mainline and a dwarf for the siding. Notice the blue doll post light is out. *Photos courtesy John Higginson.*

The last picture is of an ex N&W bracket installation where they have three tracks, and the right one is not signaled with a high signal. They mounted the doll post to an I-beam extension of the bracket. *Photo by Jim Mahelik.*

Below the pictures is an excerpt from a CSX rulebook that shows the possible combinations a doll post can appear, along with track assignments for bracketed signals.



RULE C-296

DOLL ARM	A track intervenes between the signal and the track governed by the signal. When more than one track intervenes, the number of doll arms, with or without blue lights, is correspondingly increased.

RULE C-297

ADJACENT OR BRACKETED SIGNALS	Right hand signal governs right hand track and left hand signal governs left hand track.

Backgrounds

The background of a signal is the metal shade that surrounds the entire signal or signal head. I have not seen the derivation for this term, but in looking at the old Tombstone signals on the Pennsylvania Railroad, I can clearly see that the background was a separate "device", and not part of the signal.

The main reason for using a background was to make the signal "stick out" when compared to the surrounding environment, especially if the sight line was anywhere near where the sun could be behind the signal. There are some places where backgrounds were not used, such as the lower head of some Pennsy PL signals. Some railroads also used wider than normal backgrounds, such as the Western Maryland, as shown below in Cumberland MD.

Call-on Signals

A call-on signal (oftentimes red over yellow, or red over red over yellow) displays the *Restricting* indication, which is used for train moves into unsignaled track, against the current of traffic, or into occupied blocks. The latter scenario is the one that gives the "call-on" name. It is "calling a train on[ward]" into an occupied block.

MKT in Texas used a double headed searchlight on their lines... The top head is the larger while the bottom head is smaller. Top head had the H-5mechanism while the bottom heads were ALL fixed yellow aspect. Every single lower head was a fixed yellow. I have heard these were "call-on" signals.

Thu, Apr 11, 2013