A BRIEF HISTORY OF RAILROAD OPERATING RULES, SIGNALING AND TRAIN CONTROL
Operation of a railroad is governed by rules, issued to employees in the form of the “Book of Rules”. Usually they follow a more or less standard form.

They specify general duties of various employees in the Operating Department and attempt to systematize their actions in any situation that may arise in operating trains.

Like the Rules of the Road when driving an automobile.
There are several “Books of Rules” currently used by railroads in the United States.

All rule books currently in use evolved from the:

*Uniform Train Rules and Rules for the Movement of Trains by Telegraphic Orders*

Adopted by the General Time Convention of the American Railroad Association in July of 1889 as the authorized **Standard Code**.
Originally, the General Time Convention was responsible for the establishment of Standard Time and the Time Zones in the United States on November 18, 1883.

The American Railroad Association became the Association of American Railroads in 1937.

In 1938, the *Uniform Train Rules and Rules for the Movement of Trains by Telegraphic Orders* was renamed the *Standard Code of Operating Rules*. 
Metra has adopted the General Code of Operating Rules.

Over 300 other railroads, including the BNSF Railway, Canadian Pacific and Union Pacific Railroad have also adopted the GCOR.
Approximately 60 eastern railroads have adopted the Northeast Operating Rules Advisory Committee (NORAC) Operating Rules.
Several railroads continue to maintain their own rule books:

- CN
- CSX Transportation
- Norfolk Southern
- Metro-North Railroad
- Long Island Railroad
How did this come about or how did we get to where we are today?

The process could best be described as evolution or by what is called Westinghouse’s Law:

“THE MORE THINGS WE INVENT, THE MORE THINGS WE NEED TO INVENT.”

George Westinghouse
Received a Patent for his Automatic Air Brake in 1869 at age 22.

Awarded 361 Patents during his 48 working years (1 every 1½ months)

Founder of Union Switch and Signal Company in 1881.
The original railroads consisted of wooden tracks where cars were pulled by horses.
In 1765, James Watt harnessed the power of boiling water when he perfected the steam engine.

James Watt
The father of the steam engine.
Richard Trevithick put the steam engine on wheels in 1800 and it replaced the horse for pulling the cars.

Richard Trevithick
The father of the locomotive engine.
In 1820 William Jessup introduced the cast iron edge rail on which flanged wheels were used and railroads as we know them came into being.

William Jessup
On September 26, 1825, the 26 mile Stockton and Darlington Railway, built in 4½ years by George Stephenson, opened in England.

The world’s first public railway created for carrying goods other than coal – plus passengers.

Stephenson was also one of the first advocates of railroad safety. In 1841 he suggested a speed limit of 40 MPH, self acting brakes and uniformity of signals on the various lines.
Not everyone embraced the railroad. Philadelphians were warned that a “locomotive rail road” through their “beautiful streets” would ruin their trade and annihilate their rights – and perhaps worst of all, make them a suburb of New York!
In the beginning railroads consisted of one engine on one track.

With the coming of the second engine, provisions had to be made to prevent movements in opposite directions from colliding with each other.
The steam railroad was the first system where speeds could be high enough for stopping distance to exceed sighting distance.

A clear track had to be assured by some means other than an alert engine driver.
At that time, the first operating rules came into existence.

They were comparatively simple and as traffic increased they became progressively more complicated.

It can be said that the advent of railroad operating rules coincided with the need for them.

One of the first systems to prevent collisions between opposing movements was the Timetable Schedule.
Each train was given a printed time schedule (Time Table).

Meeting points were established between trains moving in opposite directions.
Neither train could leave the meeting point until the other train arrived.

The system worked well as long as the trains ran on schedule.

If one train was delayed in arriving at the meeting point, delays to many trains could result and eventually paralyze the railroad.
The Timetable Schedule also provided time separation of trains moving in the same direction.

As traffic increased, tracks were divided into blocks and train separation was by space interval through use of manually controlled signals at the entrance to each block.
In 1837, Samuel F. B. Morse invented the electric telegraph. A simple apparatus for sending and receiving electric impulses by wire.

A quick demonstration.
It was only a matter of time before the telegraph would be used by the railroads.

On September 22, 1851 the historic event occurred on the New York & Erie Railroad.

Superintendent Charles Minot was on a westbound train that was stopped at Turner’s, New York waiting for a meet with an eastbound express.

Charles Minot
A telegraph line had recently been installed along the railroad.

Time passed and when the eastbound express did not arrive Mr. Minot, who was known as one of the most progressive railroad officials of his day, asked the station operator to telegraph Goshen, New York, 14 miles west, to determine if the express had arrived.
On being advised that the express had not arrived, Mr. Minot issued the first telegraphic train order which read:

To the agent and operator at Goshen:

Hold the eastbound train for further orders.

Chas. Minot, Superintendent
He then wrote an order which he handed to Conductor Stewart on his train:

*To conductor and engineer, Day Express:*

*Run to Goshen regardless of opposing train.*

*Chas. Minot, Superintendent*
Mr. Isaac Lewis, the engineer of the train, refused to run the train on such an order saying he would "run the train according to time card rules, and no other way."

Mr. Minot took charge and ran the engine himself.

Upon arriving at Goshen the eastbound express had not arrived.

He repeated his orders and was able to reach Port Jervis, New York at the same time the eastbound train was arriving.
Minot’s procedure was developed into rules for running trains by telegraph.
Those procedures were further refined and evolved into a set of rules known as Timetable and Train Order Operation.

**Time Table** – The authority for movement of regular trains subject to the rules. It contains the classified schedules of trains with special instructions relating thereto.

**Regular Train** – A train authorized by a time-table schedule.

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

**Extra Train** – A train not authorized by a time-table schedule. It may be designated as –

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

201. For movements not provided for by time-table, train orders will be issued by authority and over the signature of the chief train dispatcher, and only contain information or instructions essential to such movements.

They must be brief and clear; in the prescribed forms when applicable; and without erasure, alteration or interlineation.
Chicago & Iowa R.R. Train Order.

From Allum
To Conductor and Engineer No.

At Clinton Station.

Holding Order

Answer how you understand, and get my answer before starting.

Signed

Operator.

Note: Operators must exercise the greatest care and watchfulness in sending and receiving messages in regard to running trains. Blanks will be furnished each Operator to copy all orders upon, in regard to running trains by telegraph, which must be kept in readiness for use at all times.
Eng 684 works extra six ten 610 am until six thirty 630 pm between Canon City and Spikebuck
Eng 644 works extra six thirty 630 am until six thirty 630 pm between Pleasanton and Texas Creek protecting against No 73 and No 65 engs unknown and not protecting against extra trains except protect against two 2 Extras 1514 and 1506 West and against extra 1166 east after six ten 610 AM and against other eastward extra trains after ten thirty 1030 am No 73 No 65 and Westward extra trains get this order at Canon City
Timetable and Train Order
Operation remained in common use until the 1980s.
It is still in use on the Long Island Railroad.

TIMETABLE

TIMETABLE — The authority for the movement of regular trains subject to the rules. It contains classified schedules with special instructions relating to the movement of trains.

TIMETABLES

4. Each timetable, from the moment it takes effect, supersedes the preceding timetable. A train of the preceding timetable thereupon loses both right and schedule and can thereafter proceed only as provided by Rules S-97 or D-97. Schedules of the new timetable take effect at the leaving time and date from their initial station. Not more than one schedule of the same number and day shall be in effect.

5. Not more than two times are given for a train at any station. Where one is given it is, unless otherwise indicated, the leaving time. Where two times are given they are the arriving and leaving times. Unless otherwise specified, time applies as follows: On single track, at the first switch where an opposing train clears. Where there is no switch, time will apply at the station. On two or more tracks, time will apply at the station. Scheduled meeting times are indicated by figures in full-faced type. The numbers of trains to be met are shown in small figures adjoining, in brackets. Both the arriving and leaving times of a train are in full-faced type when one or more trains are to be met between those times.

MOVEMENT BY TRAIN ORDERS

201. Train orders will be issued by the Train Dispatcher over the signature of the General Superintendent — Transportation. Train orders must be brief, clear and issued in the prescribed forms when applicable. They will contain only the information essential to the safe movement of trains. They must be without erasure, alteration or interlinear figures. Figures in train orders must not be surrounded by brackets, circles or other characters.

202. Each train order must be given in the same words to all employees or trains addressed.

203. Train orders must be numbered consecutively each day, beginning at 12:01 AM. Train orders used for slow orders or similar instructions shall remain in effect until a general notice containing the required information is placed in effect. When impracticable to issue a general notice, train orders used for this purpose will be renewed each day, as soon as possible after 12:01 AM.

204. Train orders must be addressed to those who are to execute them, naming the place at which each is to receive a copy. Train orders for a train must be addressed to the conductor and engineer and to anyone who acts as the train’s pilot.

FORM 19

LONG ISLAND RAIL ROAD

TRAIN ORDER NO…………………

OFFICE OF THE

GENERAL SUPERINTENDENT

TRANSPORTATION

To

Made Time M Block Operator

Rev. 01-2000

(To be printed on yellow page 6 ¼” x 7 ¼”.)
There was no coordinated effort to produce uniform rules on the various roads.

Each railroad contrived whatever rules it deemed necessary. This resulted in loopholes.

In 1900, 2,500 railroad employees died while on duty; many as a result of those loopholes.
Standardization in the form of the **Standard Code** was the method to close the loopholes.

It served as the standard for consistency in understanding and applying operating rules from a conceptual standpoint and also for terminology, formatting, wording and numbering.
While not an actual rule book, although some railroads reprinted it verbatim and used it as such, the Standard Code served as a template from which railroads could deviate to suit their individual requirements.
First issued in 1939 with reissues in 1945, 1959, 1967 and 1980 – Primarily used by railroads in the Upper Midwest and Northwest

First issued in 1940 with reissues in 1950 and 1968 and a revision supplement in 1981 – Primarily used by railroads in the Southwest

Both were superseded by the General Code of Operating Rules in 1985.
First Edition – 1985
   Rules for Movement by
   Train Orders Eliminated
   Rules Reworded and
   Reorganized into 16
   Chapters
Fourth Edition – 2000
Fifth Edition – 2005
Sixth Edition - 2010
First Edition – 1988
Rules Consolidated and Streamlined to be More Readable
Fourth Edition – 1993
Fifth Edition – 1995
Sixth Edition – 1997
Seventh Edition – 2000
Tenth Edition – 2011
Once turnouts (switches) and crossings were developed so tracks could branch from and cross each other, a means to assure the route was clear had to be developed.
In 1843, at Bricklayer’s Arms Junction in England, Sir Charles Hutton Gregory installed the first devices where signals and switches were controlled from a single location.

The switches and signals were operated, via pipe and wire pull, by a switchman using hand levers to operate the switches and foot stirrups to work the signals.
There was no interlocking among the switches and signals.

Switches were sometimes thrown under trains and signals cleared over open switches.

In 1856, the first mechanical interlocking was developed in England.
John Saxby invented and patented the system by which signals and switches are controlled by one operation.
The first interlocking in the United States, imported from England, was manufactured by Saxby and his partner John Stinson Farmer.

The Saxby & Farmer interlocking machine was put in service in 1870 at “Top of the Hill,” a junction in Trenton, New Jersey, on the Philadelphia and Trenton Railroad.
Originally, interlockings were totally mechanical. They relied on the brute strength of the control operator.

Levers in the control building or tower were connected to rods (pipes) on rollers which moved cranks and in turn moved signal arms and switches in the field.
Between the operating levers and the rods was the interlocking machine.

Inside the interlocking machine a system of slots and locking bars with latches (dogs) between the levers, known as the locking bed, prevented the levers from being moved except in proper sequence.

The arrangement prevented signals from being cleared until all switches in the route were properly lined and also prevented giving a signal to two opposing or crossing trains.
Largest Mechanical Interlocking in North America

Installed: 1897
Retired: August 5, 2000

State Line Tower
Hammond, Indiana

128 Working Levers
State Line Tower Model Board

Locking Bed
In 1872, Dr. William Robinson invented the Closed Direct Current Track Circuit which provided the ability to electrically detect track occupancy and most track integrity problems, such as broken rails.

Dr. William Robinson
Robinson’s Closed Rail Current System was installed at Kinzua, Pennsylvania on the Philadelphia and Erie Railroad in 1872.

“He has created an epoch-making invention of incalculable value to the human race.”

Robinson on Robinson
With the invention of the track circuit and an ever increasing understanding of electricity, mechanical locking evolved into electrical locking.
In 1911, the first Absolute Permissive Block System, more commonly called the Automatic Block Signal System (ABS) was installed on the Toronto, Hamilton & Buffalo Railway.

The system allowed trains to operate on single track in either direction with full signal protection for both opposing and following movements.
In 1927, combining the Absolute Permissive Block System with electric interlocking technology, the New York Central Railroad installed several small interlockings, remotely controlled from Fostoria, Ohio by a single dispatcher, in ABS territory on the Ohio Division between Stanley and Berwick, Ohio.

This created the first Centralized Traffic Control (CTC) System that allowed operation of trains on single track under centralized supervision without train orders.
Early English railroads employed formally-attired traffic “policemen” to enforce schedules and advise trainmen of conditions ahead.

“All right.” “Caution.” “Stop.”

C. H. Gregory’s Semaphore 1841

Lattig’s Electric Semaphore Motor 1893
Another form of signal in which the arm above the lamps is used to designate which road may and which may not use the crossing. The crossing in this instance is at a very acute angle. Of the six lamps, three have red lenses and three green. The green lamps are on the side opposite the arm and designate at night which road has the right of crossing.
GCOR Rule 9.1 – Signal Aspects and Indications

Signal aspects are identified by the position of semaphore arms, color of lights, flashing of lights, position of lights, or any combination. Aspects may be qualified by marker plate, number plate, letter plate, or marker light.

Signals may display color light aspects or semaphore arms and color lights.
The human element in train control:

Control Operator

Train Dispatcher
Although they are variously called the Operator, Leverman, Towerman or Control Operator; the GCOR uses the term Control Operator which is defined as:

Employee assigned to operate a CTC or interlocking control machine or authorized to grant track permits.
GCOR Rule 1.45 - Duties of Control Operators and Operators states:

Control operators and operators are under the direction of the train dispatcher when their duties concern handling track warrants, track bulletins, lineups, the movement of trains and any other instructions issued by the train dispatcher.
GCOR Rule 1.44 - Duties of Train Dispatchers states:

Train dispatchers supervise train movement and any employees connected with that movement.

Simple and straightforward, but . . .

*What do train dispatchers really do?*
Between April and December of 1998, the Federal Railroad Administration - Office of Research and Development sponsored a Cognitive Task Analysis of how experienced train dispatchers manage and schedule trains in today’s environment.
A cognitive analysis involves identifying the knowledge, mental processes and decisions required to perform a task.

Cognitive activities include:

- Monitoring.
- Situation assessment.
- Planning.
- Deciding.
- Anticipating.
- Prioritizing.
The final report entitled *Understanding How Train Dispatchers Manage and Control Trains - Results of a Cognitive Task Analysis* was published in May 2001.
Conclusions

The train dispatcher’s job is a critical function to both the safety and efficiency of railroad operations.

Dispatchers are responsible for:

• Allocating and assigning track use.
• Ensuring trains are routed safely and efficiently.
• Ensuring the safety of personnel working on and around the track.
These are cognitively complex tasks that require:

- Integrating multiple sources of information:
  - Train schedules.
  - Computer displays of current track status.
  - Radio communications with various personnel such as locomotive engineers.
• Projecting into the future - estimating when the train will arrive.

• Balancing multiple demands placed on track use:
  - The need for maintenance of way workers to have time to work on the track.
  - The need to make sure the track will be clear when a train is anticipated to arrive.
The Other Railroad Signal System

STOP - LOOK - LISTEN

Galena, IL
May 1, 2011
The “Skull and Crossbones”

Illinois Central Railroad
Grenada, Mississippi
In Service: 1940 - 1970
How far have we come?

In 1900, there were 2,500 on-duty railroad employee fatalities.

In 2011, there were 21 on-duty railroad employee fatalities.

The 10 year average from 2001 through 2010 is 20.6 on-duty railroad employee fatalities per year.
While on time performance is an important part of our service, the SAFETY of our employees, our passengers and the public is first and foremost.

No job is so important, no service is so urgent that we cannot take time to perform all our work safely!!
BIBLIOGRAPHY


Indiana Harbor Belt Railroad. State Line Tower Photographs.


THE END
Knowledge + Understanding + Application = Compliance