Leonardo

# Student Manual

# Signalling systems

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## Copyright

# PKP CARGO S.A.

# Signalling systems

# Student Manual

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## 1 Principles of safe railway traffic.

PKP CARGO Joint Stock Company as a freight railway operator uses proper technical devices, such as signaling and telecommunications, in order to secure safe railway traffic, by separating one train from the other.
Signaling devices set precisely places of dividing railway track into parts called “block sections”. On a block section situated between semaphores may run only one train and there is a rule, according to that, a train is allowed to enter a block section only after having given a clear signal on semaphore placed at the beginning of the block section.
**Telephone block** – means that before giving a clear signal, a station inspector is supposed to ensure that a previous train has already left a block section protected by this semaphore.
Such an ensuring is acquired according to communication between block posts adjoined to the section or automatically with the use of appropriate sequence starting and control device of railway traffic –“srk”.
Control of train running on a track – section between two stations – requires communication between station inspectors in order to ensure that a train running from station “A” has entered the next station “B”, which means that the train has already cleared the track between stations “A” and “B”.
On the arrival of the whole train at station “B”, a station inspector (of a station “B”) informs a station inspector (of a station “A”) about this fact, which means that the track between these two stations has already been cleared and there is a possibility to specify direction of railway traffic again.
On tracks with one-direction running, running direction is constant, so station inspectors are supposed to forward, confirm and check the wholeness of a train.

## 2 Manual block –

at PKP there is a manual block with light and shape signals.
With manual block, similarly to telephone block, operating railway traffic means checking tail lights of trains leaving station “A” and entering station “B” by station inspectors. Moreover, a station inspector is supposed to ascertain if a track section between two stations is being cleared.
In manual block, there are used special devices, called electromechanical and electrical blocks (locks), which are operated by station inspectors. These devices are placed in station signal-boxes.

In order to exclude a possibility to forward a train from station “A”, in case the previous train has not already entered the next station “B”, there are used a couple of cooperating blocks – the initial block at station “A” – Po, the terminal block at station “B” – Ko.

## Signal Sr I “Stop”

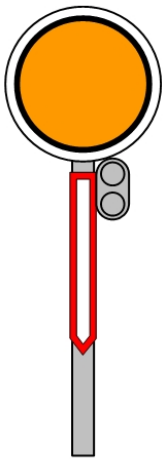
**Daily Signal**

A semaphore arm is at horizontal position, to the right of a

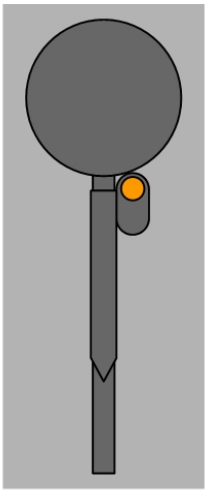
semaphore post

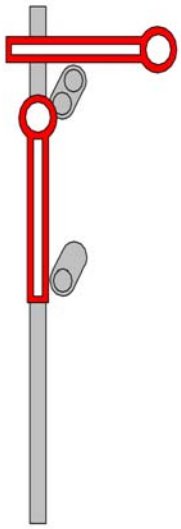
**Night Signal**

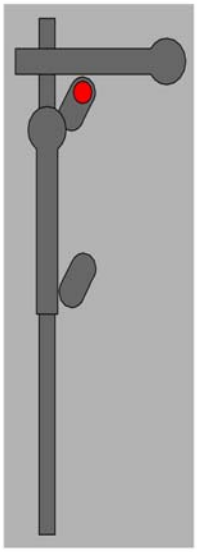
Red signal on a semaphore



Distance signal







Semaphore

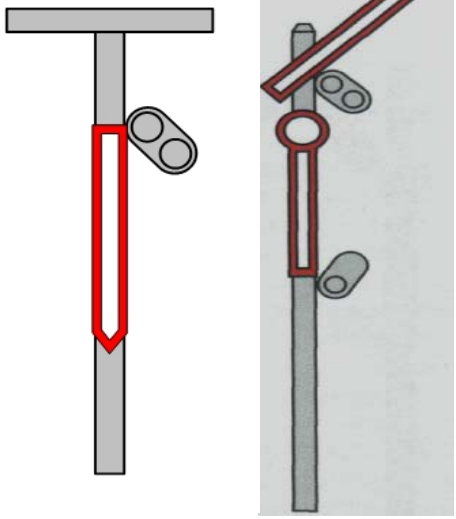
## Signal Sr 2 “Clear track”

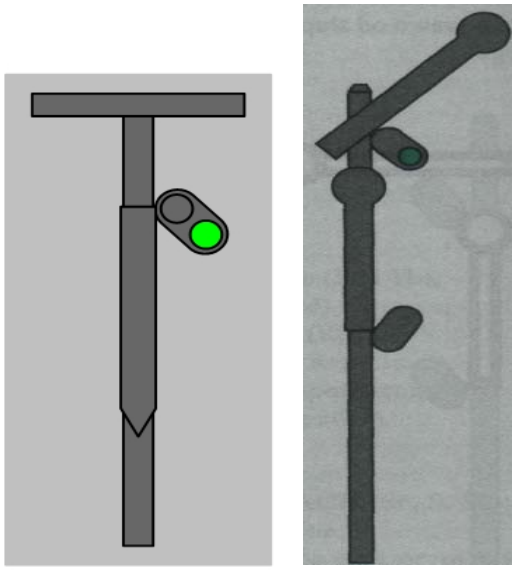
**Daily**

A semaphore arm is raised to the right of a semaphore post at an angle of $45^0$ to the level

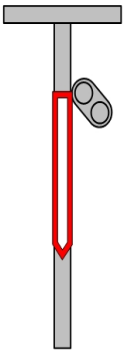
**Night**

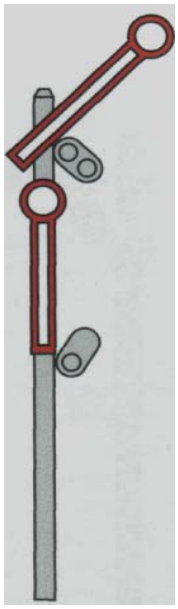
Green light on a semaphore





Signal Sr 2 allows a train to run at the speed limit on a certain track section, which is settled in a timetable.

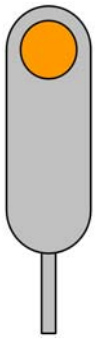


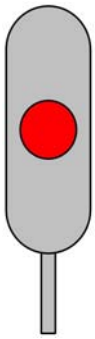


Station A Station B

## 3 Manual block with light signals.

On light semaphores there are: red, green, orange, white, permanent or flashing lights. Signal indication on a semaphore might be given with the use of one or two lights at the same time.





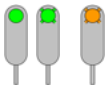
Station A Station B

# 4 Speed signals.

At PKP signal indicator of speed signaling system consists of two lights and may be completed with horizontal orange or green stripe.
Bottom light is always permanent orange, while top light is orange or green, permanent or flashing, which indicates speed at the next semaphore.

Signal indicators indicate the following speed:

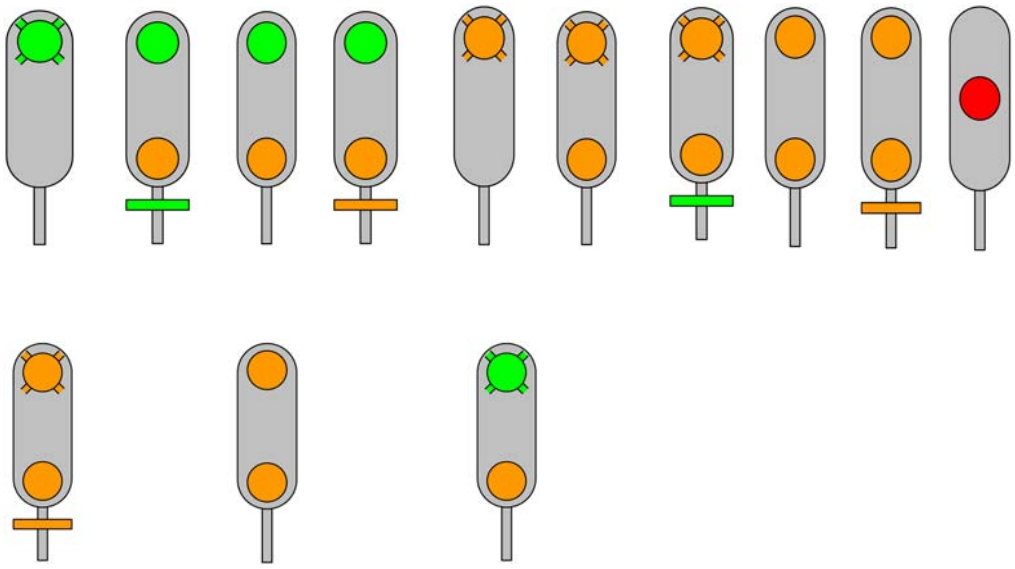
- the speed limit on a certain track section indicated in internal timetable.



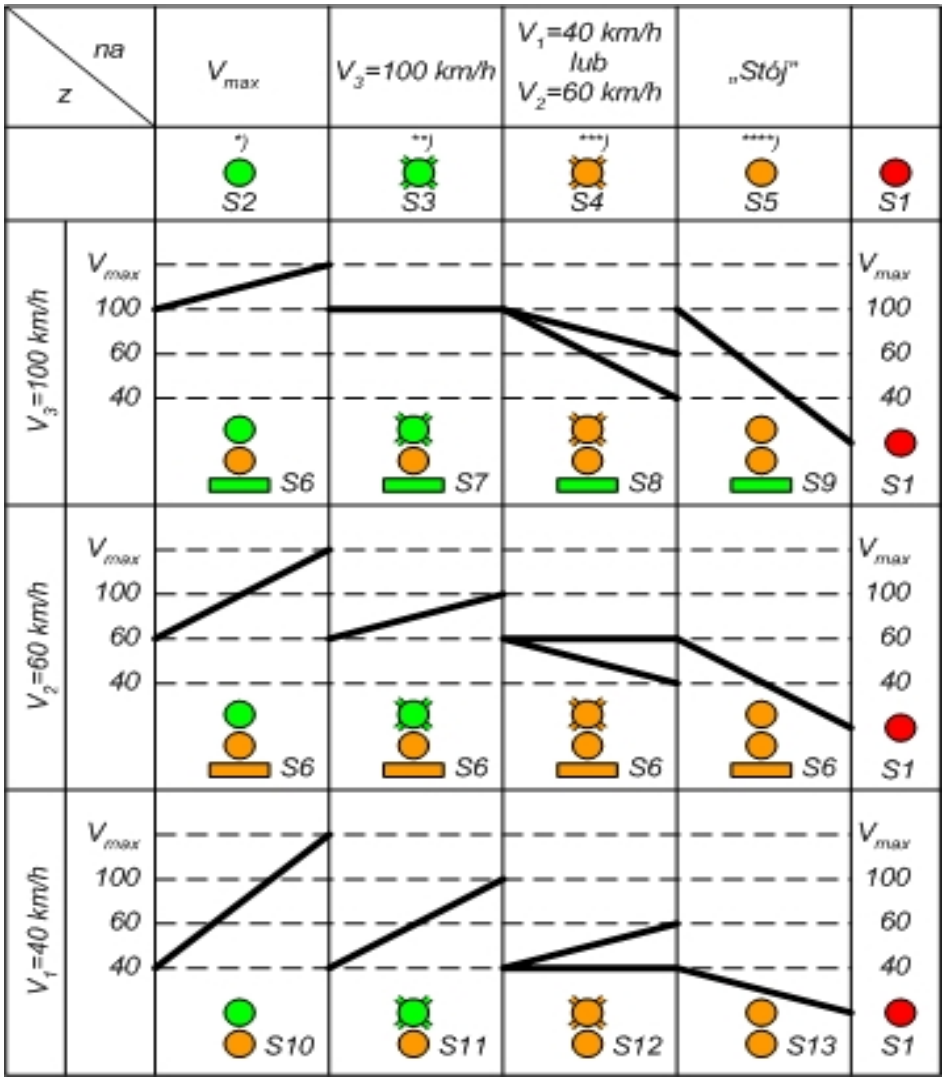
- 100km/h, 60km/h, 40km/h

- ”Stop”

There are following signals:



**The list of signal indications of light semaphores**




## 5 Automatic electric block system.

Automatic electric block system is a totally different way of operating railway traffic than manual block.

These are automatic sequence starting and control devices that play the most important part, not a man.

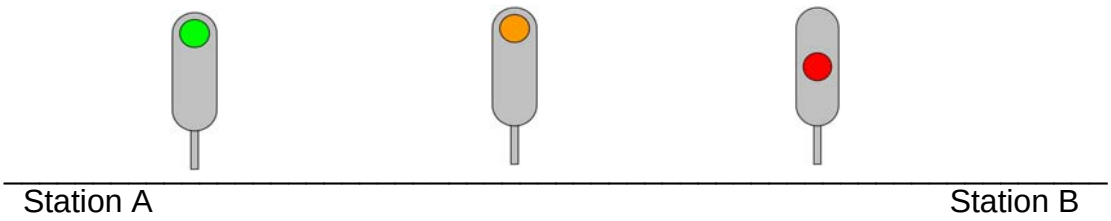
The basis of their working, the same as in most cases at PKP is track circuit. This is an electric system, which consists of source of supply, a track section separated from adjoining sections (called insulated section) and a receiver (mainly a relay).

State of a relay indicates if a section track, which is being controlled by a track circuit, is clear or not. If a track is divided into block sections equipped with track circuits, and

on their ends there semaphores are placed, then a train running through the following track circuits will automatically change semaphore lights.

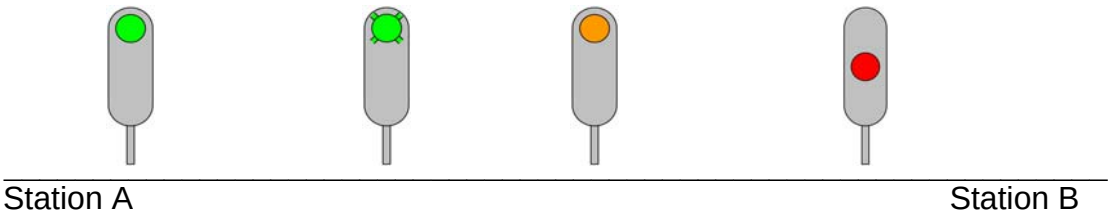
At PKP there are two kinds of automatic electric block system (sbl):

1. Automatic electric block system with three lights. Red light is preceded by orange light and orange light is preceded by green light.




Green light (permitting signal) informs about the possibility of passing this and the next semaphore with speed limit.
Orange light (warning signal) allows passing this semaphore with speed limit and indicates that the next semaphore will indicate “Stop” signal.

2. Automatic electric block system with four lights.




In this kind of system green light (permitting signal) indicates the possibility of passing this semaphore and the next one with flashing green light with speed limit. Flashing green light allows passing this semaphore with speed limit and informs that the next semaphore indicates an orange signal, which can be passed with speed within 100 km/h, and near the next semaphore a train must “stop”.
After having passed the following block sections by a train, a semaphore indicates red light. Then the next train can be forwarded from station “A”, because at least one section block is being cleared.
Changing of signals on semaphores on tracks with automatic electric block system is automatic, without any man’s participation. While specifying direction of railway traffic and its possible change is made by station inspectors with the use of proper electric systems. These are the following circumstances of change of railway traffic direction: clear track, on which the change is supposed to be done, signals “stop” on semaphores directing at this track.
On tracks which are equipped with automatic electric block system and at stations equipped with electric systems srk, man’s participation in necessary operation is little.

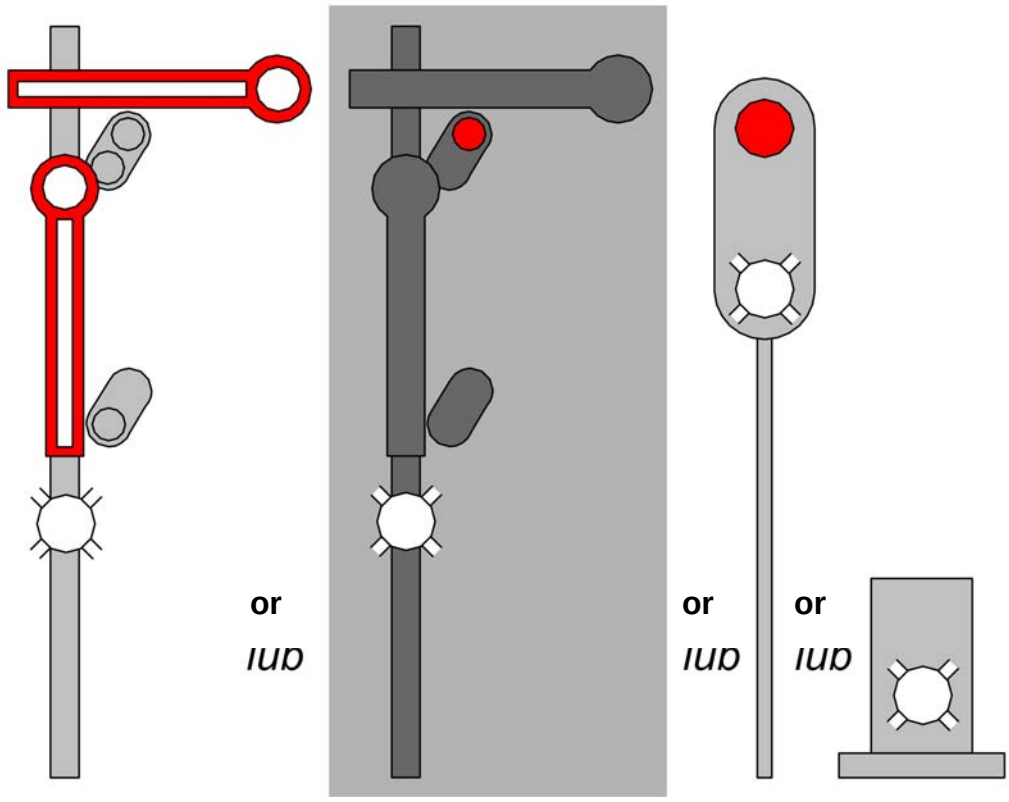
Railway traffic at stations and tracks is controlled with the use of signals, which are indicated by semaphores. A train driver is obliged to obey these signals, therefore he is responsible for safe railway traffic.

## 6 Substitute signal.

Substitute signal means that it is not allowed to pass a semaphore indicating „stop" signal and is used in case of impossibility of indicating permitting signal, indicating doubtful signal or when a semaphore is not lit and also on a semaphore constantly indicating "stop" signal. Substitute signal is flashing mat white light.

When there is a substitute signal "Sz" on a semaphore, then speed limit is not higher than 40 km/h and a train driver is not obliged to stop a train before it. A train driver is supposed to control speed of a train, so that he can halt a train in emergency.

Speed limit of a train passing a substitute signal on track with automatic electric block system shouldn't increase 20 km/h and a train driver is supposed to run a train with speed of 20 km/h until front section of a train passes permitting signal on a semaphore sbl.




Semaphores of automatic electric block system differ from semaphores of manual block system in to colour. A semaphore of manual block system is white and red, while a semaphore of automatic electric block system is grey. A train driver, after having halted a train before "Stop" signal (sbl), is allowed to pass this signal on condition that speed of a train doesn't increase 20 km/h (only driving a train with speed within 20 km/h makes it possible to halt a train in emergency).

At PKP a train driver is supposed to drive a train with speed , which is appropriate to track circumstances, indicators on semaphores, timetable or train's parameters, in order to secure safe railway traffic.

Due to man's deceptiveness, a train driver's operations must be supported. At first there was a necessity that a train is driven by two persons – a train driver and an assistant of a train driver. An assistant of a train driver is supposed to watch signals on semaphores and support a train driver in taking decisions. But it turned out that driving a train by two persons doesn't secure safety of railway traffic. Introducing radio-telephone communications between stationary devices and mobile vehicle made railway traffic operations more efficient and safer, mostly by the possibility of exchange the information about changes in circumstances on a track as well as signals.

# 7 Shunting.

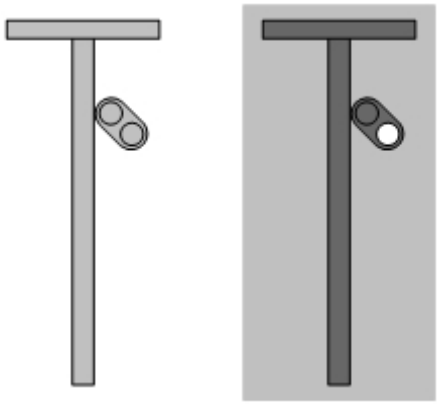
While shunting in order to communicate there are used signals, communication devices, orally and in writing.
If there are no obstacles to shunting running, then after having pointed turnout as well as derailers for each shunting route, a switchman gives a signal “Running permitted”, which means that running is allowed.

Signal on a semaphore
”Running permitted”


Light shunting disc

Signal Ms 2
Shunting running permitted

Shape shunting disc

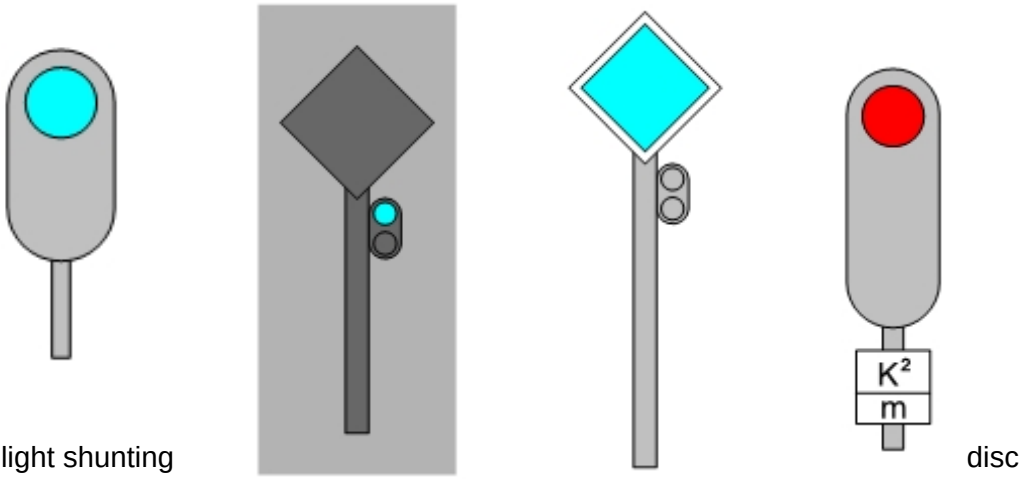


Signal M 2
Daily Night
Shunting running permitted

Permission for shunting running is valid until:

1) the next signalling device (for this shunting running),
2) in case of a lack of such a device – the next turnout, derailer or the nearest switch or crossroads in the neighbouring switching zone.

On passing signalling device by shunting rolling stock, the device must be adjusted in such a way that it indicates ”No shunting running”, which means no permission to shunting running.




On a light shunting disc

Daily Night On a semaphore

Signal M1, Ms1- „No shunting running”

In case of a lack of a signalling device, permission is given by a switchman with the use of manual signal.

While shunting a shunting crew communicates with a train crew with the use of following manual and auditory signals, using signalling devices (a flag, a torch, a horn):

1) Signal Rm 1 “Towards myself”

Daily Night

2) Signal Rm 2 “Off myself”

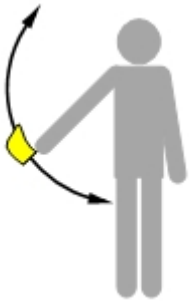


Daily

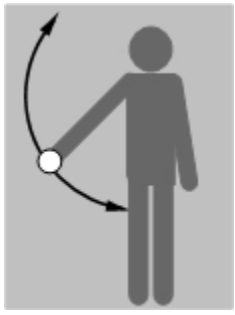
Night

3) Signal Rm3 “Slow down”
On approaching standing rolling stock, the speed of shunting running should not exceed 3 km/h. An officer gives a signal towards a train driver Rm3 “Slow down”:





Daily



Night

4) Signal Rm6 “Force”
Next to a wagon, which is being approached is standing an officer carrying signalling devices. He is supposed to give a signal Rm6 “Force” towards a train driver.

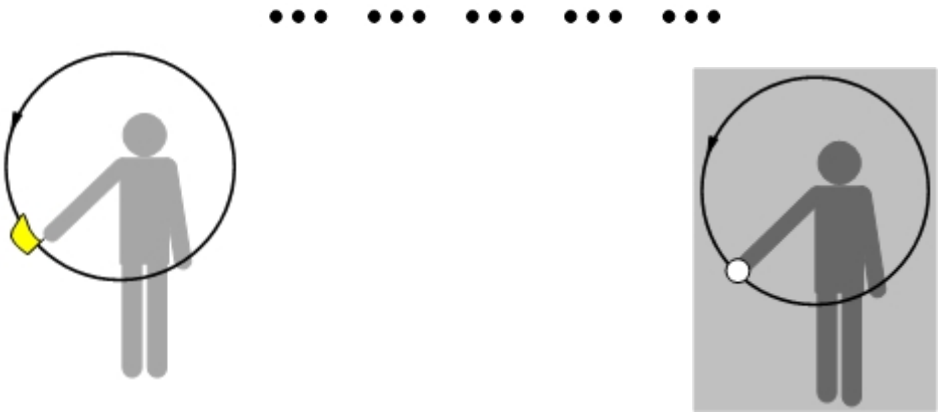
Daily

Night

5) Signal Rm5 ”Throw”
In order to throw wagons, an officer gives a signal Signal Rm5 ”Throw” towards a train driver.

Daily Night

6) Signal Rm 4 “Stop”
While shunting a shunting manager is to stand in such a place that in emergency could give a signal ”Stop”.



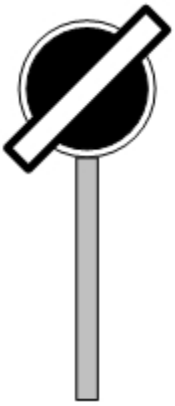
Daily Night

# 8 Marshalling on a marshalling hill.

Marshalling on a marshalling hill is conducted according to signals indicated on a marshalling disc.
According to given signals, a train driver is to comply the following speeds:

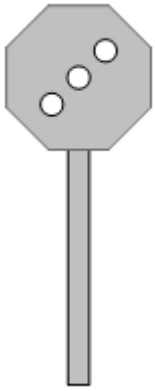
1) 3 km/h – for a signal ”Push slowly”

Shape marshalling discs



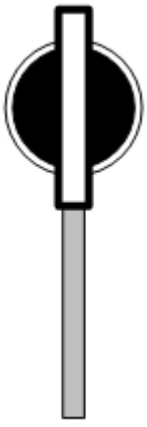
Daily

Night



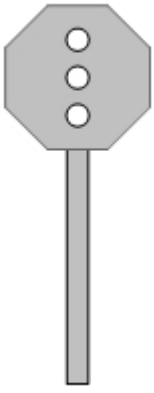
Light

2) 5 km/h – for a signal ”Push with moderate speed”.



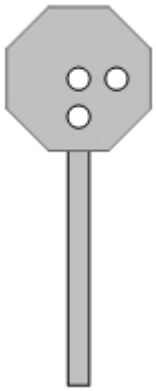
Daily

Night

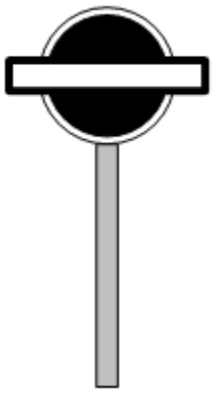


Light

3) Move back rolling stock – for a signal ”Move back”;

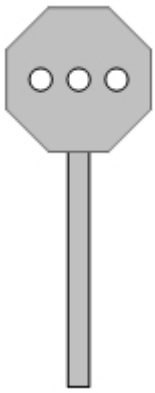


4) ”Stop” .



Daily

Night



Light