

PROPOSED SIGNAL SYSTEM FOR THE NORTHEAST CORRIDOR

Prepared by

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NORTHEAST CORRIDOR IMPROVEMENT PROJECT PROPOSED SIGNAL AND TRAIN CONTROL SYSTEM

PROJECT OBJECTIVES

- **INSTALL NEW SPEED SIGNAL SYSTEM ON ENTIRE CORRIDOR**
- **APPLY REVERSE SIGNALING ON ALL MAINLINE TRACKS**
- **UPGRADE INTERLOCKINGS TO "ALL RELAY" AND INSTALL CENTRAL TRAFFIC CONTROL WHERE FUNDING PERMITS**
 - **WASHINGTON-WILMINGTON WITH CONTROL IN PHILADELPHIA**
 - **NEW HAVEN-BOSTON WITH CONTROL IN BOSTON**
- **REHABILITATE INTERLOCKINGS AND SIGNAL SYSTEM IN OTHER AREAS (WILMINGTON-SHELL)**

SPEED SIGNAL SYSTEM FEATURES

- **PHASE-SELECTIVE TRACK CIRCUITS**
- **CAB SIGNALS**
 - **ALL VEHICLES EQUIPPED WITH FOUR ASPECTS ON 100 HZ CARRIER**
 - **SELECTED VEHICLES (PASSENGER) EQUIPPED WITH SEVEN ASPECTS UTILIZING ADDITIONAL 260 HZ CARRIER**
- **WAYSIDE SIGNALS**
 - **HOME AND DISTANT SIGNALS ONLY**
 - **COLOR POSITION LIGHT TYPE WITH SIMPLIFIED ASPECTS**
 - **FLASHING ASPECTS PROVIDE ALTERNATE OPERATION UNDER ABSOLUTE BLOCK CONDITIONS IN THE EVENT OF CAB SIGNAL FAILURE**

- AUTOMATIC TRAIN CONTROL ON ALL VEHICLES
- HUMAN OPERATION PRIMARY
- AUTOMATED BACKUP WITH:
 - PENALTY STOP ON FAILURE TO ACKNOWLEDGE CAB SIGNAL DROP
 - RECOVERABLE OVERSPEED CONTROL AT PLUS 3 MPH

ADDITIONAL SAFETY/OPERATIONS ENHANCEMENT

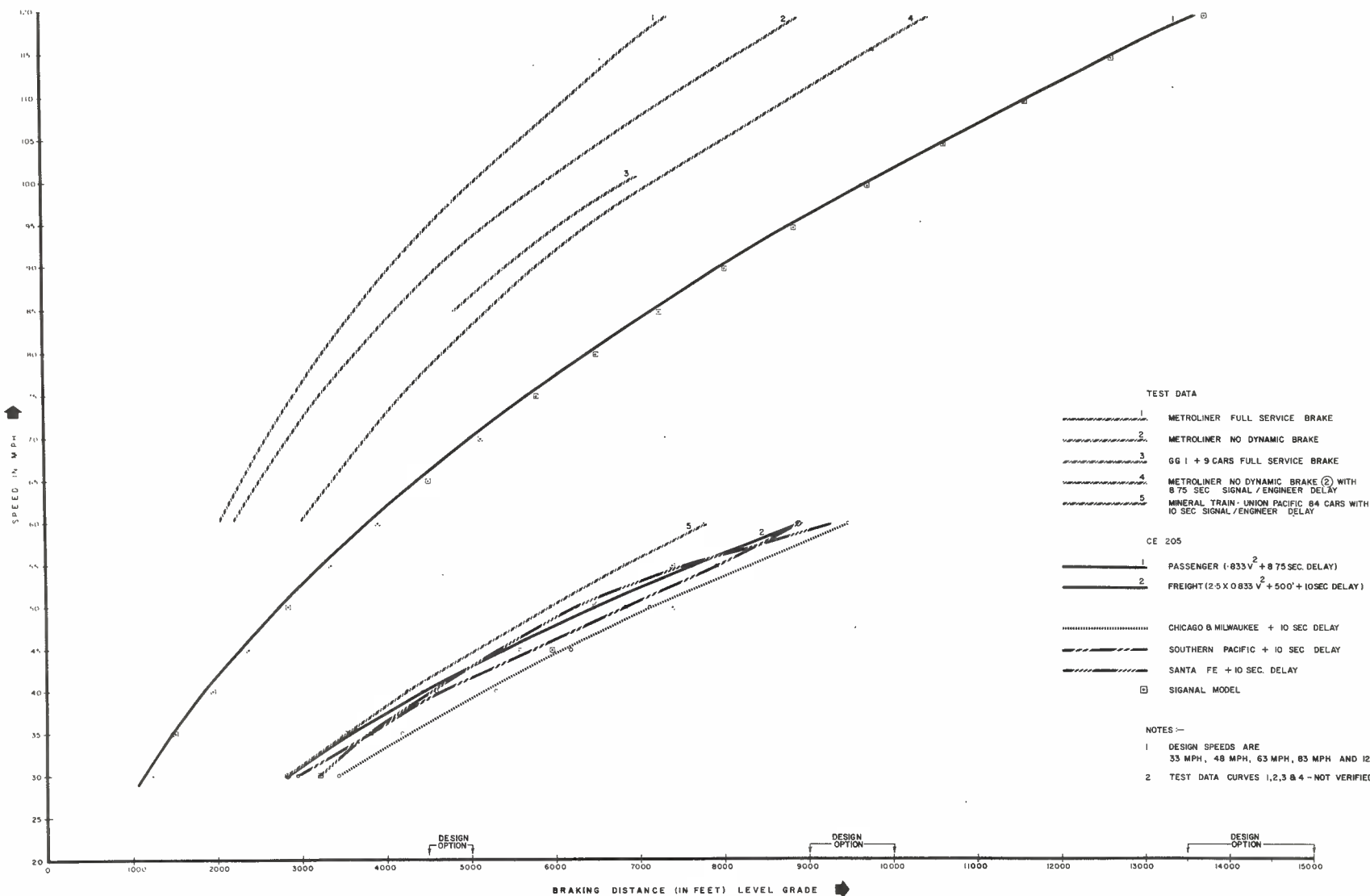
- HAZARD DETECTION EQUIPMENT
 - OVERHEATED BEARINGS
 - LOAD INTRUSION
 - DRAGGING EQUIPMENT
 - LOOSE WHEEL
- POWER-OPERATED OR ELECTRIC-LOCKED SWITCHES ON ALL MAINLINE TRACKS
- SUPERVISORY LOGIC FOR TRACK BLOCKING IN CENTRAL TRAFFIC CONTROL TERRITORY
- EXPANDED RADIO FACILITIES ON THREE FREQUENCIES FOR SEPARATE:
 - TRAIN OPERATION
 - MAINTENANCE-OF-WAY OPERATION
 - POLICE SECURITY

FUTURE DESIGN OBJECTIVES

- EXTEND CENTRAL TRAFFIC CONTROL BETWEEN WILMINGTON AND SHELL
- INCREASE SPEED WITHOUT MAJOR MODIFICATION
- SIGNAL CONTROL OF CIVIL SPEED RESTRICTIONS

SIGNAL SYSTEM RATIONALE

- **NECIP OBJECTIVE IS TO OPTIMIZE PASSENGER TRAIN OPERATION WITHOUT PENALTY TO FREIGHT TRAINS**
- **PASSENGER AND FREIGHT TRAINS OPERATE AT DIFFERENT SPEEDS WITH DIFFERENT BRAKING CHARACTERISTICS**
- **DIFFERENT ASPECTS ARE NEEDED FOR DIFFERENT TYPES OF TRAINS IN THE SAME SIGNAL BLOCK**
- **THE SYSTEM MUST BE COMPATIBLE WITH EXISTING VEHICLE EQUIPMENT**
- **A TWO-FREQUENCY SPEED SIGNAL SYSTEM WITH CAB SIGNALS AND WAYSIDE HOME SIGNALS OFFERS THE NEEDED FLEXIBILITY**
- **A WAYSIDE APPROACH SIGNAL IS REQUIRED TO EXPEDITE HANDLING OF TRAINS WITH FAILED CAB SIGNAL EQUIPMENT**



NORTHEAST CORRIDOR IMPROVEMENT PROJECT
FEDERAL RAILROAD ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

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BRAKING DISTANCE DATA


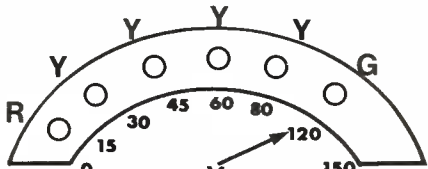

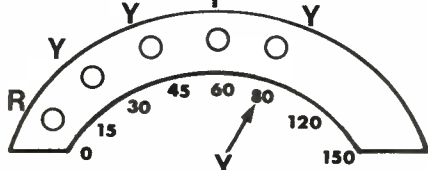
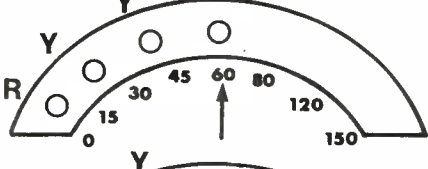

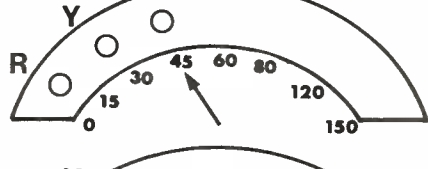
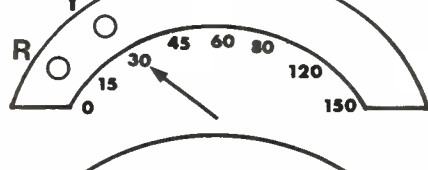

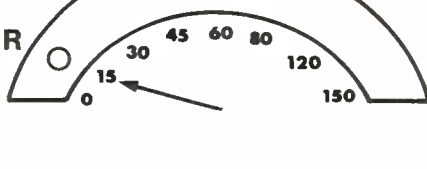
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DRAWING NO

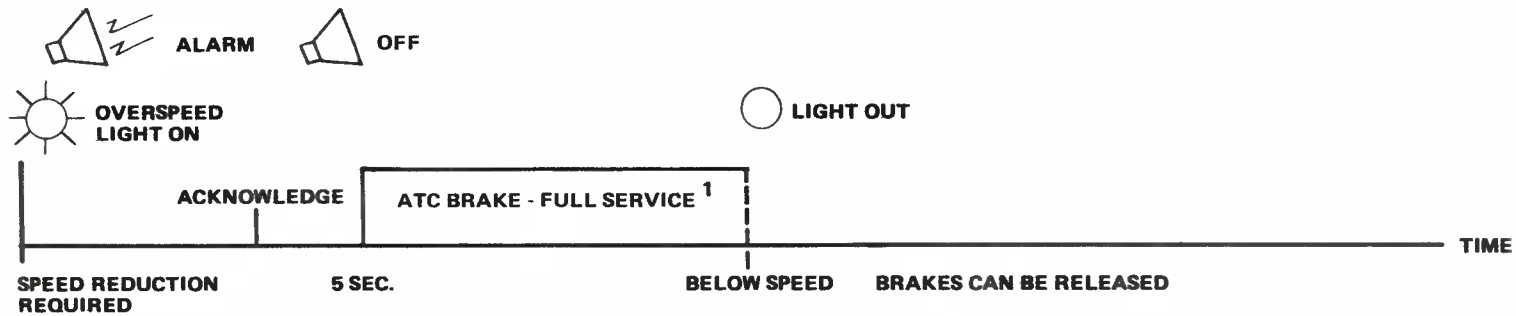
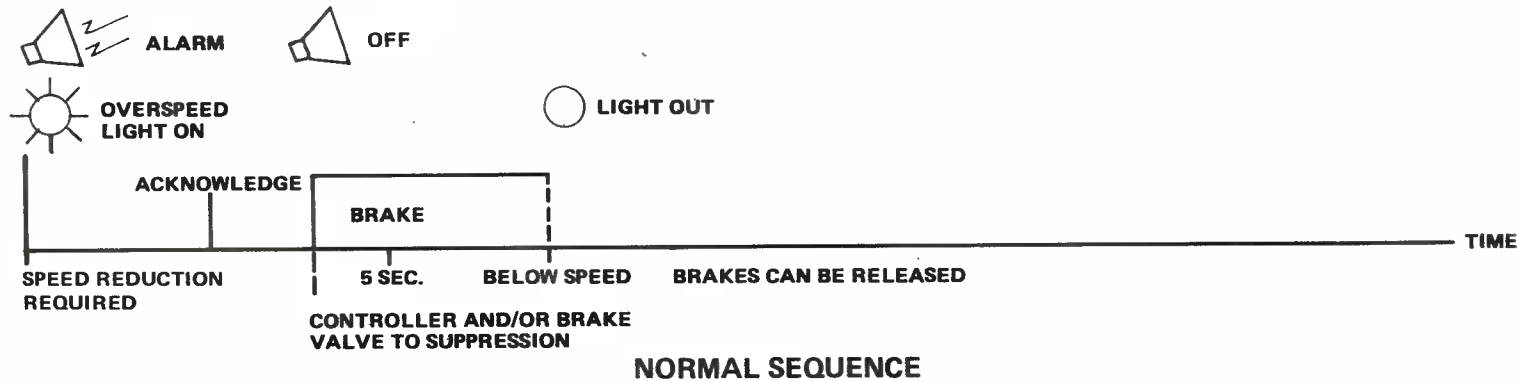
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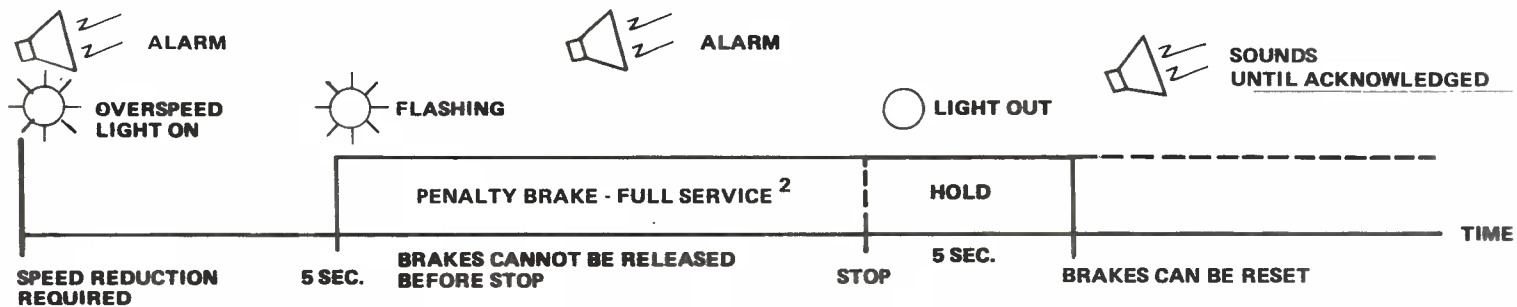
CAB SIGNAL SYSTEM SPEED ASPECTS

TRACK CIRCUIT CODE (PULSES PER MINUTE)		AUTHORIZED SPEED (MPH)	4-ASPECT SYSTEM CAB LIGHT SIGNALS	CAB SIGNAL SPEED ASPECT DISPLAYED		DIGITAL SIGNALS
100 Hz	260 Hz			METROLINER AND AEM 7 SPEEDOMETER SIGNALS	7-ASPECT SYSTEM	
180	180	NORMAL (MAS FOR EQUIPMENT AND TRACK)		FUTURE		N
180	—					
120	120	80				80
75	75	60				60
120	—	45 (LIMITED)				45
75	—	30 (MEDIUM)				30
0 (OR 0 CURRENT)	—	15 (RESTRICTED)				R

CAB SIGNAL WITH ATC AND PENALTY BRAKE

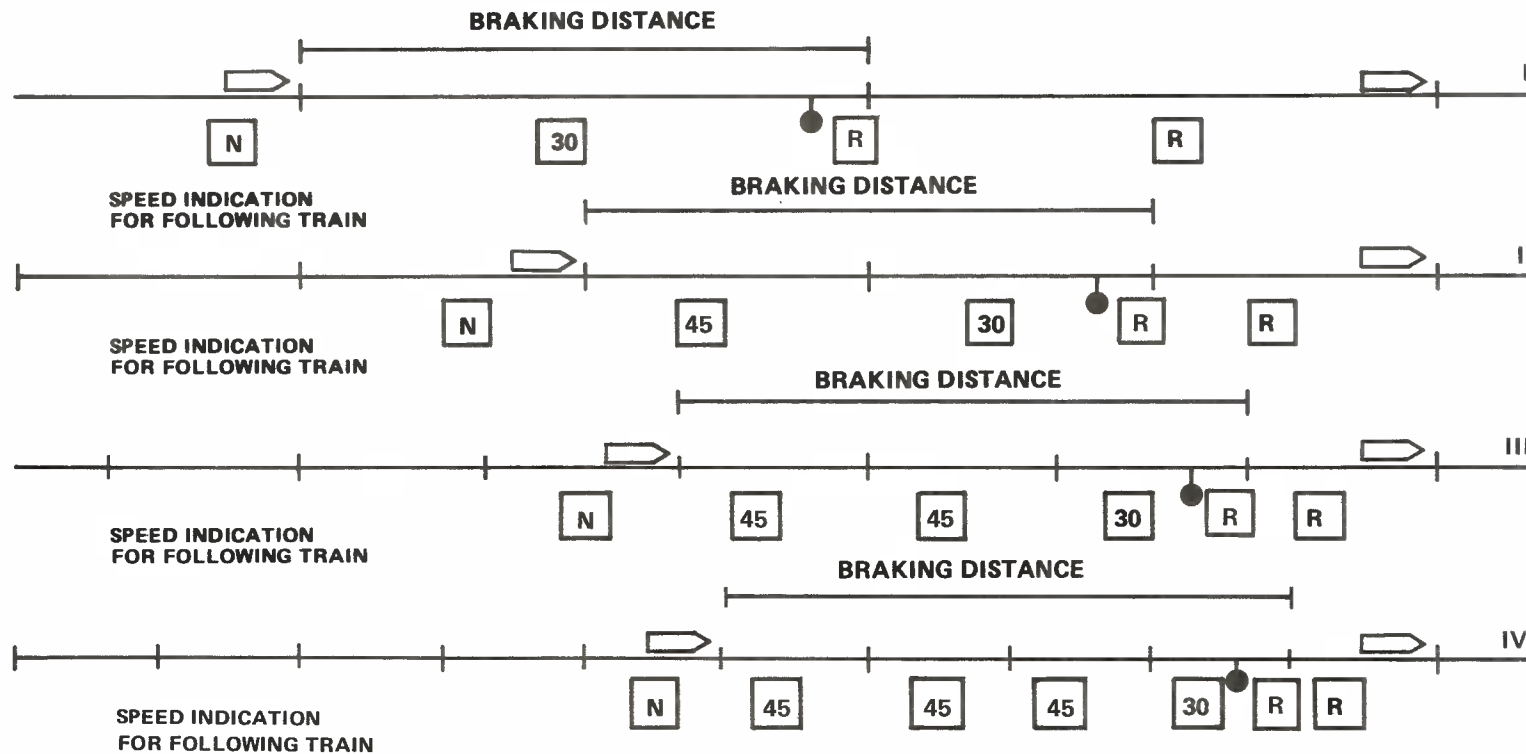


1. FULL SERVICE BRAKE APPLICATION MAY BE DELAYED UP TO 30 SECONDS ON FREIGHT TRAINS BY PARTIAL BRAKE PRESSURE REDUCTIONS.
2. FULL SERVICE BRAKE IS APPLIED BY SPLIT REDUCTION ON FREIGHT TRAINS.



NO ACTION TAKEN BY ENGINEMAN

EFFECT OF NUMBER OF SIGNAL BLOCKS IN BRAKING DISTANCE ON RUNNING TIME BETWEEN TRAINS



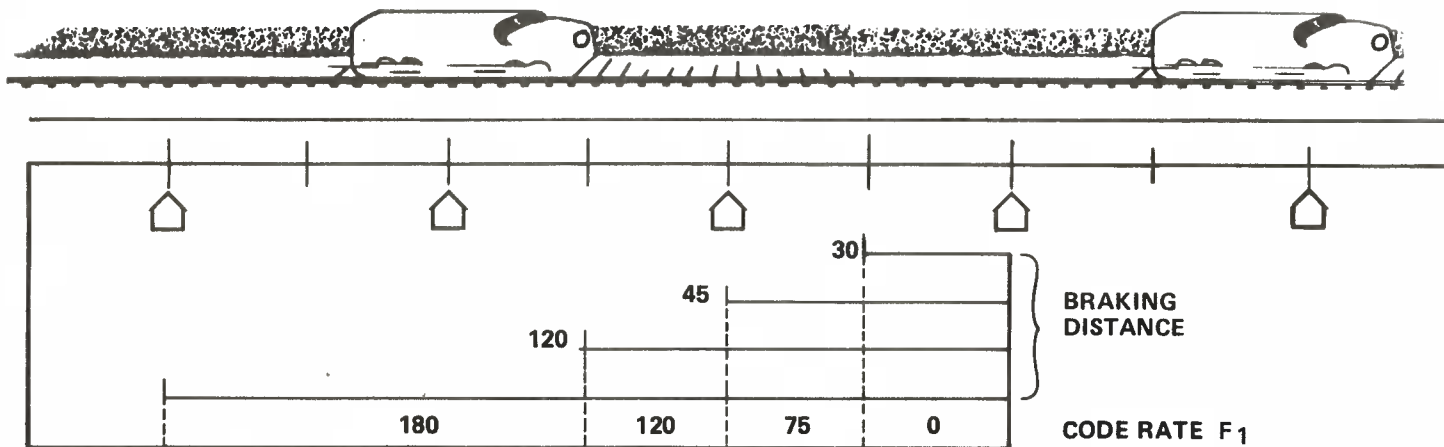
BRAKING DISTANCE ON LEVEL TERRAIN (FEET)	MAXIMUM AUTHORIZED SPEED (MPH)	TIME BETWEEN TRAINS (SECONDS)			
		I	II	III	IV
13856	120	157.45	118.09	104.97	98.41
9730	100	132.68	99.51	88.45	82.93
6482	80	110.49	82.87	73.66	69.06
3885	60	88.30	66.22	58.86	55.18

LEGEND:

+ SIGNAL BLOCK POINT
 [M] MAXIMUM AUTHORIZED SPEED
 [R] RESTRICTED SPEED

— CODE CHANGE POINT LOCATED ON EACH SIDE OF EACH BLOCK POINT
 (ONLY THE CODE CHANGE POINT ACTIVATED IS SHOWN)

AUTOMATIC SPEED SIGNAL SYSTEM WITH FOUR ASPECTS BETWEEN INTERLOCKINGS



N

45

30

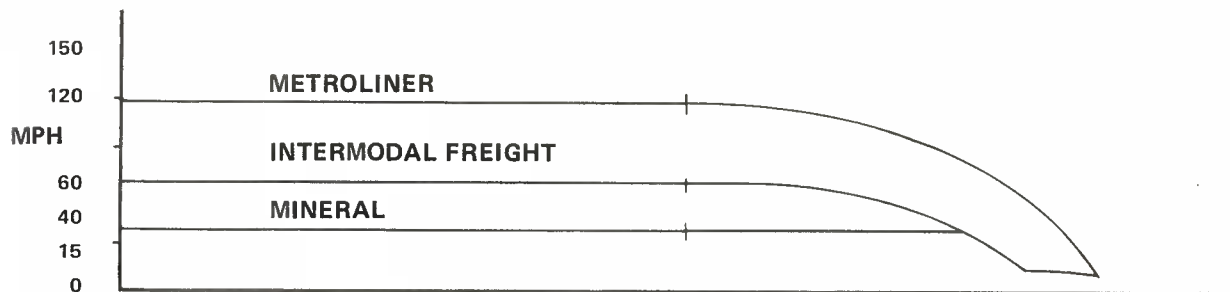
R

R

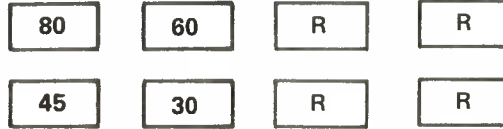
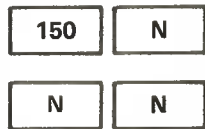
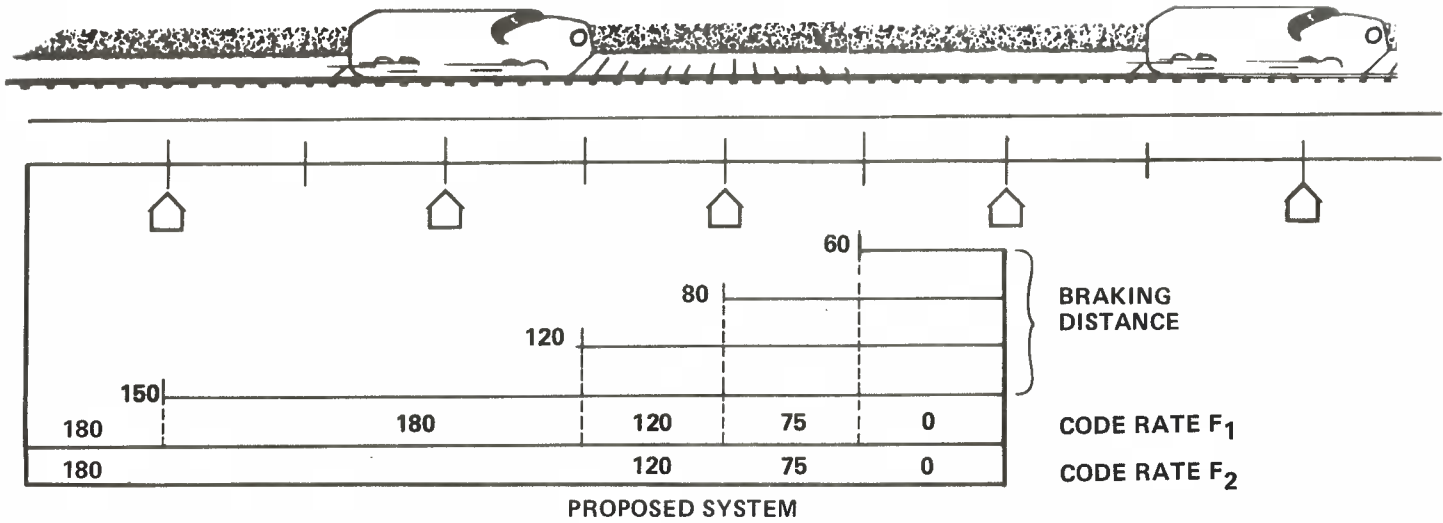
DIGITAL
CAB
SIGNAL



LIGHT
CAB
SIGNAL



AUTOMATIC SPEED SIGNAL SYSTEM WITH SEVEN ASPECTS BETWEEN INTERLOCKINGS

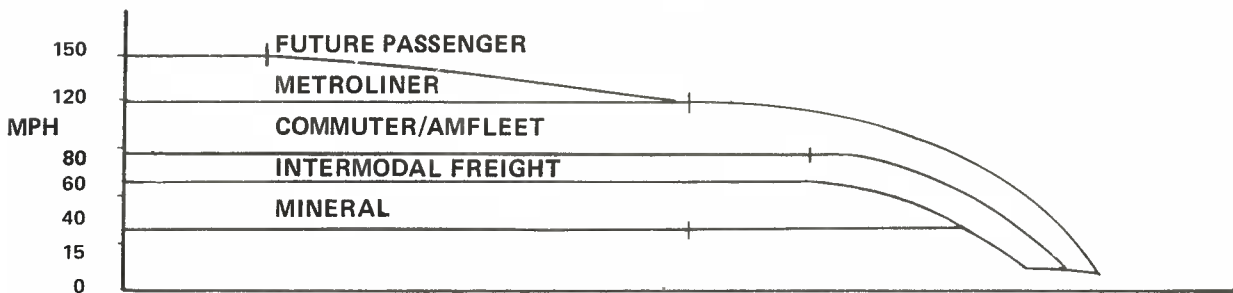


SEVEN-ASPECT
DIGITAL
CAB SIGNAL

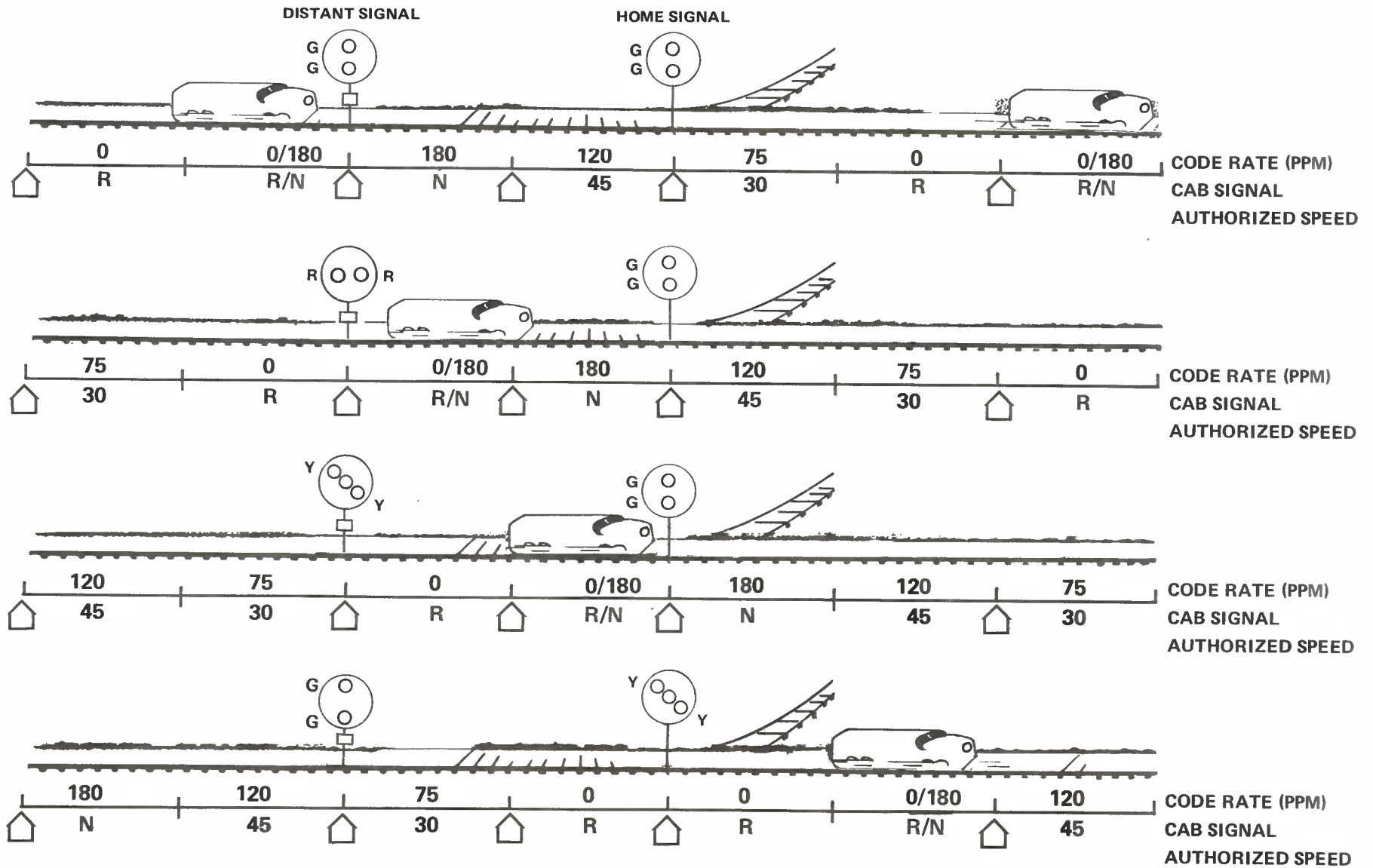
FOUR-ASPECT
DIGITAL
CAB SIGNAL



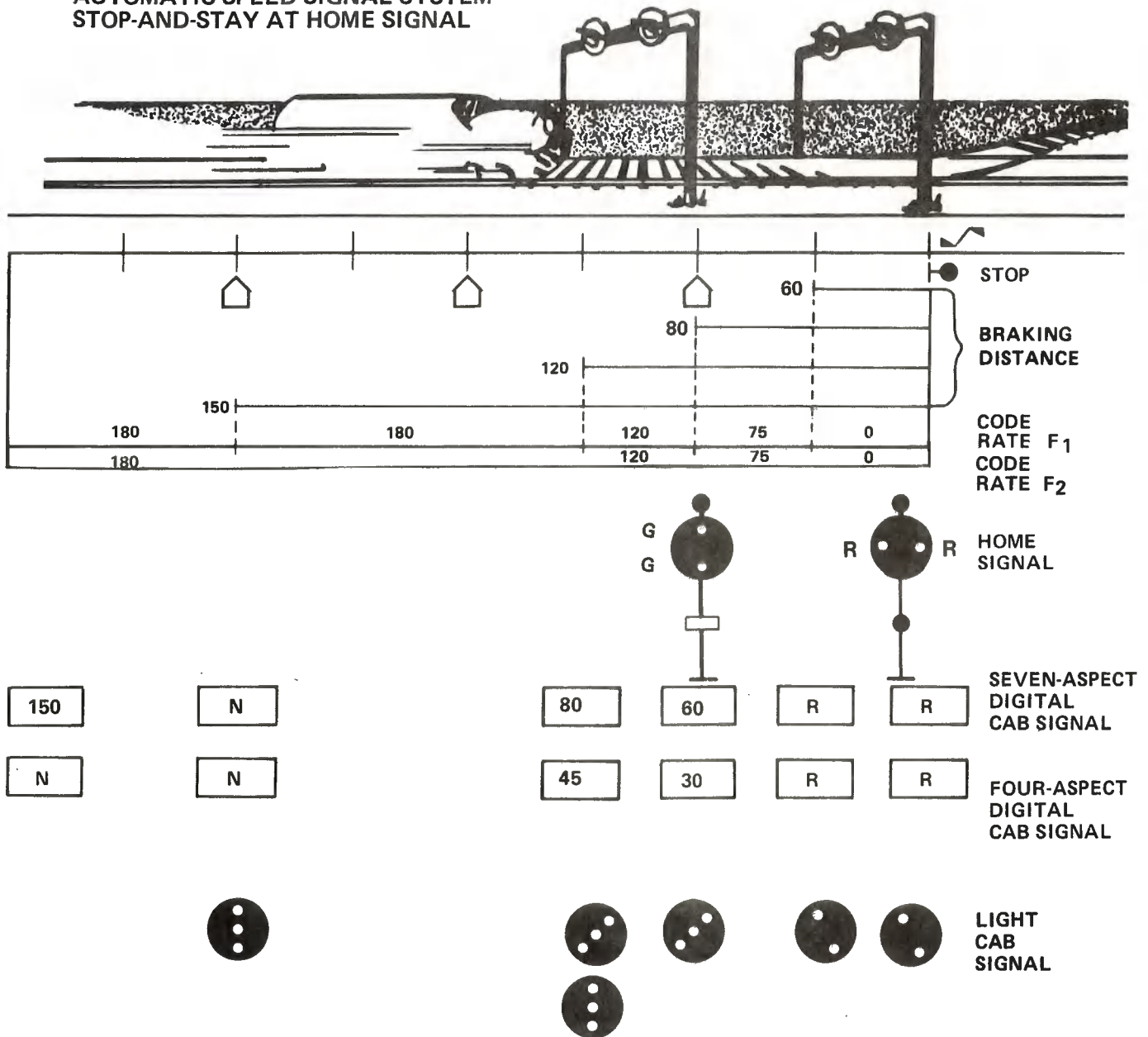
LIGHT
CAB
SIGNAL



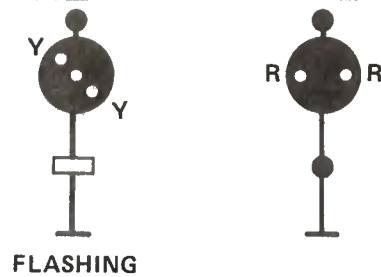
SIGNAL SEQUENCE STRAIGHT ROUTE



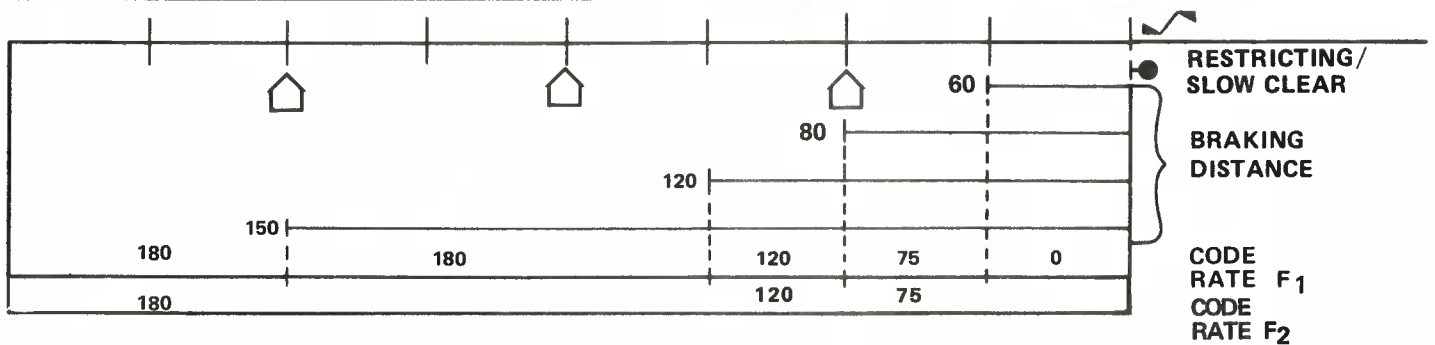
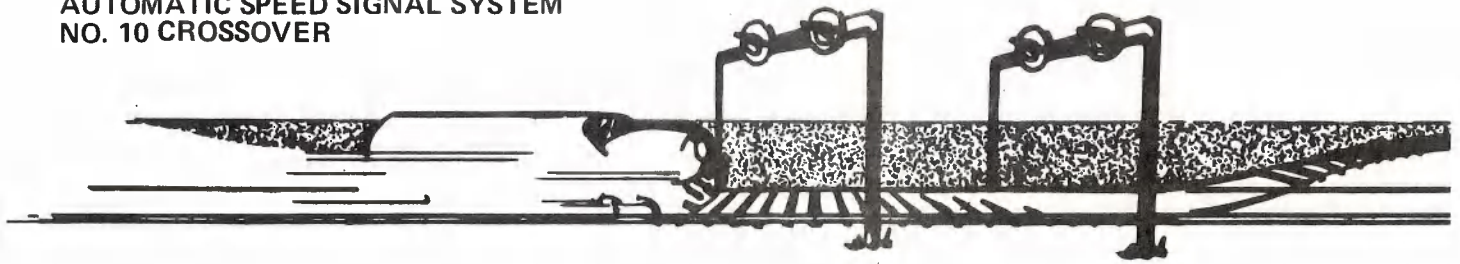
AUTOMATIC SPEED SIGNAL SYSTEM STOP-AND-STAY AT HOME SIGNAL



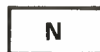
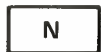
FAILED CAB SIGNAL PROCEDURE



AUTOMATIC SPEED SIGNAL SYSTEM NO. 10 CROSSOVER



SEVEN-ASPECT
DIGITAL
CAB SIGNAL



FOUR-ASPECT
DIGITAL
CAB SIGNAL



LIGHT
CAB
SIGNAL



FAILED CAB SIGNAL PROCEDURE

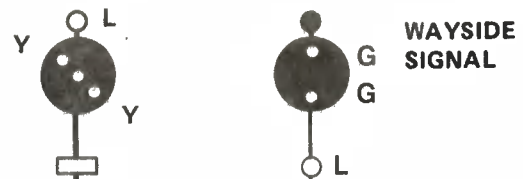
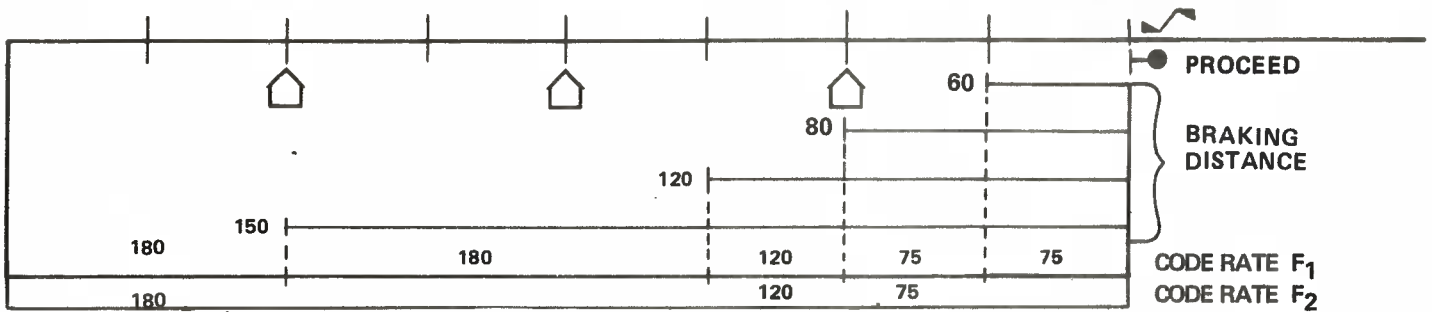
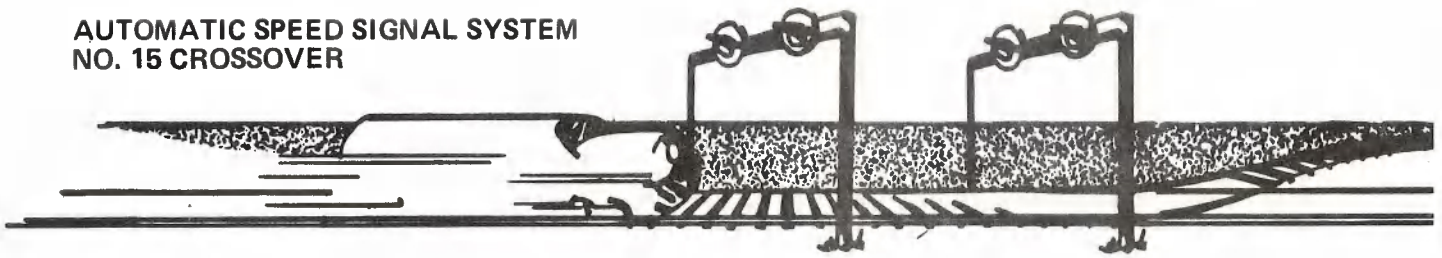


FLASHING



FLASHING

AUTOMATIC SPEED SIGNAL SYSTEM NO. 15 CROSSOVER



150

N

80

60

30

30

**SEVEN-ASPECT
DIGITAL
CAB SIGNAL**

N

N

45

30

30

30

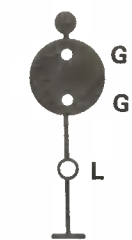
**FOUR-ASPECT
DIGITAL
CAB SIGNAL**



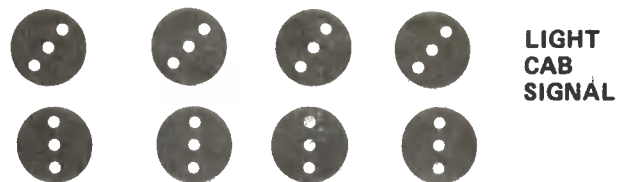
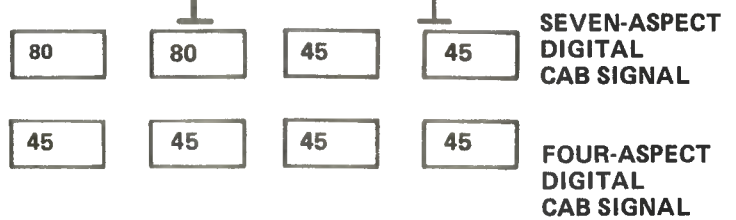
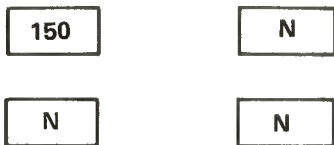
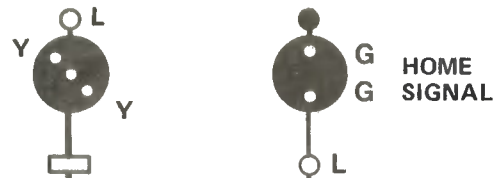
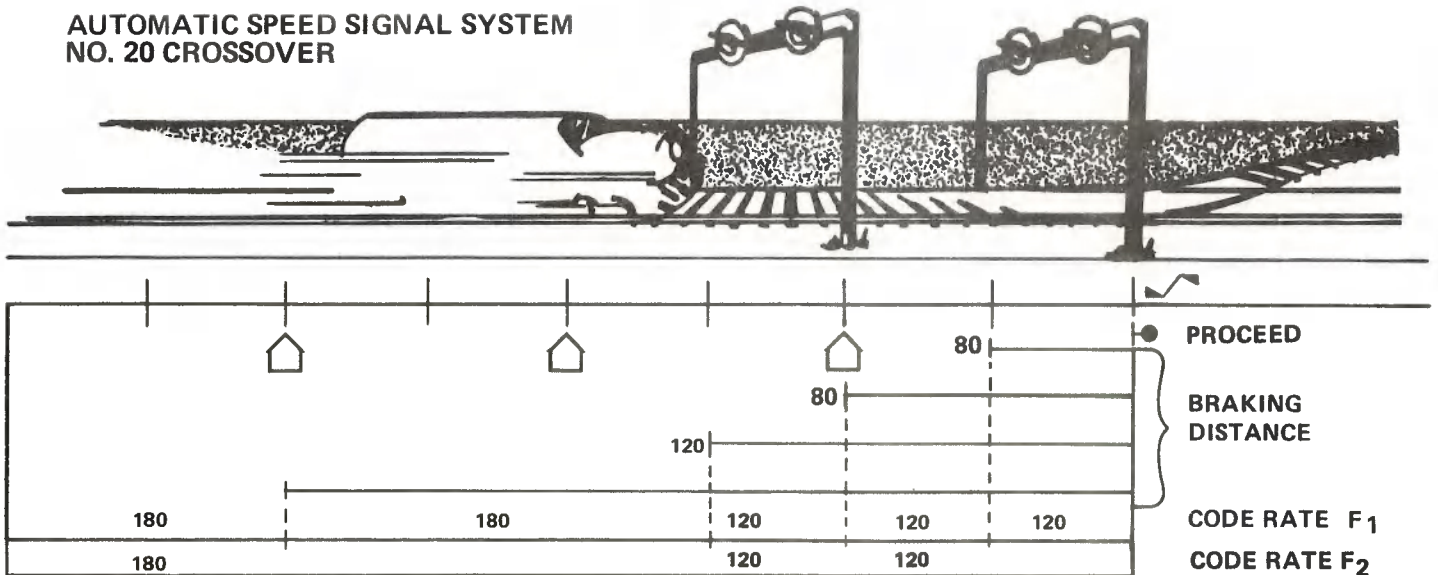
**LIGHT
CAB
SIGNAL**



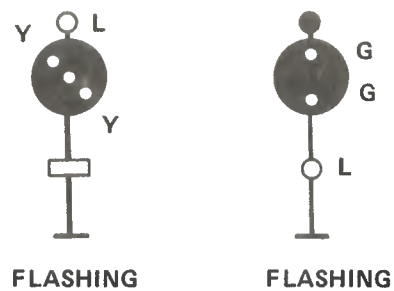
FAILED CAB SIGNAL PROCEDURE



AUTOMATIC SPEED SIGNAL SYSTEM NO. 20 CROSSOVER

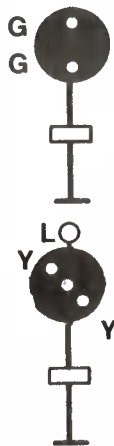


FAILED CAB SIGNAL PROCEDURE

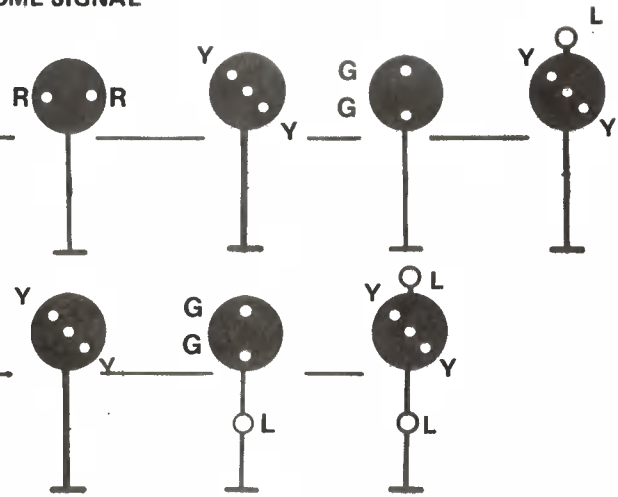


WAYSIDE SIGNAL ASPECTS CAB SIGNALS IN OPERATION

DISTANT SIGNAL



HOME SIGNAL



FIRST BLOCK IN ADVANCE OF SIGNAL
OCCUPIED

MASTER LOCATION

FIRST BLOCK IN ADVANCE OF SIGNAL
CLEAR

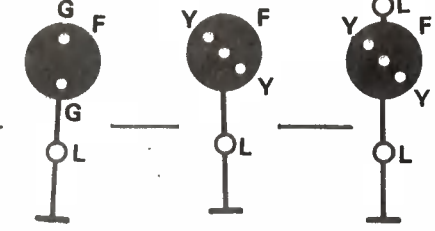
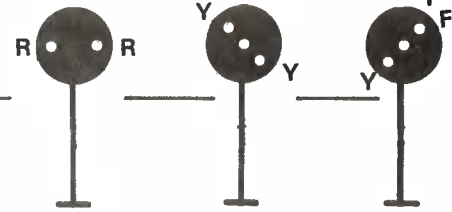
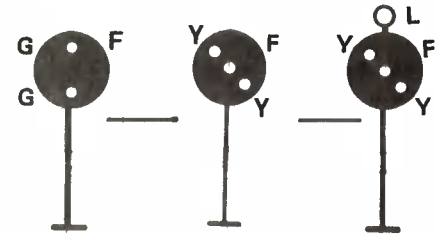
SECOND BLOCK IN ADVANCE OF SIGNAL
OCCUPIED

MASTER LOCATION

FIRST- AND SECOND-TRACK CIRCUIT
IN ADVANCE OF SIGNAL CLEAR
THIRD-TRACK SECTION IN ADVANCE
OF SIGNAL OCCUPIED

MASTER LOCATIONS

F CAB-SIGNAL FAILURE MODE



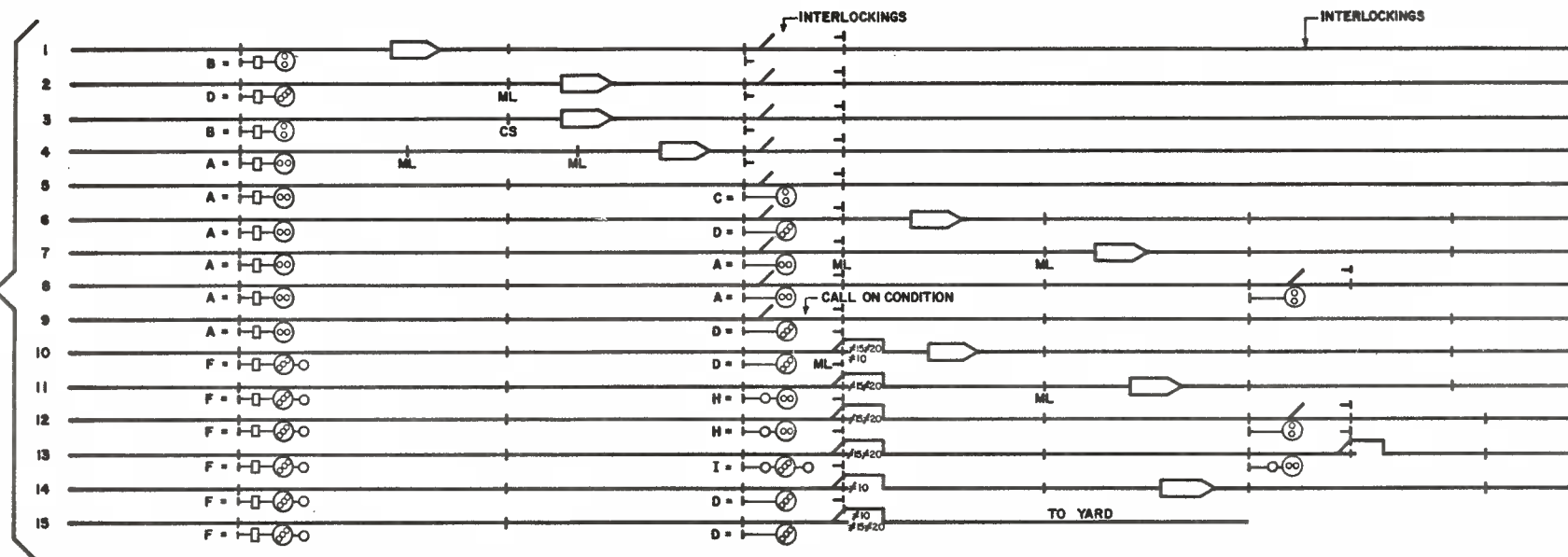
F- FLASHING

L- LUNAR

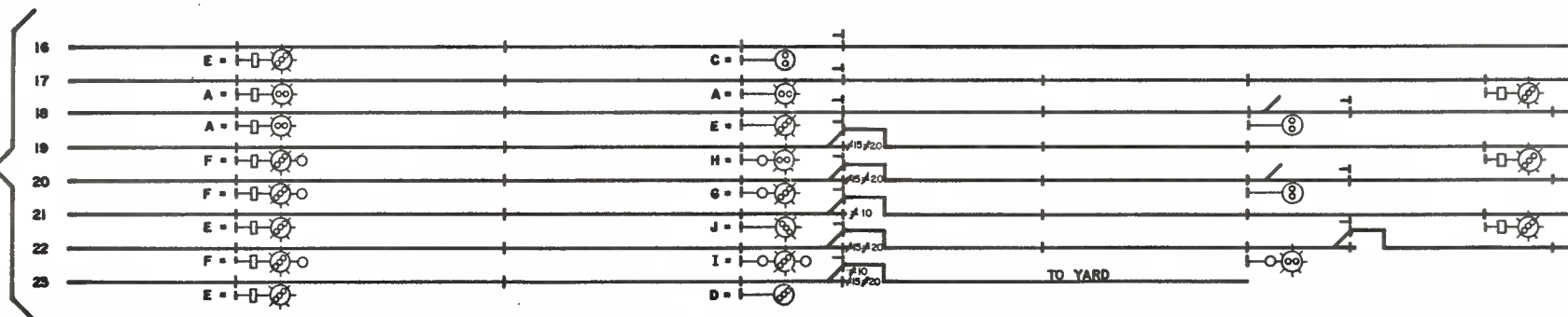
G- GREEN

Y- YELLOW

EQUIPPED



NON EQUIPPED



ASPECT KEY

• FLASHING
ASPECT

- | | |
|---|---|
| A = PROCEED | F = APPROACH DIVERGE |
| B = STOP AND PROCEED | G = DIVERGE APPROACH |
| C = STOP | H = DIVERGE CLEAR |
| D = RESTRICTING | I = DIVERGE APPROACH DIVERGE |
| E = APPROACH NEXT SIGNAL
PREPARED TO STOP. | J = PROCEED - SLOW SPEED WITHIN
INTERLOCKING LIMITS. |

* SUBJECT TO CHANGE IN WORDING