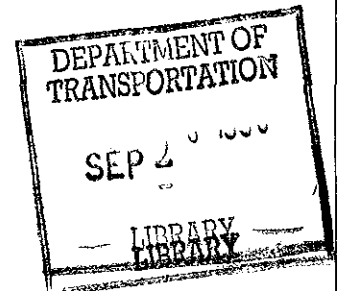


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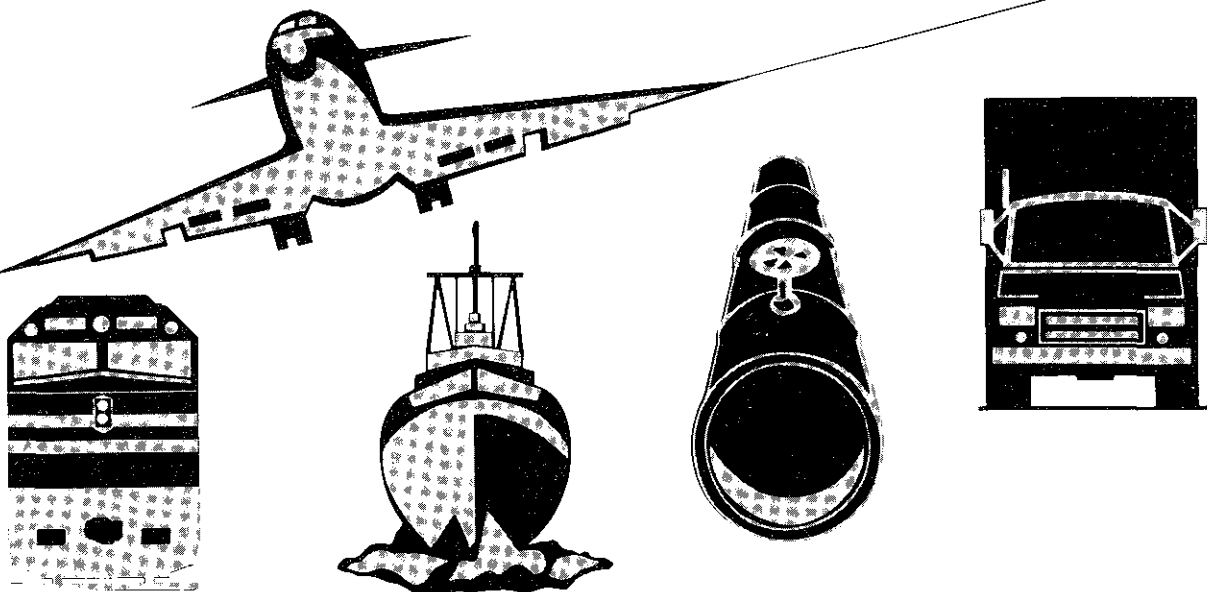
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ATIONAL TRANSPORTATION SAFETY BOARD



RAILROAD ACCIDENT REPORT

**REAR-END COLLISION OF TWO
NEW YORK CITY TRANSIT AUTHORITY TRAINS
103RD STREET STATION
NEW YORK, NEW YORK
MARCH 10, 1989**



TECHNICAL REPORT DOCUMENTATION PAGE

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16 Abstract This report explains the rear-end collision of two New York City Transit Authority trains in New York City on March 10, 1989. The safety issues discussed in the report are train speed, signal system repairs, signal system failure, management of signal department, emergency procedures, and the operator's cab design. Recommendations addressing these issues were made to the New York City Transit Authority.			
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EXECUTIVE SUMMARY

About 5:05 a.m. eastern standard time on March 10, 1989, two New York City Transit Authority (NYCTA) trains were involved in a rear-end collision. Train 3A, a revenue collector train was in the station at 103rd street station, New York City, New York. Train 428 entered the station area and collided with the standing train 3A. Train 428 had received green/clear signal indications as it approached and entered the station. Inspection of the signal system at the 103rd street station following the accident revealed that a jumper wire had been installed and tucked away (out of easy sight) in the circuit rack of the 204 circuit (the track circuit at which train 3A was located at the time of collision). Further inspection revealed that two track wires were broken in the 204 track circuit, eliminating the connection between the relay and the negative rail and the transformer and the negative rail. Three crewmembers and 38 passengers were injured as a result of the accident. The estimated damage as a result of this accident was \$360,000.

The major safety issues in the accident include:

- o excessive speed of train 428 entering the station;
- o the lack of a speedometer or other reliable method to determine speed of a subway train;
- o improper repairs to the signal system, a jumper wire used instead of proper maintenance repairs;
- o NYCTA management failure to enforce prompt permanent repairs to track circuit;
- o failure of signal personnel to record incidents of failure of the signal system;
- o lack of information for passengers of emergency procedures;
- o NYCTA management oversight failure to detect improper procedures in the signal department;
- o the design of the train operator's cab that did not allow a means to escape following an accident.

The National Transportation Safety Board determines that the probable cause of this accident was the improper application of a jumper wire in the signal circuit. Contributing to the cause of this accident was the failure of NYCTA management to require proper repairs to the signal circuit in a timely manner. Contributing to the severity of the accident was the operation of train 428 into the 103rd Street Station at a speed in excess of the posted speed, in part, as a result of the failure of the NYCTA management to furnish a reasonable means for operators to determine speed.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: March 13, 1990

REAR-END COLLISION
OF TWO NEW YORK CITY TRANSIT AUTHORITY TRAINS
103RD STREET STATION
NEW YORK, NEW YORK
MARCH 10, 1989

INVESTIGATION

The Accident

On March 10, 1989, New York City Transit Authority (NYCTA) 2-car revenue collector train 3A had been collecting and delivering receipts and tokens to the token booths at stations along various lines of the NYCTA system. Train 3A had been placed on the number 1 IRT line at 137th Street terminal at 4:35 a.m. (eastern standard time) to travel southbound on track 1 following the 0408/IRT (408), a 10-car subway passenger train and preceding the 0428/IRT (428), a 10-car subway passenger train (see figure 1). Train 3A stopped at each station to allow the on-board personnel to pick up receipts and tokens; this required the train to remain in a station for about 5 minutes. After continuing southbound, train 3A made a normal stop at the 103rd Street Station about 5:00 a. m., and the on-board employees began their delivery and collection of cash and tokens.

Meanwhile, train 428 had departed the 242nd Street terminal at 4:28 a.m., 20 minutes behind train 408, as scheduled. Train 428 which was making all the local station stops, had about 500 passengers on board; normally the train was in each station about 10 to 15 seconds. According to the operator of train 428, which made a normal station stop at 110th Street station, the train departed and continued southbound on track 1 attaining a speed of about 35 mph¹ (the authorized speed) as it moved from the station at 110th street to the 103rd Street station. The operator of train 428 stated that as he approached the 103rd Street Station he first received a green/clear signal (signal 244) indication 240 feet north of the station and a green/clear signal (signal 224) indication 45 feet north of the station platform. The operator stated that, as the train entered the station at a speed he estimated at 18 mph, he was preparing to make a stop, he was also

¹NYCTA trains do not have speedometers and the train operator estimated the speed of his train based on his experience

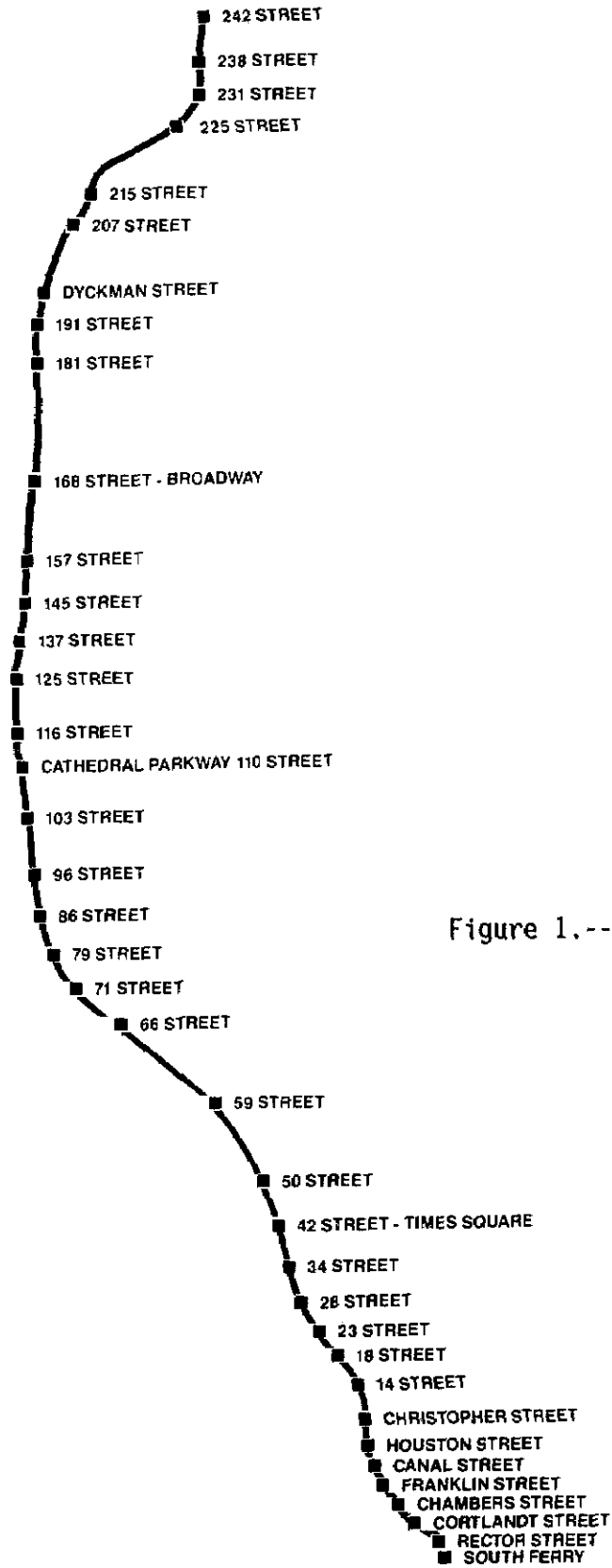


Figure 1.--Map of NYCTA Line Number 1.

watching for a repeater signal on the left side of the track structure as the train moved along the station platform. Then, as the train rounded the 4-degree curve to the right, he saw a standing train 2 car lengths ahead (about 130 feet) and he put the train brakes in emergency using the brake valve handle. However, before he could stop the train it collided with the standing train (see figure 2).

Injuries

	Crews		Passengers		Total
	Train 428	Train 3A	Train 428	Train 3A	
Fatal	0	0	0	0	0
Serious	0	1	0	0	1
Minor	1	1	38	0	40
None	<u>1</u>	<u>0</u>	<u>462</u>	<u>14</u>	<u>477</u>
Total	2	2	500	14	518

The data is based on an estimated 500 passengers provided by NYCTA.

Damage

Of the 10 cars of train 428, only the lead car sustained major structural damage. The end door was buckled, sheet metal was torn, and the door was pushed inward 6 inches. The left front of the car was deformed rearward 14 inches and the roof panel was separated from the left front corner. The sheet metal on the left corner was separated from the side, a vertical frame member was deformed and the left front window was displaced rearward 2 inches.

Damage to train 3A was confined to the rear end of the last car. The damage occurred to the undercarriage and floor near the center and extended from the rear end of the car inward 51 inches.

Seven load bearing columns in the station located adjacent to the track structure were heavily damaged. The columns are constructed of I-beams, measuring 10 inches in width and secured to concrete bases at the bottom. It was necessary for NYCTA to make temporary repairs, timbers measuring 12 inches by 12 inches were set in place adjacent to each side of the damaged columns, to support the street above. Subsequently, two columns were replaced and five repaired.

Track damage was limited to a guard rail, tie plates, and spikes struck by a derailed wheel.

Estimated damage was:

Equipment	\$296,000
Track	56,000
Structure	<u>8,000</u>
Total	\$360,000

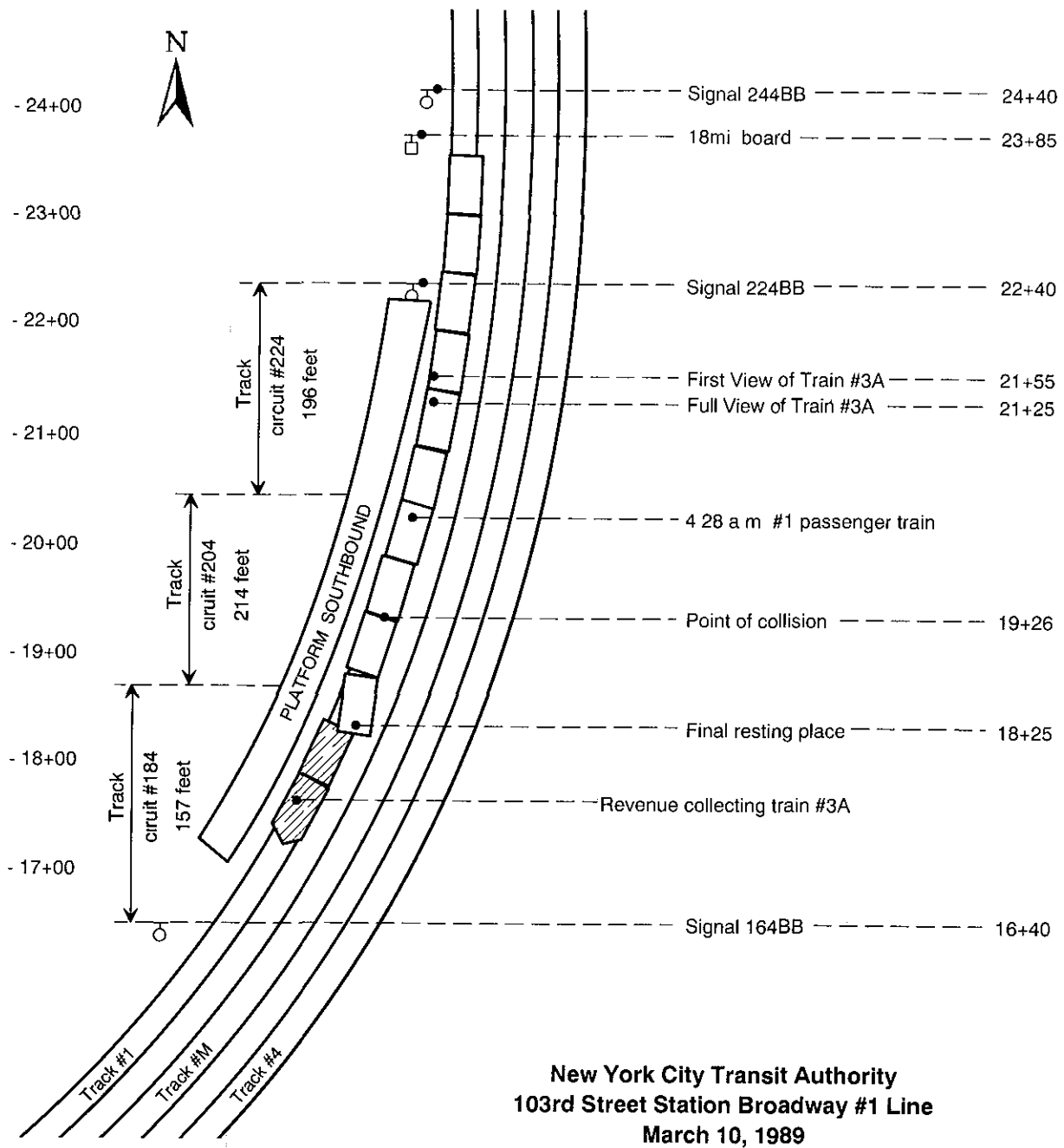


Figure 2.--Accident Site.

Signals

The NYCTA uses a train control system with an automatic block signal system to direct the movements of trains. The signal system includes a three-color light displaying green, which indicates clear; or yellow, which indicates approach; or red, which indicates stop. The signal system constructed in 1912 is designed so that generally, the two signals immediately behind a train display red and the third signal behind a train displays yellow (see figure 3). There are three track circuits for track 1 in the 103rd Street Station; track circuit 184, which is 157 feet long, track circuit 204, which is 214 feet in length, and track circuit 224 which is 196 feet long. The station platform is about 500 feet in length. At the 103rd Street Station, the three block protection (two red signals and one yellow signal) is not always provided. When a train enters the 103rd Street Station, track circuit 224 will provide the three block protection as described and if the train proceeds into the track circuit 204 or overlaps from 204 into 244 the system is designed to still provide the three block protection. However, if the train moves into track circuit 184 and does not overlap into 204 the system is designed so that signal 224 at the entrance to the station will remain red, but signal 244 will be yellow, providing only a two block protection (see figure 4). Train 3A was completely within track circuit 204 at the time of the accident.

The train control is an automatic system utilizing trip arms located outside the rail adjacent to the signal. The system is designed so that when a signal is red, indicating stop, the trip arm raises. If a train fails to stop at a red signal, a brake valve tripper on the lead car will strike the raised trip arm of the signal system automatically placing the train brakes in emergency.

The track circuits are designed so that when a track circuit is unoccupied, current flows from the transformer through a resistor, a fuse and electrical wire to the positive (signal) rail, then through electrical wire, a fuse, a resistor, and a relay to the negative (propulsion) rail, and then again through electrical wire to the transformer; much of electrical wire is routed through the concrete inverts which support the tracks. When the relay is energized the signal system will display a clear indication (see figure 5). When a set of wheels are on the rail, the track circuit is shunted. Thus, current will not flow to energize the relay and the signal system will display a stop indication (see figure 6).

Inspection of the signal system at the 103rd street station following the accident revealed that a jumper wire had been installed between the transformer and the relay and tucked away (out of easy sight) in the circuit rack of the 204 circuit (the track circuit at which the train 3A was located at the time of the collision). With either of the negative relay or feed wires broken, current flow through the negative rail would be eliminated causing the relay to deenergize and the signal system to display a stop indication. However, with the jumper wire in place, current would still flow through the relay and the signal system would indicate clear when no train is

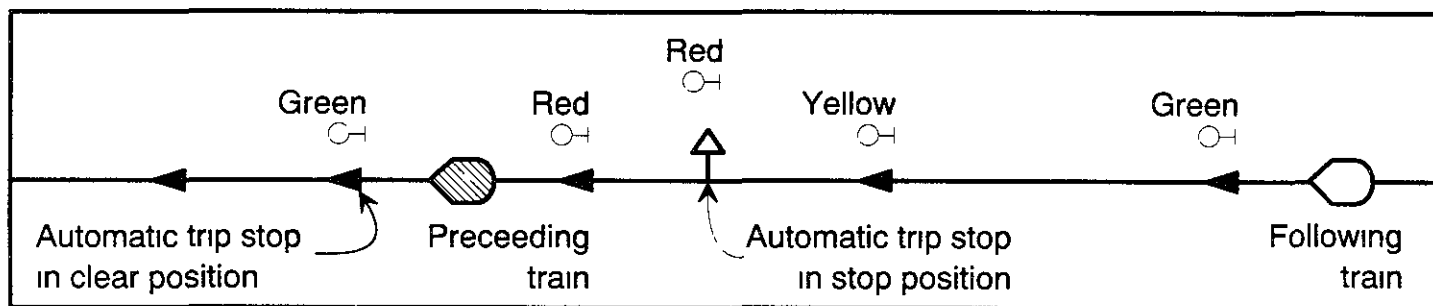


Figure 3.--Tripper and Signal Indications.

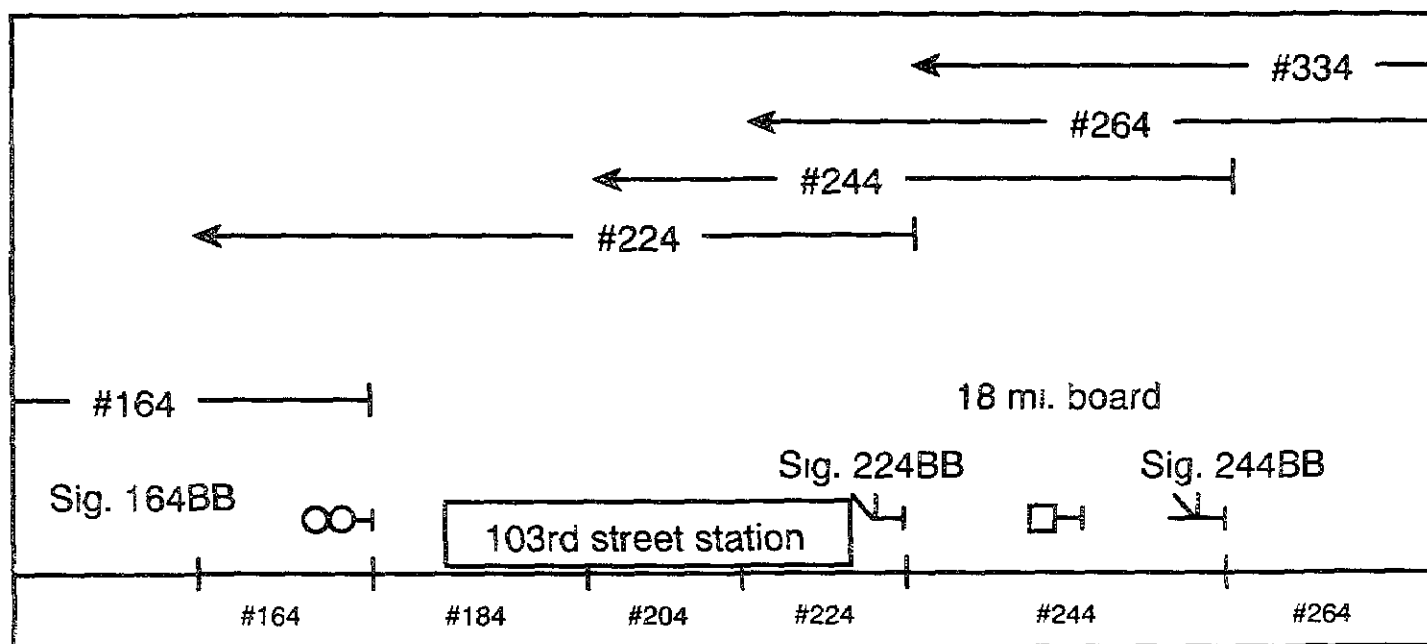


Figure 4.-- Track Circuits in 103rd Street Station.

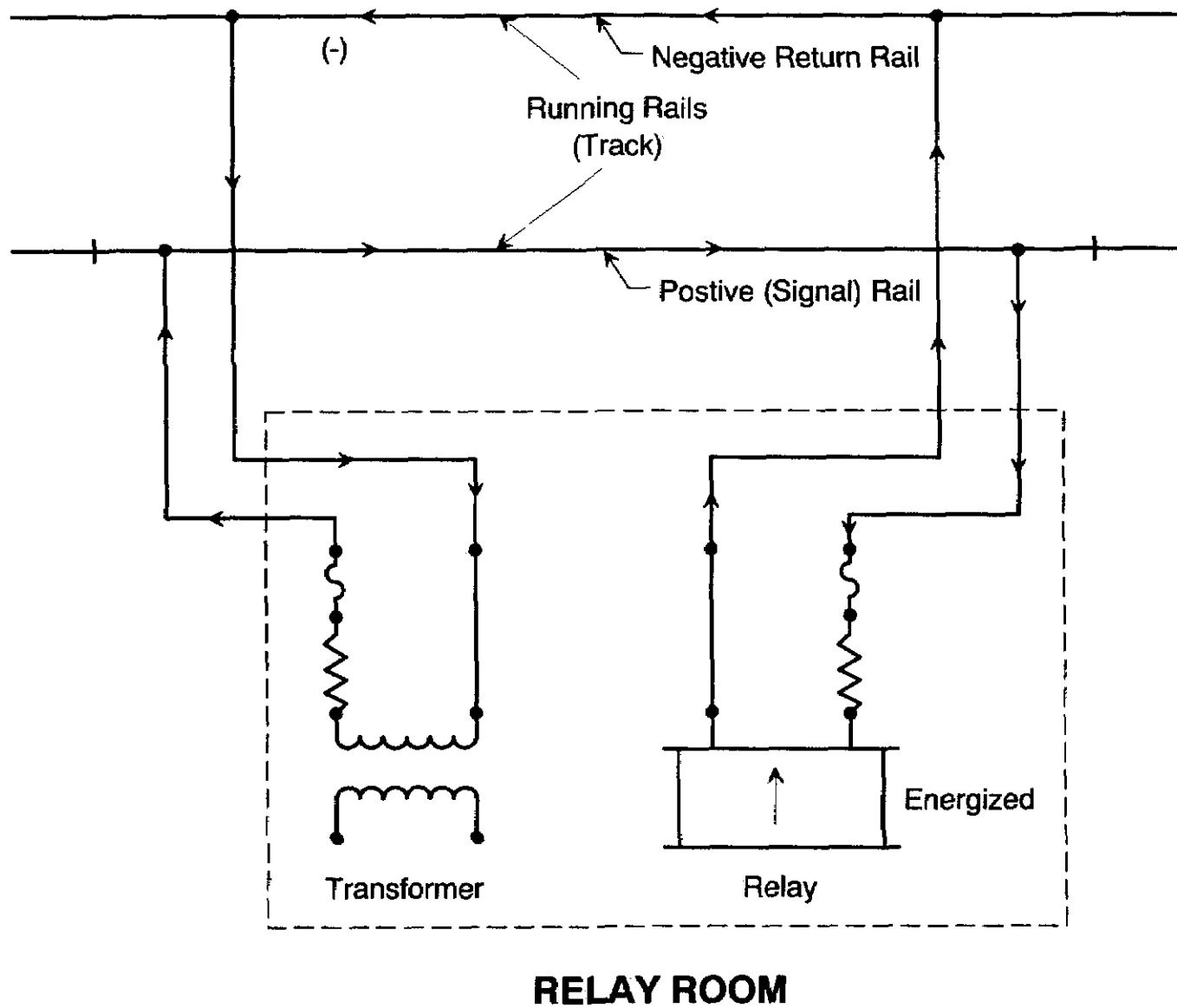


Figure 5.--Energized Signal Circuit.

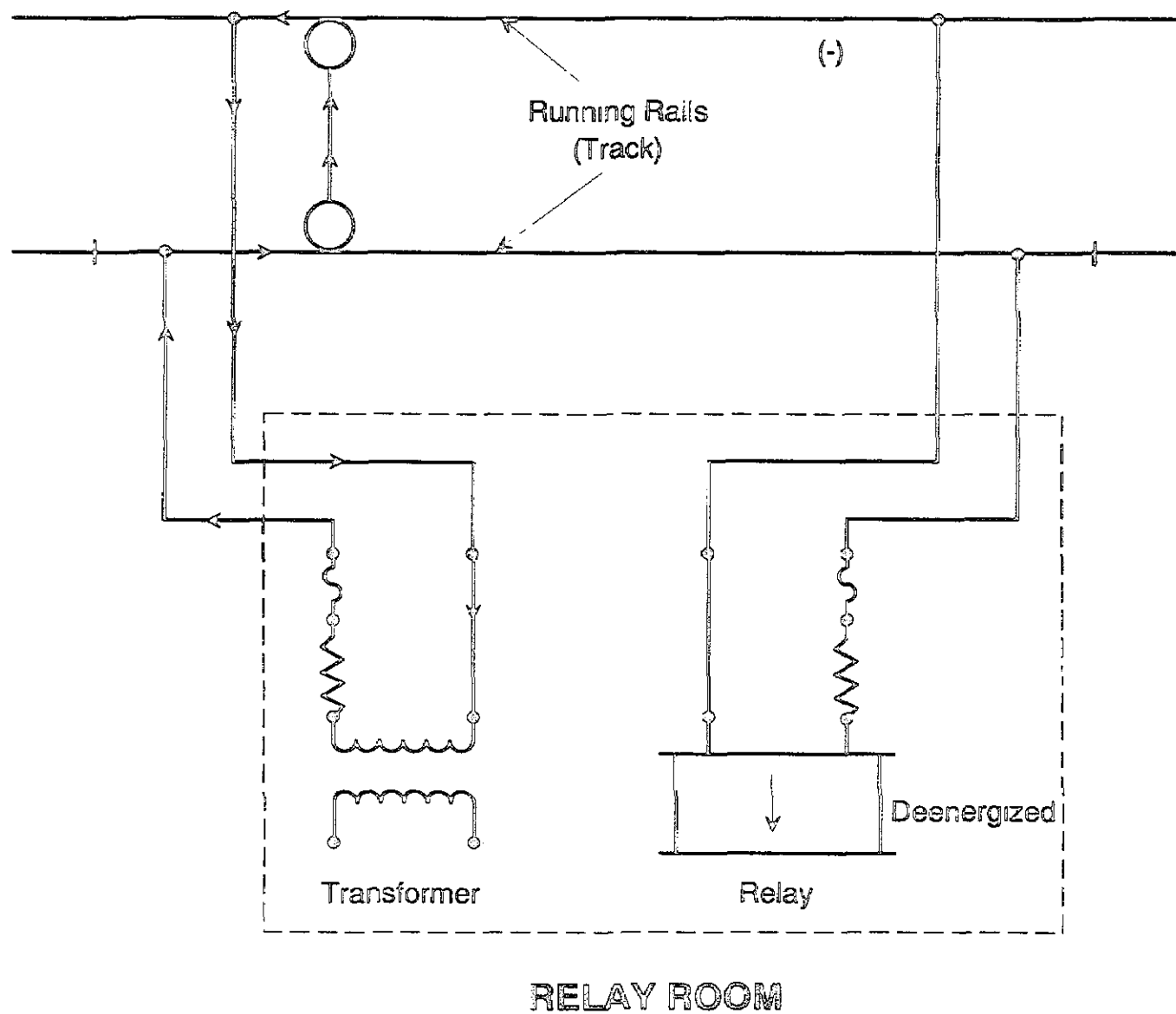


Figure 6.-- Track Circuit Shunting.

present (see Figure 7). Also, with the jumper wire in place, train wheels would still shunt the circuit removing the current to the relay, the relay would be deenergized and the signals would display a stop indication.

Further inspection revealed that both the negative feed wire and the negative relay wire were broken in the 204 track circuit, eliminating the connections between the relay and the negative rail and the transformer and the negative rail (see figure 8).

However, with both negative wires broken, any connection to the negative rail is eliminated and the current is directed through the jumper wire energizing the relay. Thus, with both negative rail wires broken and a jumper wire in place the wheels of a train would not shunt the current flow to the relay, the relay would remain energized, and the signals would display a clear indication (see figure 8). Following the accident a second jumper wire applied in the same manner as the one on circuit 204, was found on the next track circuit 224. Additionally another jumper wire, installed in the same manner, was found at the 116th Street station on track circuit 534. All three of these jumper wires were in the same signal maintenance district.

Method of Operation

NYCTA trains are operated on the number 1/IRT line by signal indications of the automatic block signal system, by timetable, and by NYCTA rules and regulations governing employees engaged in the operation of the New York City Transit system. On portions of its rail system, the NYCTA controls train speed by using signals that are time controlled. However, on the portion of the system where the accident occurred the signals are not time controlled.

Headway (the time interval between trains departing original terminal and to be maintained while en route) at the time of the accident was scheduled to be 20 minutes. The 20-minute headway schedule was reduced when train 3A was inserted into the route between trains 408 and 428. Mid-day headway for trains on this line is 3 to 5 minutes. Collector trains do not operate on a fixed schedule, and are placed on a rail line on a random basis; collector train operations are not published for security reasons.

Each time train operators and conductors report for duty they are required by the rules to sign a register for payroll purposes, read the current general orders, and review all bulletin board notices. The rules also require that after boarding their trains the crewmembers make a rolling resistance brake test.

Trains operating on the number 1/IRT line between 242nd street and South Ferry are under the supervision of a desk superintendent located at the NYCTA command center in Brooklyn, New York. The desk superintendent has oversight responsibility of train operations on the six IRT lines. There are also four console operators monitoring train operations on the six IRT lines; to assist them they have a model board that shows when trains are at certain locations on the line. They are also in radio contact with train operators and train dispatchers at 17 locations along the line. The train dispatchers at the 17

TYPICAL TRACK RELAY CIRCUIT

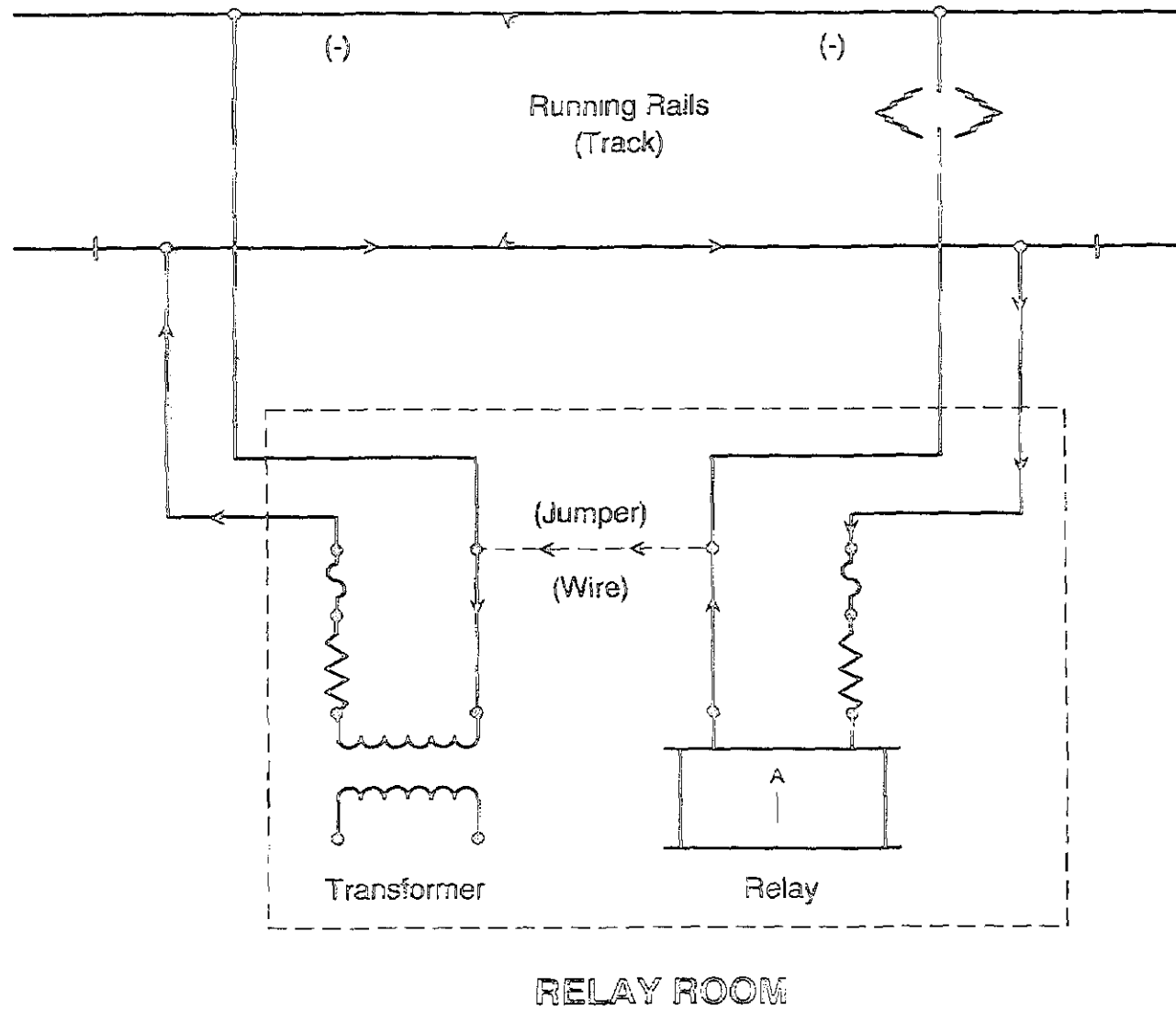


Figure 7 --Signal System Displays Clear With Jumper Wire Applied.

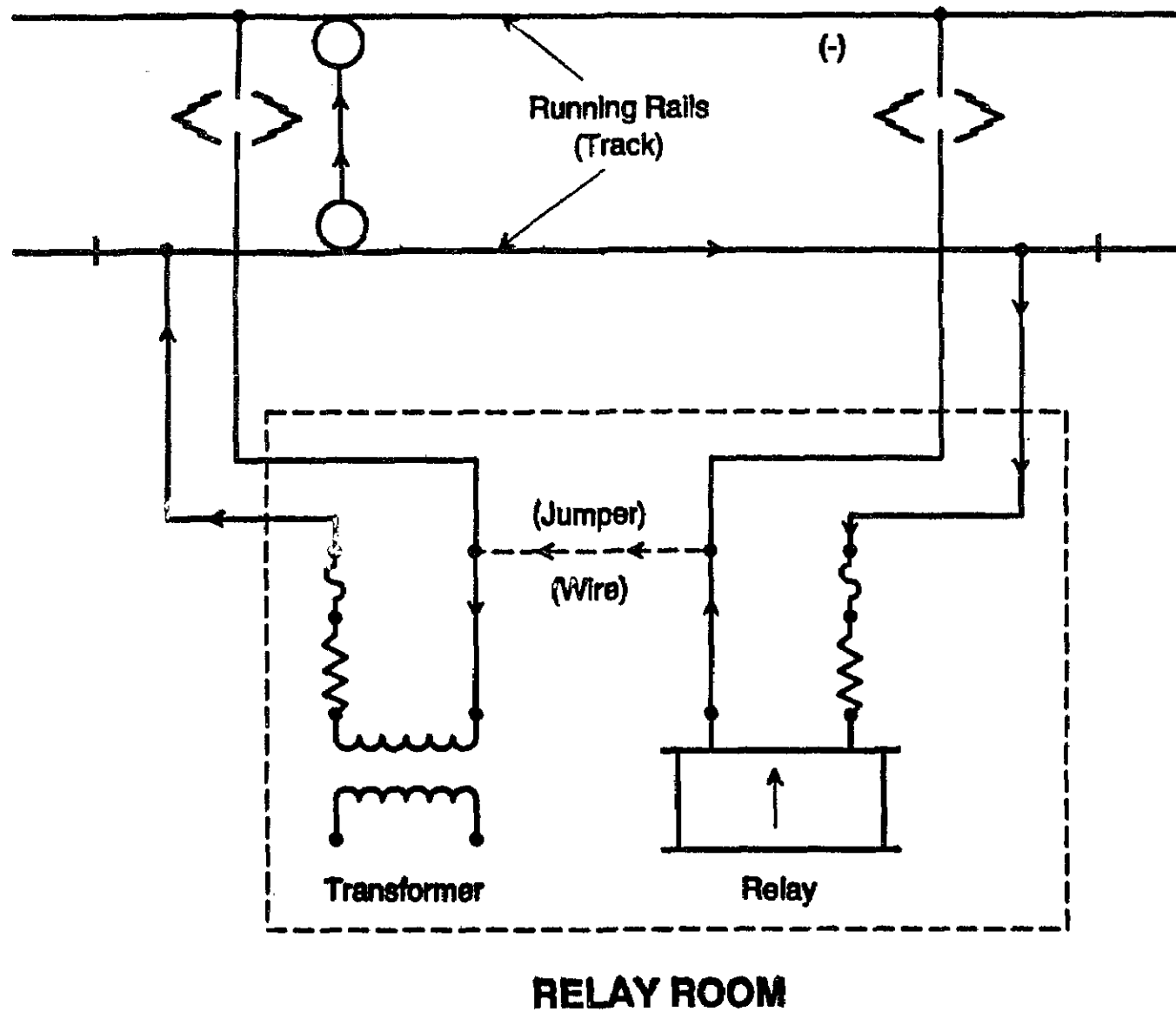


Figure 8.--Jumper Wire Applied, Train Wheel Not Shunting Signal System.

locations supervise towermen who control the switches and signals at interlockings for train movements.

The desk superintendent monitors and supervises the activities of the console operators and the on-board train personnel. From the desk superintendent's work station, radio communication can be established with all train operators, train dispatchers, and all IRT department personnel. The desk superintendents make decisions about train movements based on information furnished to them by the console operators. Desk superintendents can communicate directly with various public safety agencies from their work stations. A computer-assisted display (CAD) fire safety system allows the desk superintendent to furnish the fire department with access and escape route maps for the IRT system. The maps can be displayed in each fire station on dedicated display terminals.

At the time of the accident a train dispatcher and a towerman were on duty at Times Square (42nd Street). The Times Square train dispatcher stated that about 15 to 20 minutes before the accident he was notified that train 3A had been put on the line following the 408 and ahead of train 428. He also stated that he had not communicated with either train 3A or train 428. The train dispatcher also said that by the time a revenue collector train arrived at the 103rd Street Station, it was not unusual for the regular train to close the separation and be close behind the collector train. The general practice, as explained by the train dispatcher, was to put the revenue collector train on track 2 at 103rd Street and allow the regular train to proceed on track 1. The dispatcher further stated that the operator of a passenger train would not be advised that a revenue collector train was ahead of his train; however, if the passenger train was stopped by a red signal, the operator would then be told why his train was being delayed. The dispatcher explained that it was his intention to send train 3A direct from 103rd Street to Times Square and then put him in a siding track to allow the 428 to go by train 3A. The dispatcher said that he was not aware that a train had arrived at 103rd Street until the accident occurred. The dispatcher has a model board at the Times Square location that displays a light indication for various locations under his control. A train entering the 103rd Street Station should illuminate a light on the dispatcher's model board for that location. However, according to NYCTA signal personnel, with a train standing entirely within the second track circuit (204) as was train 3A and with the broken wires and jumper wire as was found following the accident, the light for 103rd Street Station would not be illuminated on the dispatcher's model board.

NYCTA subway trains are manned by a crew of two: a train operator and a conductor. The train operator normally operates the train from the control compartment in the lead car. The conductor is required to ride in the center of the train. NYCTA rules and regulations indicate that the conductor is in charge of the train, and is responsible for its safety, on time performance and proper care for the train to which they are assigned. The rules require that the conductor and train operator must familiarize themselves with the rules of the NYCTA, the conductor must know the rules that apply to the train operator and determine that they are executed properly.

The rule book contains 23 references to maximum allowable speed. NYCTA rule 106 (g) states in part:

... They must reduce speed to conform with slow signs and other instructions before reaching curves and continue at the prescribed speed until the entire train has rounded the curve. Motormen must approach all stop signals, train ahead, junctions and terminals with their trains under full control (see appendix C).

A sign posted on the north approach (185 feet north of the station platform) to the 103rd street station contains the number 18 in yellow on a black background. Several NYCTA supervisors questioned by Safety Board investigators stated that they did not know why the sign was posted at that location and what it meant. Safety Board investigators later learned from NYCTA officers that the posted sign was intended as a "proceed at speed sign" indicating 18 mph speed, because of the limited visibility of the 4 degree curve in the station area. NYCTA rules provide for a "proceed at speed sign" with black numerals on a yellow background. The operator of train 3A stated that he believed the sign with the number 18 indicated the speed limit for entering the station; however, he estimated the speed of his train as it entered the station at 20 mph. The operator of train 428 stated he understood the sign to indicate the speed for entering the station and estimated the speed as he entered at 18 mph. The two train operators involved in this accident stated that when operating their trains without speed indicators, the speeds of their vehicles were an "estimated guess." Safety Board investigators who learned from NYCTA that many signs had been posted over the years that have not been understood by NYCTA personnel currently employed and that NYCTA has established a committee to study and correct the problem.

NYCTA's timetable stresses the importance of on time performance and furnishes the operator with the time the train should arrive at selected key station (see appendix D). Train operators are responsible for the speed of their train.

Twice yearly operators are evaluated by a motor instructor riding in the train with the operator. NYCTA form 58-69-0695 is used to report the check rides and three areas involving speed are checked; judgment of speed and distance, speed over switches, and speed entering tunnels (see appendix E). Radar guns are not usually used for this purpose and are most often used only in response to speed complaints. NYCTA officers advised the Safety Board that because the operators use their best guess, +/- 5 mph of the posted speed is allowed; the motor instructors also use the best guess method to determine speed.

Revenue collector trains had been four cars in length until March 31, 1986, when the NYCTA went to two car revenue collector trains because of a lack of equipment (see appendix F).

Signal Maintenance

The Director of Operations-Signals told Safety Board investigators that the proper field maintenance repair for a broken track wire was for the signal maintainer to cut the conduit, find the broken wire, string and connect a new wire from the connection at the equipment end to the rail connection and then issue an "A" priority work order requesting that permanent repairs are made. NYCTA management has indicated that "A" priority work order repairs is generally completed within 30 days. He further stated that it was forbidden by the NYCTA to use jumper wires and they are not an acceptable substitute for the "proper maintenance repair."

A signal supervisor issued an "A" priority work order for permanent repairs to track circuit 204 in March 1988. He stated that he had issued this work order because he had been advised that his September 1987, "A" priority work order for permanent repairs to track circuit 204 had not been entered into the maintenance computer system. A description of the work requested in 1988 was to "replace rotted wire duct to pothead at negative rail; replace rotted negative rail wires for 204 TCX and 224 TTCX. Reason; conduit rotted away, wires rotted. Loss of TTCX wire at location." When questioned by Safety Board investigators, the signal supervisor first stated that he submitted the 1987 work order for the permanent repairs after he saw the broken wires during one of his walking inspections. He later said that a signal maintainer had told him the wires needed to be replaced. Inspection following the accident of the wiring of the track circuits disclosed that the two wires were broken within the conduit of the concrete invert.

Signal maintainers are required by the NYCTA signal department to conduct shunt tests every 60 days on each of the track circuits. NYCTA signal maintenance records indicated that on February 9, 1989, a shunt test was performed on circuit 204 and no defects were found. A signal supervisor was required to check each circuit and device twice a year. Records indicate that the last check of circuit 204 by a supervisor was made on September 10, 1988. There were no abnormalities shown on the signal supervisor's reports for the year 1988 for circuits 204 or 224.

The NYCTA signal department rules require the signal maintainer on duty to enter in a log book for the location each time a signal failure is reported by the trainmaster (at command center) to the signal maintainer or his supervisor and each time the signal maintainer is aware of a signal failure that resulted in a train delay. Dating back to 1982, no entry could be found by Safety Board investigators in any of the log books of signal maintainers on the IRT division of any signal problems reported for circuit 204 or circuit 224. The control center records were also checked for the same 7-year period and no entry was found of a signal failure that would have required the placement of a jumper wire in the system. The records for the operation of trains was also checked for the years 1986, 1987, and 1988 and no train delays could be found which would indicate a signal failure relating to track circuits 204 or 224.

At the time of the accident, work had not been done on 199 outstanding work orders for permanent repairs of broken track wires (all 199 were more than 30 days old). As of November 1, 1989, an additional 242 work orders had been received for broken track wires, but, only 19 were outstanding with none more than 30 days old. NYCTA furnished to the Safety Board a computer print-out for January 5, 1990, which indicates there are no outstanding track wire repairs, but that there are 855 remaining repairs yet to be made to signal equipment, such as replacement of equipment housing doors, equipment cases, and signals that have been damaged but are still in operable condition.

Crewmember Information

All of the crewmembers involved in this accident were qualified in accordance with NYCTA rules. The operator of train 428 was employed by the NYCTA on March 12, 1984, as a conductor. In the fall of 1987, he entered the train operator training program; when he completed the training on October 7, 1987, he became a yard train operator. After additional training he became a passenger train operator on July 7, 1988. He was assigned to the extra board² after becoming a passenger train operator and worked different lines at varying times. During this period he also worked as a train operator of a revenue collection train similar to the 3A train involved in this accident. For 6 weeks prior to the accident he had been assigned to a regular schedule operating postmidnight trains on the number 1 line.

The 428 train operator's personnel record indicated that he "must wear glasses with corrective lenses while on duty." He stated to Safety Board investigators that while he does wear glasses, he is not required to wear them on the job and he was not wearing his glasses at the time of the accident. Shortly after the accident it was determined by the NYCTA medical department that the train operator was wearing contact lenses and he was given a vision test with the contact lenses by the NYCTA medical department. His distance vision with the contact lenses in his right eye was 20/25, and in his left eye was 20/70. The NYCTA requires 20/30 in each eye for proper depth perception. Therefore, he failed the depth perception test and was not medically qualified to operate a train. He had good color perception, however, and normal peripheral vision. A NYCTA doctor, in a statement given to NYCTA management, indicated that there was no record of a physical examination having been given to the operator of train 428 at the time he was promoted from conductor although an examination was required. The doctor also stated it was possible that at the time the operator was promoted he was tested while wearing contact lenses and had not received any depth perception test. However, according to the doctor the use of contact lenses is not permitted by the NYCTA for any operational position, including conductor and train operator, because of the steel dust in subway tunnels.

²With out a regular assignment, called for work from a rotating list of available qualified employees.

The form given to a motor inspector for a check ride on any train operator does not indicate if the individual being checked is required to wear glasses when on duty.

The operator of train 428 had two drivers licenses, one from New York and one from New Jersey; both carried restrictions requiring corrective lenses to operate motor vehicles (see appendix B).

Train Information

Train 0428/IRT consisted of ten R-62A type, self-propelled electric subway cars with four-wheel trucks, built between 1984 and 1987 by Bombardier, Inc. An R-62A car is 51 feet 4 inches long and empty each car weight is 75,328 lbs. and gross weight with 182 passengers is 103,500 lbs. The braking rate for each car is: in service braking 2.5 mph per second; in emergency braking 3 mph per second. Traction power is carried from the third rail through a current collector shoe on each truck. End doors on each car permit passengers to move from one car to another, and six bi-parting side doors, three on each side, permit passengers to enter and exit from the car to station platforms (see figure 9). The bi-parting doors on the station platform side of the train are opened and closed by a conductor, operating a side door master controller, located in an operating cab on a car in the middle of the train. These doors can also be opened in an emergency by a manual door release lever concealed behind hinged advertisement frames adjacent to each of the six bi-parting doors; no information for the manual operation of the side doors is provided to the passengers in the car.

Each car is equipped with an operating cab at each end. The R-62A car is designed with hinged doors and partitions so that the operator's compartment can extend across the entire width of the end of the car or across only the right portion of the end of the car (with the leading edge of the door forward and the full length door hinge at the trailing end). NYCTA does not operate the cars with the full front cab configuration but instead uses only the portion of the cab area on the right side of the car and requires that train operators close the cab door (see figure 10). This NYCTA arrangement allows more passenger seating in the area opposite the train operator's cab. The operating cab contains a brake valve and a master controller. The brake system uses both dynamic and electropneumatic blended braking and is controlled by the train operator with the brake handle. The propulsion master controller regulates the speed of the train and its handle must be kept depressed while the train is moving under power; otherwise, the "deadman" feature will apply the emergency brakes. The operating cab has a train operator's side door master controller; the opposite cab side is also equipped with a door master controller (see figure 10).

The operating cab also contains a radio, to communicate with command center, wayside radios, and other trains, and a microphone to make announcements throughout the train and to communicate with the conductor. NYCTA cars are not equipped with speed indicators. When the cars are inservice, two sealed-beam headlights are illuminated at the front of the train and two red rear lights are illuminated on the last car in the train.

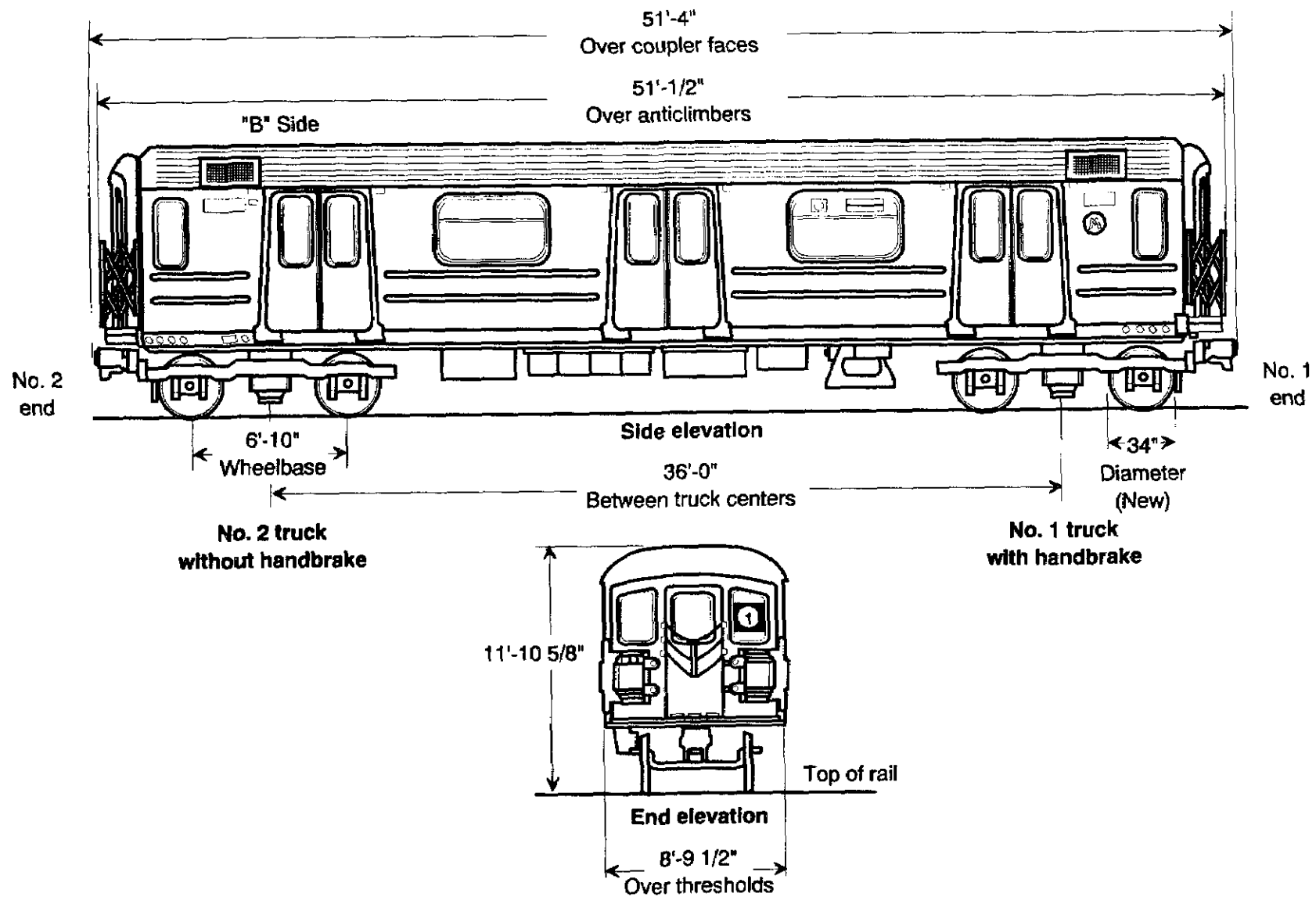


Figure 9.--Details of Car.

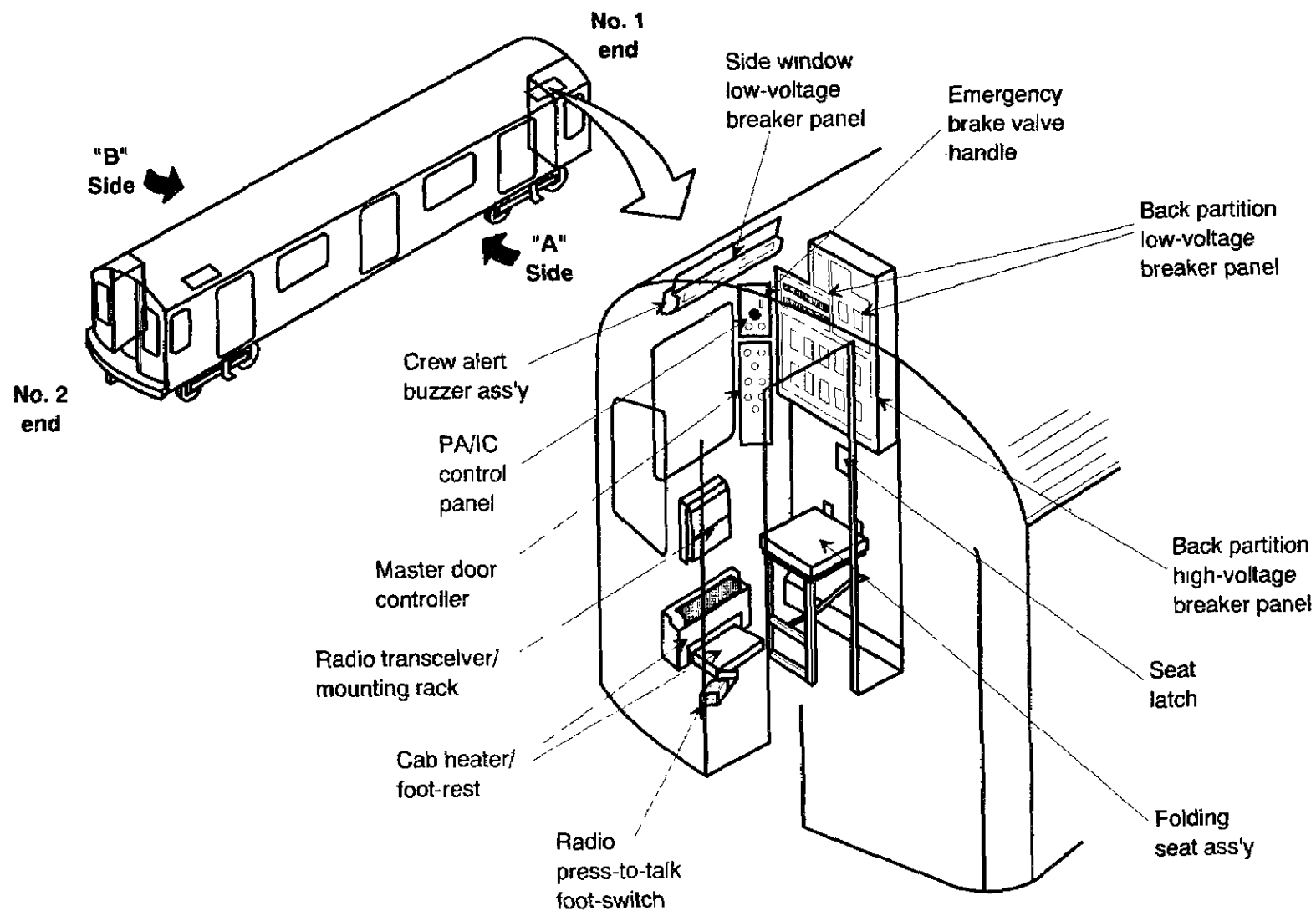


Figure 10.--Operating Cab Configuration.

Train 3A consisted of two 1950's vintage R-21 type cars. These cars are not used in passenger service but have been retrofitted exclusively for the purpose of collecting receipts and tokens from the NYCTA stations. The cars, which are 51 feet 4 inches long, have had all passenger seats removed and safes and tables installed. The cars have the same type braking and power arrangement as the R-62A cars; they are also equipped with radios to communicate with the command center. These cars are equipped with two sealed-beamed headlights, two lights adjacent to the illuminated route number and destination sign on the lead car, and four red rear lights on the last car in the train. When in collector service this train displays an "out of service" indication on the destination sign on each end of the train.

The wheel/rail contact for a two car train was 94 feet 2 inches from the trailing wheel to the lead wheel. For a four car train the wheel/rail contact was 196 feet 10 inches.

Track and Structures

In the area of the accident there are three tracks numbered from west to east. The track on which the accident occurred was the westerly track, designated as number 1 track. The middle track was designated as the middle track and the east side track was designated as number 4 track (see figure 11).

The tracks in the area of the accident were constructed with 100-pound ARA-B control cooled 39 foot rail sections. Rail sections were joined together with 36-inch, six-hole joint bars. The tracks were constructed on 12-foot 6-inch centers. The tracks in the area of the accident were classified by the NYCTA as design type II modified with 9 foot wood ties and 30 inch wood tie blocks embedded in a concrete invert (see figure 12).

Track maintenance and construction is the responsibility of the track and structures department of the NYCTA. According to the NYCTA the tracks are inspected twice weekly by assigned NYCTA track inspectors. The last major track rehabilitation program for the area of the accident had been performed in 1972 and 1973.

The tracks are tangent approaching the 103rd Street Station from the north for 640 feet then curve to the right for a distance of 450 feet; the curve is 4° and measures 1433 feet in radius. The north end of the curve begins 400 feet from the center of the 103rd street station platform.

The grade is level for 634 feet through the 103rd street station area. At the north approach to the station there is a descending 1.08 percent grade for 838 feet.

The track measurements of the gage and guard rail clearances were within limits and requirements of the NYCTA track and structures department.

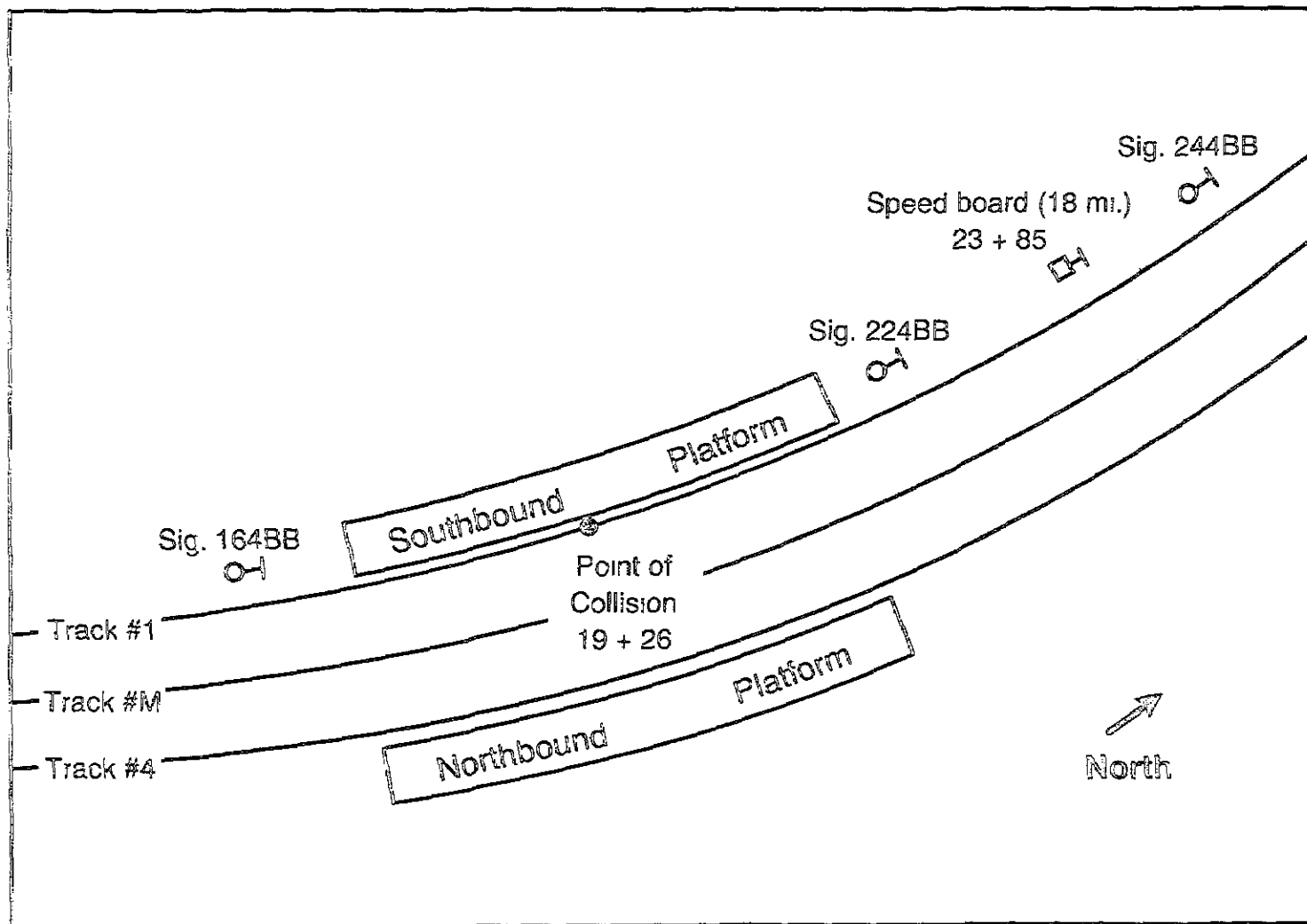


Figure 11.--103rd Street Station Track Layout.

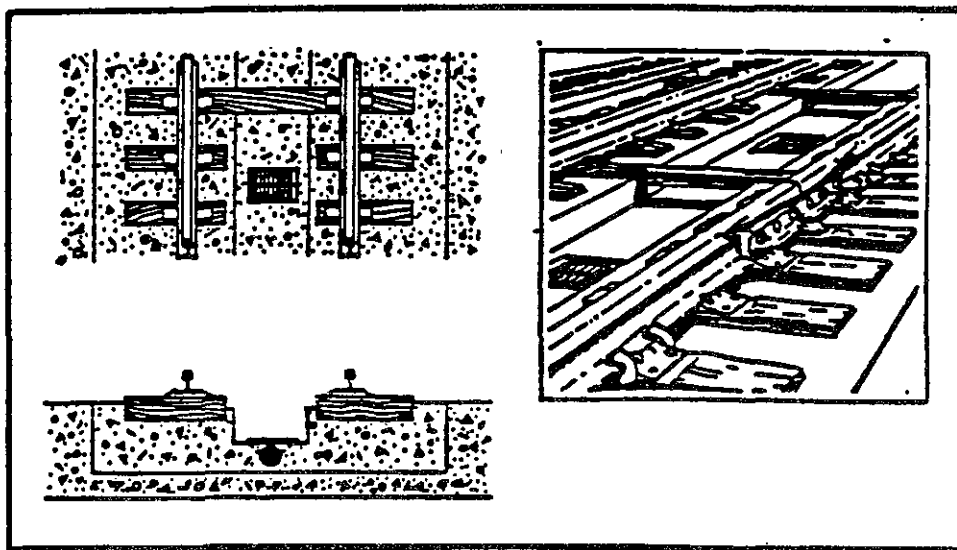


Figure 12.--Design Type 2 Track.

The station platform has a row of columns along the outer edge which limits visibility in the curve area.

Hiring Criteria

An applicant for employment with the NYCTA must take one of the various civil service examinations which are offered about every 4 years. No one single exam qualifies all applicants, rather, specific examinations are given for a single job title or small group of titles. Candidates who pass the exams are then placed on an eligibility list for 4 years. If demands for personnel exhaust a current list in a shorter time period, new exams are administered; however, no one is hired from a newly established list until the old list is completely depleted.

There is no pretest screening nor educational requirements for applicants for entry level exams. However, not all job titles are available at the entry level. Many jobs are obtainable only through promotional examinations. These are available to NYCTA employees after 1 year in an entry level position. Post exam, pre-employment screening focuses primarily on medical prerequisites and illicit drug use. Pre-promotion screening is conducted and includes a medical department examination and also includes a review of the employee's attendance and discipline records.

Train Operator Training

The position of train operator is not subject to examination and hiring from the entry level, but is available only through a promotional exam after successful completion of a probationary year as an NYCTA employee. In addition, the exam is only open to certain classes of employees with specific job titles. Until about 1980, train operator positions were filled from three titles, conductor, tower operator, and bus operator. Since that time, the need for operator applicants has not been completely met by applicants from those titles. Many employees are eligible for retirement after 20 years. The NYCTA needs approximately 3,100 train operators to operate its system. In 1988, about 600 employees were promoted to train operator and in 1989, 400 more were added. Many more train operators are expected to retire and thus, the list of qualifying titles has been expanded. Currently, persons in the following additional job titles are eligible for promotion to train operator, railroad clerk, car cleaner, railroad protection agent, and maintenance helpers.

Once an individual is selected for training as a train operator; they receive 5 days orientation in a classroom, followed by 23 days of practical operating experience in a school car designed for training. Instruction, during this 23 days of training is taken from the operations training manual that is given to each trainee to keep. The areas covered during this period include: train movement; speed limits; knowledge of signals; moving against traffic; indication lights; air brake troubles; defects and unusual conditions; emergency brake valve operation; passengers leaving train; employee between or under cars; power failure; trains breaking apart; pushing

immobilized trains; coupling and uncoupling; setting signs, doors and equipment; main knife switch; poor vision and slippery rail; smoke, fire, flood or accident; and handbrakes.

This training is followed by 17 days of field training, conducted by the Training and Qualifications Unit of the Rapid Transit Operations Department. Trainees are assigned throughout the operating system to receive individual instruction, providing the trainee increased operating time. The student also gains system familiarity by operating in nearly every yard and terminal. This training does not include operating in passenger service. Interspersed within the 17 days of field training are an additional 5 days with the training division where the student is further tested. An overall score of 80% is required to pass; an earlier test on signals requires 100% to pass. Trainees who pass the tests are promoted to the job title of train operator. However, they are not allowed to enter into passenger service until they have completed from 8 months to a year in yard and terminal service. When an operator moves into passenger service, 5 days of road familiarization is conducted.

Speed Training

NYCTA's book of Rules and Regulations contains approximately 20 different rules concerning speed. The various speed limits that are set by rule are 5, 10, 15, 25, and 35 mph depending on the specific operating situation. In addition, the physical track construction may dictate certain intermediate speed limits.

In the first few days of operator training, trainees are exposed to various speed conditions. Trainees have an opportunity to operate trains at various speeds from a standing start and while accelerating and decelerating. They operate trains inside and outside of tunnels and in close proximity to other trains. The speed they travel is determined by training instructors using time/distance calculations. Trainees are not taught to do time/distance calculations but are expected to learn to judge the speed of their train by feel and visual cues. Speed is not specifically taught following this early training and no recertification is required. On the job experience is counted on to provide sufficient judgment to allow operators to comply with the mandated speed limits.

The master controllers of NYCTA cars have three settings--switching, series, and multiple. A speed range is associated with each of the control settings. The switching setting produces a speed of 10 mph or less. The operator of train 428 stated that, he "...never operated at switching. Switching isn't a power position, and we were told in school not to operate in any switching position." The series setting produces a speed of 10 to 15 mph. The multiple setting is the typical operating setting and spans from about 15 mph to 45 mph. According to the operator of train 428, he was using the multiple setting before the accident and that he shut the controller off at the signal at the entrance to 103rd Street Station. He also stated that it was the 18th sign he shut the controller off.

Signal Maintainer Training

The position of signal maintainer for the NYCTA encompasses two major responsibilities: The first is to conduct preventive maintenance on the signal circuit components. This includes testing to determine that the system functions properly and inspecting for physical and electrical defects. The other major responsibility is troubleshooting signal problems. The maintainer must isolate any problem and correct it by making temporary repairs that will allow for the safe and efficient operation of trains. NYCTA provides training and instructional material to assist the maintainers in the performance of their duties.

The position of signal maintainer is a promotion position that is only open to those with the job title of signal maintainer helper. Signal maintainer helpers are offered an optional 20-hour program by the training department, to assist them in preparing for the signal maintainer test. When a candidate is accepted after successfully completing the testing they enter a 3-month classroom training program. The training includes electrical circuit theory and practical application. Manuals are provided that detail instructions on the operation of the signal system, how and why it works, and what tests are to be performed to maintain system integrity and to locate problems. They are also instructed in the methods to repair the system. All of the equipment used in the NYCTA signal system is duplicated at the training center and is used to provide hands on experience.

Testing and evaluation of the students' progress is done throughout the training period. Following the classroom training students work with signal maintainers at trackside for three months. During this period, the progress of the student is evaluated on a weekly basis. Successful completion of both classroom and practical application in the field allows a student to begin functioning as a signal maintainer.

Signal Maintainer Workload

Signal maintainers are assigned service areas and trouble coverage areas. A service area is an area in which the maintainer is responsible for maintaining the signal equipment. A trouble coverage area is the area for which a maintainer is responsible when a malfunction in the signal system occurs. The two areas are not necessarily physically the same, nor is responsibility totally exclusive. On weekends and holidays trouble coverage areas are extended and handled by relief workers.

NYCTA signal maintainers are normally assigned responsibility for 35 to 50 units of equipment requiring servicing on a 30-day cycle. A signal maintainer stated that in rush hours, trains can be spaced 2 minutes apart and that maintenance service and troubleshooting takes a greater length of time. Therefore, trackside maintenance service must be performed during periods of less heavy traffic; trackside testing and service for the 4 p.m. to 12 p.m. shift must be delayed until 8 to 9 p.m. He also stated that during the first 4 hours of duty, housekeeping chores away from the track are

usually performed and signal maintainers are available for malfunction corrections. Another signal maintainer stated that there was "little to do early but much to do later."

The signal maintainer assigned to the area of 103rd Street on the 4 p.m. to 12 p.m. shift also stated that when malfunctions that require immediate attention occur in the non-rush hours they delay regular maintenance work and this often prevents completing all the work in the 30-day cycle. He further stated that when malfunctions occur in rush hours it may be too time consuming or dangerous to make repairs between train movements. The maintainer said that in such a situation he and his helper would flag trains through the affected area until traffic volume subsided.

Survival Factors

Passengers stated to Safety Board investigators that the accident occurred without warning as train 428 arrived at the 103rd street station platform. The passengers indicated that they had been thrown forward at impact from their seats and areas where they stood.

The operator of train 428 stated that shortly after impact he advised NYCTA command center by radio of the collision, requested assistance, and then told the passengers by the public address system in the cars to evacuate onto the 103rd Street Station platform. At the time the operator was reporting the accident to the command center, the conductor, who was in the fifth car, opened the doors of the cars to allow the passengers to evacuate to the station platform. The operator was not able to immediately evacuate the train because the cab door was distorted and jammed, the end door also prevented the operator's cab door from opening because it was pushed inward, and could not be opened (see figure 13). He stated that the window of the cab was too small for him to pass through without the help of the conductor, taking several minutes for his extrication (see figure 14). A crewmember, assigned to the 3A train, saw the collision from the station platform and called 911 from a token booth and reported the emergency to the public safety officials. The evacuation of the trains was orderly, according to the NYCTA employees and the passengers interviewed.

As the passengers made their way onto the station platform NYCTA employees assigned to train 3A and 103rd Street Station provided assistance. Emergency medical service (EMS) personnel from the New York City Fire Department (NYCFD) set up a triage station and treated the injured. By 6:00 a.m., all of the 41 injured persons were transported by NYCFD ambulance and two NYCTA buses to 11 area medical facilities for treatment.

The NYCFD was notified of the accident at 5:05 a.m. by an NYCTA employee who called 911 from the station and at 5:07 a.m. by a direct telephone call from the NYCTA command center. The NYCFD dispatched 3 engine companies, 3 ladder companies, and 2 ambulances to the 103rd Street Station. The first NYCFD units arrived at 5:15 a.m. and all responding NYCFD equipment and personnel were on scene by 5:24 a.m. The senior NYCFD officer assumed command at 5:15 a.m. and established a command post at the 103rd street station, from which rescue activities were coordinated with the NYCTA police,

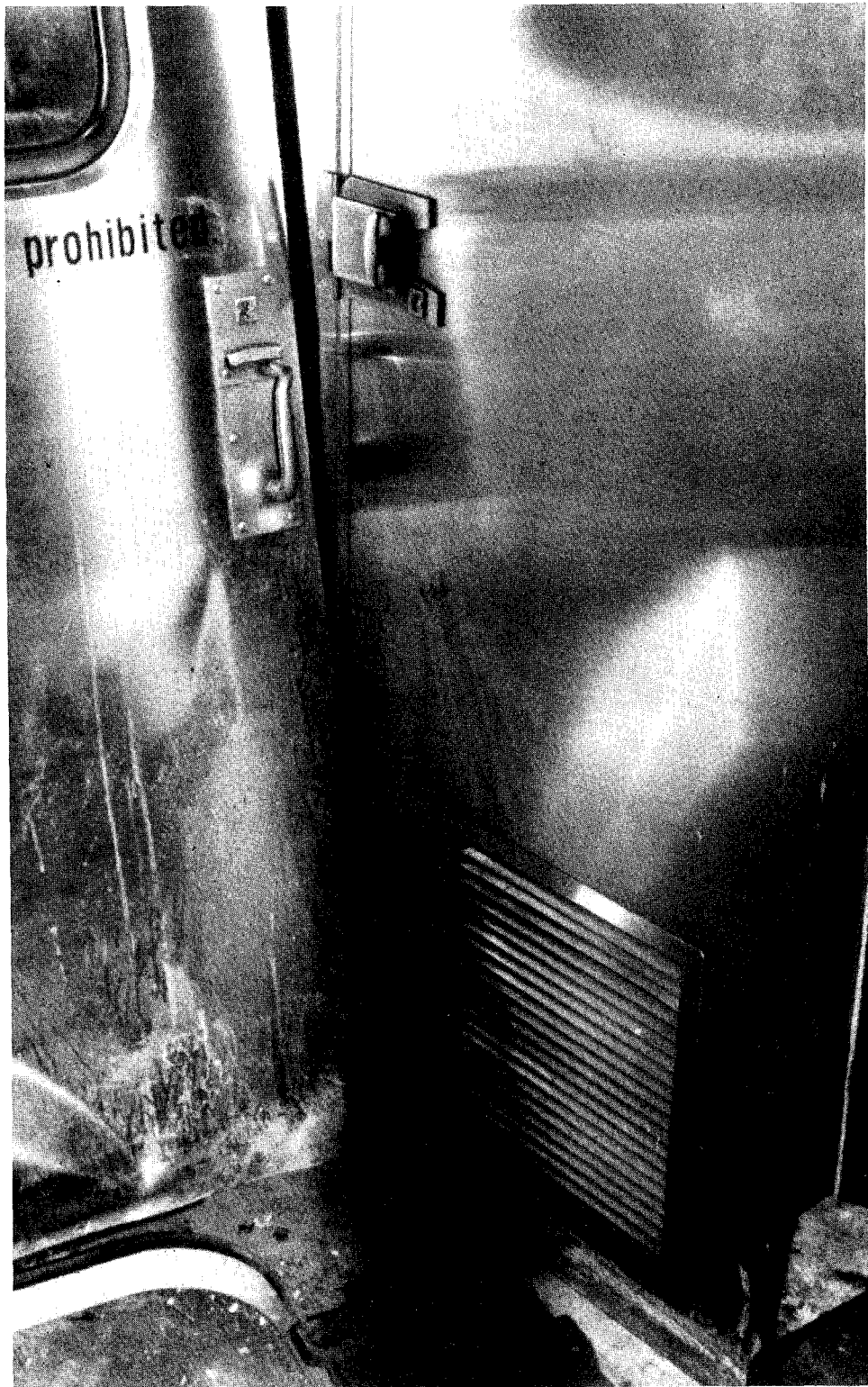


Figure 13.--End Door and Cab Door Obstruction.



Figure 14.--Cab Side Window.

other city agencies, and area medical facilities. Firefighters were assigned to assist the NYCTA police in evacuating the passengers while the EMS personnel treated the injured (see appendix G). There was no post crash fire.

The train 428 operator sustained a broken right leg and the train 3A conductor sustained a fractured skull. Other persons sustained contusions, primarily to their heads, arms, and/or upper torsos.

A post-accident critique of the emergency response was conducted by the NYCFD, New York City Transit Police (NYCTP), and the NYCTA. A review of the NYCTA's request for assistance (report number IRT009) was conducted and the response and activities of the involved agencies were examined. The agencies involved were satisfied that the onscene rescue activities were conducted in an efficient manner and were in accordance with established NYCFD guidelines NYCFD Circular No. 207 "Operations on Track Areas of Subway System and Railroads" which was issued on March 17, 1980.

The critique examined response time, manpower requirements, coordination between city agencies, special problems encountered in subway accident situations, and the adequacy of medical support. It was also the consensus of the critique committee that the response plan was adequate as a guideline in handling the emergency.

Tests and Research

An examination of the jumper wire between the transformer and the relay for signal circuit number 204 confirmed that it was the type of wire used by the NYCTA for wiring signal circuits and was standard wiring furnished to signal maintainers to make repairs to the signal system. The eyelets on each end of the jumper wire were also standard equipment furnished to signal maintainers.

Examination of the derailment marks indicated that train 3A had been pushed forward 150 feet from the rear end collision.

The operator of train 428 stated the brakes of his train had functioned properly. A test following the accident found the brakes functioned as designed.

Sight distance tests were conducted at the accident site using similar train equipment. The test train operator's first view of the rear car of a standing train 3A on track 1 could be seen at a distance of 225 feet.

Braking tests were conducted at the site of the accident to determine the braking and stopping distances. Radar guns were used at the entrance to the station and at the point of impact to determine speeds. In one test, the test train operator was instructed to proceed into 103rd Street Station "normally." The operator shut the power off and began to brake at the 18 mph sign. The train was traveling at 26.5 mph when train 3A could first be seen. The brake handle was immediately placed in the emergency position and the train stopped 45 feet short of the collision point.

In another test the operator was instructed not to take any action at the 18 mph sign and to proceed into the station; the train entered the station at 35 mph and at first view of standing train 3A, the brakes were placed in emergency. The train passed the point of collision at a speed of 21 mph and stopped 110 feet beyond the point of collision.

In another test the operator was instructed to take action at the 18 mph speed sign consistent with "normal" train operation. The operator again shut the power off, began to brake and the train entered the station at 28 mph. The operator was told not to apply the emergency brakes until the full view of the rear car of the train 3A came into view. The brakes were then applied in emergency by the operator at a speed of 27.3 mph and came to a stop 3 feet beyond the point of collision.

During the test the test train operator, based on radar gun readings, consistently underestimated the speed of the train, at times by as much as 15 mph.

Other Information

A rear-end collision occurred on the NYCTA on October 5, 1981, when subway train FR/207 struck the rear of a revenue collector train at the 207th Street station in Brooklyn, New York. Following that accident it was found that a signal department employee had made a temporary repair to correct an open wire condition. The temporary repair caused the system to function so that it would not detect the presence of that revenue collector train and the signal system would not shunt the signal circuit to cause the signal to indicate stop. This temporary repair to the signal system went undetected for more than 13 months even though the signal circuit had received 11 maintenance servicings and was inspected twice.

Following that accident the Safety Board issued Safety Recommendation R-82-105 asking that NYCTA:

Establish a procedure for scheduling and making permanent repairs within an established minimum time after temporary repairs have been made on signal circuits.

NYCTA responded to this recommendation on February 17, 1983, stating that the NYCTA's Maintenance-of-Way Department issued directive no. 82-68 on November 12, 1982, requiring signal maintainers to immediately notify their supervisor whenever they make changes or repairs to signal circuits. The directive further required that a signal supervisor would inspect and test the signal circuit to ensure that it was operating properly as well as issue an "A" priority work order for permanent changes or repairs to be made. NYCTA management further advised that work on "A" priority orders is generally completed within 30 days. Based on the NYCTA response the Safety Board placed Safety Recommendation R-82-105 in a "Closed--Acceptable Action" status on June 13, 1983.

ANALYSIS

According to the operator of train 428, he had lowered his (perceived) train speed from about 35 mph to about 18 mph as he entered the station prepared to stop. He had not slowed his train prior to that because he was unaware that a train was in the station. The operator had received clear signals into the station because both negative wires for circuit 204 were broken and the fail safe protection of the automatic block signal had been nullified by the jumper wire (installed after the negative relay wire for track circuit 204 broke) from the transformer to the relay of track circuit 204. Further, he had not been advised by anyone in the dispatching system that the revenue collector train was ahead of him. The operator stated that as he entered the station and he saw a train standing about 2-car lengths ahead, put the brakes in emergency but was unable to stop before striking the standing train.

However, the sight distance tests performed after the accident demonstrated that the train could be seen about 4-car lengths ahead. Further, the brake tests demonstrated that if the train were traveling at a speed of 26.5 mph, with the brakes placed in emergency when the standing train could first be seen, the braking train could be stopped short of a collision. In fact, the results of these tests indicate that had the operator reacted to the posted "18" sign consistent with "normal" train operations, he could have stopped the train only 3 feet past the point of collision, even if he did not place the brakes in emergency until he saw the full view of the rear of train 3A; this would have significantly reduced the severity of the accident.

The Safety Board concludes that although the train operator had not been warned by the signal system that train 3A was standing in the station at 103rd Street, the accident may not have occurred or could have been mitigated had the operator reduced the speed of this train as he entered the station to his perceived 18 mph and applied the brakes at the earliest opportunity.

There are several possible reasons that the operator may not have acted in time to prevent the collision. Because of the apparent confusion and uncertainty of NYCTA supervisors over the meaning of the 18 sign posted north of the 103rd Street Station, the supervisors were probably not enforcing compliance with the speed sign, and therefore the operator may not have taken any action to slow his train (by removing power and beginning to brake) at the sign. Further, because he had no warning that a train was standing in the station, the operator believed he had the entire station in which to stop his train. (The stopping distance tests already demonstrated that the train could have been safely stopped within the station if there had been no other train in the station even if no effort had been made to slow the train at the 18 sign.) Also the operator stated that he was looking for a repeater signal on the left and thus may not have seen the standing train as soon as it became visible. Finally, because the operator was not wearing his corrective eye glasses, his vision was not what it should have been to operate a train in accordance with the NYCTA requirements. However, there is no evidence that this caused the operator to see the standing train significantly later than he would have if he had been wearing his corrective glasses.

Based on the stopping distance tests and the fact that train 428 pushed train 3A 150 feet past the point of impact, the Safety Board believes that train 428 entered the station at a speed of 35 mph and struck the standing train at a speed of 26 mph or more and that the operator was unaware of how fast his train was traveling because he had no reasonable means to determine his speed.

Signals

Although the fail safe protection was eliminated when the jumper wire was installed between the transformer and the relay, trains would still shunt the track and provide the required signal indication to protect a train with only one negative wire broken. Therefore, had the first broken wire been repaired when the work order was submitted in September 1987 this accident probably would not have occurred. But, because the broken wire remained unrepaired and the jumper wire remained in place when the second wire broke (sometime after the shunt test was performed on February 9, 1989), the signal system was unable to detect the presence of a train.

It appears the NYCTA had not continued the program it established to promptly schedule permanent repairs in response to Safety Recommendation R-82-105 following the 1981 collision of a passenger train with a revenue collector train. Two work orders had been issued for permanent repairs to the circuit involved in this accident, one dated 12 months prior to the accident and the other 17 months prior to the accident. Also, 199 Priority "A" work orders to repair broken track wires in the signal system were outstanding at the time of this accident. If NYCTA had been following a program to make permanent repairs of "A" Priority work orders within 30 days this accident would not have occurred.

An additional safety recommendation R-82-106 was also issued to the NYCTA following the October 5, 1981, accident:

Establish a training program for signal department employees performing inspection and testing signal circuits to give them a thorough understanding of proper signal circuit test procedures and principles.

Recommendation R-82-106 was closed acceptable action by the Safety Board following the NYCTA response of February 17, 1983. A review of the training program for signal maintainers following this accident indicated that the program should have been sufficient to equip them to perform their duties. In fact, it appears that maintenance training was not an issue in this accident. In this accident someone understood the signal circuits well enough to install a jumper wire in the circuit, allowing the signal to clear. The Safety Board believes that some time in September 1987, a signal maintainer or signal supervisor was dispatched to 103rd Street because a signal would not clear, and found the broken track wire. Instead of making repairs as required by the NYCTA, the individual applied a jumper wire.

In addition to the failure to perform correct repairs, the reporting of failures and repairs was not performed. The lack of a log book entry suggests that the individual making the improper repair with a jumper wire knew it was not a proper repair and did not want to alert anyone that correct repairs had not been performed. The Safety Board believes this unsuitable repair may have been done for expediency to keep trains running on time, and because of the small window of time available for a signal maintainer to perform the correct repairs and testing of the system in rush hour traffic. The lack of any unusual occurrence report indicating a signal failure at the time the first wire broke is also a failure to adhere to the reporting requirements of the NYCTA.

The repeated use by signal personnel of jumper wires in the circuits, the lack of log book entries, the absence of signal failure reports, and the 199 outstanding work orders for broken track wires in the signal system indicate that NYCTA management was not providing sufficient oversight of its signal department employees.

The Safety Board recognizes that there are times when it may be necessary to use jumper wires for repairing a signal circuit, such as replacing a fuse, and thus the NYCTA position prohibiting the use of jumper wires may not be realistic. Because the jumper wire was made of standard material furnished to signal maintainers to make repairs to the system and because it was tucked away in the signal circuit rack it was difficult to detect the jumper wire when making visual inspections. Following this accident, several rail carriers indicated to the Safety Board that they recognize the need for jumper wires for certain applications, but require that the jumper wire be made from a wire of a different color from their standard wire (many use red) so that if left in place, it will be readily visible to anyone checking the system. These rail carriers also indicated that the use of a jumper wire is allowed only after a signal maintainer receives permission from supervision and proper safeguards are taken. Subsequent to this accident, the Safety Board has been advised by NYCTA management that jumper wires, yellow in color, are approved for use. However, the jumper wire found in place following this accident apparently had been used to avoid doing proper repairs. Signal maintenance personnel could easily make such a jumper wire from the material furnished to them and install it just as the one in this accident had been. The Safety Board believes that the NYCTA must immediately instruct signal department employees of the extreme danger of wiring a signal circuit in such a manner, and monitor the activities of signal personnel to prevent such a situation from occurring again.

Method of Operation

The Safety Board is concerned about the improper speed sign posted north of the 103rd street station (the yellow and black colors reversed from what is required by NYCTA rules), and the general lack of understanding as to why this sign was posted at that location. The Safety Board is even more concerned as it has learned during the course of this investigation that this was not an isolated situation. Over the years, there has been neither consistency in the reason and intent for posting signs nor consistency in the

design and color of signs posted. As a result, these signs are often not understood. The Safety Board recognizes that the NYCTA has established a committee to review the posting of signs to determine their purpose and correct display and to develop a uniform system of signs for the subway but the Safety Board remains concerned because it believes that this problem grew out of an inconsistent practice by the NYCTA of enforcement of its operating rules over many years. The Safety Board encourages NYCTA management to speedily conclude this study, develop standards, install signs in accordance with the standard, and instruct employees in the intent of and response to each type of sign.

The 428 train was continually closing the gap with train 3A ahead. During this investigation it was determined that a subway train making a normal station stop is in the station about 90 seconds, but a revenue collector train like 3A is in each station about 5 minutes. Because the revenue collector train is not scheduled, the operator of train 428 was not aware of the train or that his train was closing the gap between the two trains. He did not expect to find a train standing in the 103rd Street Station and probably was prepared to enter the station normally to make the scheduled station stop. The train dispatcher at Times Square tower knew that train 428 would be closing the gap with train 3A and intended to switch train 3A off track 1 at Times Square to avoid delay to train 428. However, the trains did not reach that point before the collision. The train dispatcher at Times Square did not have any radio communication with either train prior to the accident, and did not have a display of the signal indications for 103rd Street Station. The console dispatchers in command center did not have any radio communication with either train nor did they have at their location any indication of the signals displayed in the field. The need for security of revenue collector trains is recognized by the Safety Board, but it believes the need to maintain train separation required for passenger safety is of greater importance. The Safety Board believes that the operator of train 428 should have been advised before departing the originating terminal that train 3A had been placed on the line ahead. The alteration of the signal system removed the necessary warning and there was no reliable back up to warn the operator of the standing train. The Safety Board believes that the NYCTA must review the events of this accident and develop the necessary protection to prevent trains from closing and striking.

The operator of train 428 estimated the speed of his train as he entered the 103rd Street station to be about 18 mph. The lack of speed indicators and the best guess method for speed does not provide a sufficiently accurate means for operators to determine the speed of their trains. The NYCTA has a very complex system of switches and crossovers. Further, many maintenance people need to be around the tracks. Speed restrictions must be enforced to protect train movements and workmen along the tracks. During the post-accident testing the train operator on the test train consistently underestimated the speed of the train. The Safety Board believes, based on the post-accident testing, that train 428 entered the station at speeds well in excess of posted speed, in part, because the operator had no reasonable means to determine his speed. Speed indicators are needed to allow train operators to properly control the speed of their trains. The Safety Board believes that the NYCTA is aware of the difficulties of controlling speed

without speed indicators, but NYCTA has not taken sufficient action to address the problem. The infrequent use of radar guns to perform speed checks by supervision responsible for train operations and the failure to train operators to use time and distance to determine speed are indications that the NYCTA may not have recognized the importance of this problem.

Crewmember Information

The Safety Board is also concerned that the train operator was not wearing corrective glasses and may have been wearing contact lenses which did not correct his problem with vision. Although this may not have contributed to the accident, contact lenses are prohibited for operating employees and yet there is no method in place on NYCTA to alert supervision that an operating employee is required to wear corrective glasses while on duty. Therefore, the operator of train 428 was allowed to operate trains for some period of time with contact lenses. The Safety Board believes that the NYCTA needs to provide operations supervisors sufficient information to check its employees for compliance with operating rules. When a supervisor receives a form indicating a check ride is needed on a train operator it should indicate if the operator is required to wear corrective glasses.

It has not been possible for the Safety Board to determine just how long the operator had not been using the required corrective glasses, because the NYCTA could not produce a record of the physical examination that was required to be taken by the train operator for promotion from conductor. It is also possible that the train operator was promoted without a physical examination as no record of an examination could be found. This is another indication that NYCTA management oversight is not adequate to detect noncompliance with its rules. There must also be a sufficient review process in the system to determine that each operating employee receives required physical examinations.

Survival Factors

The emergency response was performed in accordance with the Emergency Plan developed by the NYCTA and NYCFD. The response was timely and adequate for this accident.

This accident demonstrates that with any deformation to the front end of the car, the door of the train operator's cab cannot be opened. The window on the cab side of the car is small and does not open for its full length; this created a problem in evacuating the train by the train operator. The NYCTA should evaluate the door design for the operator's cab so that in the event of an accident the door can be opened or removed. The NYCTA should also consider the desirability of designing the cab window with a pull-out strip so that the window can be removed quickly in the event of an accident.

The NYCTA should also consider that in an accident it is possible that the crewmembers may become incapacitated and not be able to open the side doors for emergency passenger evacuation and provide instructions inside each car on the proper manner to open the doors manually and exit safely.

CONCLUSIONS

Findings

1. Train 428 entered the 103rd Street Station without the train operator knowing that train 3A was standing in the station because no one had advised him of train 3A's existence nor was train 3A shown on the timetable.
2. The operator of train 428 entered the 103rd Street Station at a speed in excess of the posted speed of 18 mph, because, in part, no reliable means had been provided to determine actual speed.
3. Improper repairs of signal circuit 204 had been made using a jumper wire because of expediency; with the jumper cable in place and two broken circuit wires, the signal at the entrance to 103rd Street Station displayed a false clear signal indication to the operator of train 428 entering the station when train 3A was occupying the circuit.
4. NYCTA management had not enforced compliance with an NYCTA order that required an "A" priority work order be completed within 30 days and signal circuit 204 went unrepaired for 17 months until the accident occurred.
5. Because no reports had been made when the first wire broke and the jumper wire was applied, no follow-up inspection was made to determine if proper repairs had been made.
6. The operator of train 428 operated trains without corrective glasses as required by NYCTA Medical Department and may have been wearing contact lenses in violation of NYCTA rules and yet NYCTA supervisors are not furnished information about employees who are required to wear corrective glasses when operating trains.
7. NYCTA management oversight was inadequate in that it did not correct the improperly displayed speed signs, allowed the operator to be promoted without a record of a physical examination, failed to have the signal system repaired promptly or correctly and did not enforce its own operating rules.
8. The design of the cab door and the deformation of the front end of the car prevented the train operator from exiting the car through the cab door.
9. The initial notification of the accident was communicated to the New York City Transit Authority communications center, by the operator of train number 428 and the New York City Transit police officer, in a timely manner.

10. The evacuation of passengers onto the 103rd Street station platform from the train number 428 was conducted in an orderly manner by the conductor and other NYCTA employees who were at the 103rd Street Station.
11. The emergency response by the New York Fire Department, the New York City Transit Police, and the New York City Transit Authority Train Trouble Control Personnel was adequate and timely.
12. The New York City Fire Department subway and railroad disaster plan adequately addressed the mission requirements of public safety agencies involved in this accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the improper application of a jumper wire in the signal circuit. Contributing to the cause of this accident was the failure of NYCTA management to require proper repairs to the signal circuit in a timely manner. Contributing to the severity of the accident was the operation of train 428 into the 103rd Street Station at a speed in excess of the posted speed, in part, as a result of the failure of the NYCTA management to furnish a reasonable means for operators to determine speed.

RECOMMENDATIONS

As a result of this accident investigation, the National Transportation Safety Board made the following recommendations to the New York City Transit Authority:

Provide speed indicators on each car in service on the system to allow train operators the ability to properly determine speed. (Class II, Priority Action) (R-90-2)

Establish a procedure to notify train operators before leaving the originating terminal when an extra train is placed in front of their train. (Class II, Priority Action) (R-90-3)

Conduct random testing, using radar guns, of train speed, with special emphasis given to those locations where speed restrictions are in effect. (Class II, Priority Action) (R-90-4)

Redesign cab doors and provide a removable strip to enable removal of cab window to provide an escape route for train operators. (Class II, Priority Action) (R-90-5)

Provide procedures for use and reporting of jumper wires in the signal system. (Class II, Priority Action) (R-90-6)

Establish a procedure for supervisors to determine when making ride checks if the train operator is required to wear corrective glasses. (Class II, Priority Action) (R-90-7)

Install emergency evacuation placards on all New York City Transit Authority passenger train cars. (Class II, Priority Action) (R-90-8)

Conspicuously post emergency procedures for opening side passenger doors adjacent to each set of doors on all passenger cars. (Class II, Priority Action) (R-90-9)

Establish audit procedures to determine that signal maintainers and signal supervisors are properly logging any activity involving the signal system. (Class II, Priority Action) (R-90-10)

Establish procedures to require that physical examinations are given when required by NYCTA rules. (Class II, Priority Action) (R-90-11)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ James L. Kolstad
Chairman

/s/ Susan M. Coughlin
Acting Vice Chairman

/s/ Jim Burnett
Member

/s/ John K. Lauber
Member

Adopted: March 13, 1990

APPENDIXES**APPENDIX A****INVESTIGATION**

The National Transportation Safety Board was notified at 7 a.m., eastern standard time, on March 10, 1989, of a rear-end collision of two New York City Transit Authority subway trains. The investigator-in-charge and other members of the investigative team were dispatched from the Washington, D.C. office and field offices in New York City, New York, Atlanta, Georgia, and Los Angeles, California. Investigative groups were established for engineering, signals, mechanical, operations, human performance, and survival factors.

The Safety Board appointed parties the following parties and were assisted in the investigation by the New York City Transit Authority and the New York State Public Transportation Safety Board.

APPENDIX B

PERSONNEL INFORMATION

Operator of train 42 Vincent O. Davis (27) was employed by the NYCTA on March 12, 1984. He was hired for the position of conductor. During his training as a conductor he was qualified by NYCTA over several track areas and scored 82 on his final examination of the operating rules. He worked as a conductor on the I/IRT line for a year.

In the fall of 1987, he was promoted to train operator. He completed the NYCTA training program and passed the practical and oral examinations for yard train operator on October 7, 1987. In his practical examination, he was rated "satisfactory" to "very good" in all 13 areas tested. On his written examination his grade score was 90.

In the spring of 1988, he received additional training and instructions and qualified for passenger train service on July 7, 1988. He was first assigned to the extra board and worked different lines at varying times. For six weeks prior to the accident, he had been assigned to a regular schedule operating post-midnight passenger trains on the I/IRT line.

Train operator Davis' personnel record indicated that he "must wear glasses with corrective lenses while on duty." The record also indicates that he has been disciplined by the NYCTA for rule infractions 7 times. Four of the rule infractions resulted from taking sick days without submitting the proper doctor's certification upon return to duty. He has not been disciplined for operational procedures since becoming an operator and has never been cited for a speed violation.

APPENDIX C

NYCTA OPERATING RULES 105 THRU 108

(e) They must make a personal, weekly, physical inspection of their yards and compile a written inventory of the cars actually therein at the time of such inspection.

(f) They must report promptly any defects in cars, tracks, signals and other equipment which may cause trouble or interfere with the safe and expeditious movements of trains. They must report all "out of service" cars and their movements.

(g) They must keep records of all absent employees and of other employees who fill their places and of the time worked and must submit such records daily to the Assistant General Superintendent, Rapid Transit Operations, as may be required.

(h) They must cooperate with the Car Maintenance Department to facilitate the movement of cars to and from inspection shops and must be extremely vigilant to prevent cars requiring repairs from being placed in revenue operation.

(i) They must qualify to operate and, upon such qualification, must operate, when directed, interlocking plants and control points within the limits of the section assigned to them.

(j) They may be required to hook down stop arms and flag trains in emergencies to expedite train service.

ASSISTANT TRAIN DISPATCHERS

Rule 105.

(a) Assistant train dispatchers will report to trainmasters, train dispatchers and yardmasters.

(b) They have charge of the crewing of trains and must keep Train Register Sheets on which they will note the time of arrival and departure of all trains, the car numbers, the names of the motormen and conductors and such additional information for submission to the superintendent as may be required. They must also enter on Train Register Sheets the names of motormen and conductors putting trains into, and laying trains up from, service.

(c) When necessary, they will regulate the intervals of trains as traffic requires and keep gap sheets on which they will note the time of arrival and departure and, when possible, the leading car number of all trains. They will submit any resulting changes in intervals to the Deak Trainmaster or other superior as may be required.

(d) They will report to the train dispatcher daily the names and pass numbers of all absent motormen and conductors and of the employees who have been substituted for such absentees.

(e) They must properly record all car trips on the prescribed forms.

(f) They must qualify to operate and, upon such qualification, must operate, when directed, interlocking plants and control points within the limits of the section assigned to them.

(g) They may be required to hook down stop arms and flag trains in emergencies to expedite train service.

MOTORMEN

Rule 103.

(a) Motormen will report to train dispatchers, yardmasters and assistant train dispatchers; in addition, they

APPENDIX C

are subject to orders from trainmasters and motormen instructors

(b) **THEY MUST TAKE EVERY PRECAUTION FOR THE SAFETY OF THEIR TRAINS AND PASSENGERS WHEN A TRAIN IS IN MOTION THE RESPONSIBILITY FOR SAFE RUNNING RESTS ENTIRELY UPON THE MOTORMAN NO COLLISIONS WILL BE EXCUSED**

(c) They are under the orders of the conductor in regard to starting, stopping and general operation of the train between terminals, but they shall not obey any order that may endanger the safety of the train or passengers or which may involve a violation of the rules

(d) They must never leave their trains en route, except in an emergency; in such case they must first secure the train against moving

(e) While en route they must keep a constant look-out to observe the position of all switches and signals. If a route is set up for other than scheduled line, they must bring their train to an immediate stop and report to the towerman or to the Desk Trainmaster, stating the circumstances, and must not start their train until satisfied that it is safe to do so. If a route is established from express to local track, they must accept such route and proceed without further orders, **PROVIDED SAID ROUTE DOES NOT DIVERT THEM FROM THEIR SCHEDULED LINE**. They must, when running on other than their normal track, upon arrival at a subsequent interlocking equipped with a route request device, operate route request button or use route request telephone to communicate with towerman to return to their normal track. If, after a route request button is used, the alternate route continues to be displayed, they must accept said route, **PROVIDED SAID ROUTE PERMITS THEM TO CONTINUE ON THEIR SCHEDULED LINE AND TO RETURN TO THEIR NORMAL TRACK AT A SUBSEQUENT INTERLOCKING**

(f) They must not rely on information from anyone as to the time interval between their train and the one ahead as the preceding train may have stopped just after passing out of sight. They must govern themselves strictly in accordance with the rules at all times

(g) At any time when passing a fixed signal indicating proceed, prepared to stop at next signal, motormen must govern the speed of their trains so that there is no possibility of their running past the next signal, should that signal indicate STOP. They must reduce speed to conform with Slow Signs and other instructions before reaching curves and continue at the prescribed speed until the entire train has rounded the curve. Motormen must approach all STOP signals, trains ahead, junctions and terminals with their trains under full control

(h) They must regulate the movement of the train, as nearly as possible, to a uniform speed on all parts of the road, except as prescribed around curves or over switches. **THEY MUST COAST AS MUCH AS POSSIBLE CONSISTENT WITH MAINTAINING SCHEDULE TIME.**

(i) They must not run ahead of schedule time unless ordered so to do by proper authority. When a train leaves a terminal late or when an excess interval separates it from the train ahead, motormen will endeavor to economize time to close the gap, **PROVIDED THIS CAN BE**

DONE WITH SAFETY Reckless running is strictly forbidden

(j) They must see that there is always sufficient air in reservoir and brake pipe. The air gauge must be carefully examined in every instance before starting a train, rounding curves, descending grades, approaching signals or other trains and before materially increasing speed

(k) Should train trouble develop en route, motormen must immediately notify the Desk Trainmaster, giving name, location, destination, the interval represented and the nature of the trouble

(l) If, at any time, electric brake trouble occurs and motormen are compelled to operate pneumatically, they must bear in mind that a train cannot be stopped as quickly as with the electro-pneumatic brake and must handle their trains accordingly

(m) They must observe station car stop signs and must stop the first car of a train of designated length opposite the proper sign

(n) They must be careful not to overrun station platforms. Should this happen, however, they must give the prescribed signal and wait for the prescribed signal from the conductor before proceeding. Should they make a short stop at a station for any cause, they must give the prescribed signal and must wait for the prescribed signal from the conductor before pulling up to the proper station car stop sign

(o) UNDER NO CIRCUMSTANCES SHALL A MOTORMAN BACK A TRAIN IF HE HAS OVERRUN A STATION PLATFORM

(p) They must use care in starting and stopping their trains to avoid sudden jerking

(q) They must see that on the front end of the train the safety chain is in position, the storm door closed and locked and the proper end destination and route signs, marker and running lights are illuminated and displayed. They must also see that the proper side destination signs are illuminated. When the train has arrived at the turning track and is stopped, said lights must be changed to display RED

(r) Upon observing a person in or around the tracks, they must sound their whistles or horns and not pass such person until he is in the clear and has given a proper proceed signal

(s) In all cases where a train comes to an undesired emergency stop and the motorman knows that a fixed signal is not involved, he must, after properly securing his train, make an inspection of the roadway on both sides of the train, where possible, to determine whether the emergency stop resulted from some obstruction on the roadway. He must, in addition, walk a sufficient distance behind his train, to try to determine the exact location and cause of the emergency application of the brakes

(t) They must familiarize themselves with destination and route signs, markers and signals on cars and with the general and special rules and regulations governing the operation of trains.

(u) They must not move a train at any point without first knowing that the train has sufficient brakes working properly.

(v) At all times they must be extremely vigilant to observe that switches and signals are operating properly and particularly during cold and stormy weather

to avoid damage to the equipment and, at all times, must be extremely vigilant to observe that switches and signals are operating properly

(w) Motormen assigned to road service must be on their trains at least two (2) minutes before their scheduled departure time from terminals with all train identification equipment and other fixtures properly displayed and in place

CONDUCTORS ASSIGNED TO TRAIN SERVICE

Rule 107

(a) Conductors assigned to train service will report to train dispatchers, yardmasters and assistant train dispatchers. In addition, they are subject to orders from trainmasters and motormen instructors

(b) They have charge of trains and are responsible for the safety, regularity and proper care and condition of trains and such orders as they may give, not conflicting with the rules and regulations or special instructions, must be obeyed

(c) THEY MUST TAKE EVERY PRECAUTION FOR THE SAFETY OF THEIR TRAINS AND PASSENGERS

(d) They are directly responsible for carrying out the rules and regulations and special instructions as they apply to the cars governed from their respective operating positions and, on all divisions, must, when the running time between two stations is five or more minutes, patrol the cars governed from their operating positions when the number of passengers in the train will permit

(e) Conductors finding any defects in the cars of their trains must report same promptly to the motorman thereof and to the first road car inspector and train dispatcher available and must enter all defects on the Car Defect Sheet upon arrival at their terminals

(f) They must familiarize themselves with the rules and regulations and special instructions governing motormen and the movement of trains so that they may know that such rules, regulations and instructions are properly executed. Should a motorman without authorization fail to make a scheduled station stop, they must immediately operate an emergency valve and investigate the cause therefor

(g) Conductors assigned to a secondary position are subject to the orders of the conductor in charge of the train to which they are assigned and must assist him in the performance of his duties

(h) While en route they must never leave their train (except in cases of emergency) and will then be governed by subdivision (v) hereof until they have been properly relieved.

(i) They must know the markers of all trains designating class and destination and must see that the proper side destination and route signs are displayed on all cars of the trains to which they are assigned.

(j) They must see that safety chains between adjacent cars are properly in place while the train is in service. At locations where they are required to mount steps, they must properly replace the safety chains as soon as they get down from the steps

(k) They must never open side doors until the train

has come to a full stop and they know from careful observation that all such doors are abreast of the station platform

(l) If, for any reason, some side doors do not open, passengers must be given ample opportunity to detrain and entrain

(m) Before closing the doors, they must afford passengers an opportunity to detrain and entrain. Doors must not be closed until they have been fully open for at least (10) seconds

(n) In case a side door is out of order, the use of the door must be discontinued. On all but R-type cars a sign reading, "THIS DOOR NOT WORKING" must be placed on the door

(o) They must be alert to prevent the operation of, or interference with, car doors, at any point, by unauthorized persons

(p) At stations where starting or holding lights are installed they must not close doors until such lights so indicate and then they must close doors promptly but with safety

(q) They must keep doorways, aisles and passageways clear of all obstructions

(r) Conductors assigned to lay-up trains must close all storm doors, windows and ventilators on such trains

(s) If a passenger becomes disorderly, annoying or dangerous, such passenger must be asked to leave the train at the next station. Upon his refusal to do so, he must be ejected in compliance with Rule 27

(t) Conductors on all divisions must observe the doors of their trains from their operating positions until they have reached the end of the station platform or until the train has moved a distance of three (3) car lengths, whichever distance is shorter. Failure to comply with this subdivision constitutes of itself a reason for charges of misconduct and incompetence in accordance with Rule 85 and is prima facie evidence of incompetence and misconduct in the performance of duties

(u) Train conductors must pay strict attention to the cleanliness of the cars of their trains and, without interference with the performance of their primary duties, must remove discarded newspapers and other large pieces of paper therefrom depositing same in waste receptacles provided for this purpose

(v) Before leaving their trains to descend to the trainway or to go onto a station platform, they must first open a conductor's emergency valve. Upon their return they must reset the emergency valve and, when it is safe to proceed, pass the prescribed proceed buzzer signal to the motorman.

(w) When it is necessary to set up a new door operating position, the train must be stopped in a station. The conductor must open a conductor's emergency valve at his original operating position, pass one (1) long buzzer signal to the motorman, then proceed to the new operating position. At the new operating position he must first open a conductor's emergency valve and then set up the new operating position, BUT only after he has depressed the closing caps, levers or buttons on both sides of the train, so that there is no danger of the doors' on the off-platform side of the train opening. He must then reset the conductor's emergency valve at the original position,

APPENDIX C

change the drum switch, or drum switches, there, to function with the new operating position, and then return to the new operating position where he will reset the conductor's emergency valve and, when it is safe to proceed pass the prescribed proceed buzzer signal to the motor man

(x) They must use the Public Address System, on cars so equipped, to inform passengers of delays, in emergencies and as required by special instructions

(y) They must be on their trains at least two (2) minutes before their scheduled departure time from terminals

(z) Conductors assigned to duties as handswitchmen are responsible for the safe passage of trains over manually operated switches which must be properly secured. Their duties require the closest attention—since any neglect may cause serious accident—and must be performed in accordance with the following:

1 They must carefully examine the condition of all switches and promptly report any defects therein

2 They must keep switches clear of snow and other obstructions

3. When necessary they must carry lighted lights in the performance of their duties so that their positions may be known to other employees

4 They must familiarize themselves with horn, whistle, hand and light signals

5 When using switches at points not interlocked, they must see that they are properly set and locked before allowing trains to pass over same and must not unlock or unlatch a switch until the entire train has passed. They must be positive that switches are properly set and locked after use

6 In the uncoupling of cars the signal to move must NOT be given until safety chains, safety gates, air hoses, electrical connections, etc., have been disconnected and, where used, the coupling pin drawn. The latter must always be drawn LAST. In coupling cars, the draw bar connections must be made before any others

7 They must see that air hoses not in use are secured in dummy couplings and that jumpers not in use are hung upon racks and never left lying where they may be damaged

(aa) Conductors assigned to fare collection tricks are accountable for the collection of fares from all persons entering their trains, except those specifically authorized to ride free by Rule 24

(ab) They must remit in the prescribed manner all monies, tokens, tickets, etc. received through the medium of their fare boxes, money meters, or otherwise

(ac) They must not deposit any fares or monies in fare boxes or money meters. Fares must be deposited only by passengers

(ad) They must change coins or bills in the denomination of two (2) dollars or less. They must return to the passengers the full change and/or tokens for coins or bills tendered to them for change. They are not required to sell more than one (1) token per passenger at any time. They must make each transaction without any discourtesy or any show of dissatisfaction

(ae) Failure to comply in any respect with any of the

provisions of subdivisions (aa), (ab), (ac) or (ad) of this rule will be deemed prima facie evidence of mishandling of revenue.

(af) Should any person claiming the right to ride free fail to establish his or her identity satisfactorily, they will endeavor to cause the arrest of such person therefor and must thereafter submit a report of the circumstances and a description of the individual

CONDUCTORS ASSIGNED TO PLATFORM DUTY

Rule 98

(a) Conductors assigned to platform duty will report to train dispatchers, yardmasters and assistant train dispatchers; in addition, they are subject to orders from train masters and motormen instructors

(b) They must render such assistance as is needed to maintain the scheduled movements of trains and must take such precautions as are necessary to maintain order and to guard passengers against accident or annoyance.

(c) They must announce in a carrying voice the class and destinations of approaching trains and must stand at car doors when trains stop to see that passengers detrain and entrain as rapidly as possible consistent with safety

(d) Just before the doors close they must announce in a carrying voice, "WATCH THE DOORS, PLEASE" and pass the proper signal

(e) They must carefully observe closing doors to prevent passengers' being struck or clothing or packages of passengers being caught by same.

(f) They must prevent anyone from entering upon or crossing the tracks from one platform to another or entering upon the cat-walks at the ends of stations, unless he be an official of the System or an employee in the discharge of his duties or a person with a special permit.

(g) They must not leave their posts of duty until they are properly relieved except in emergency or to render assistance to passengers

(h) If necessary to leave their posts of assignment to guard defective doors on a train or otherwise to ride a train or to assist in an emergency at their assigned stations or elsewhere, they must report the circumstances by telephone to the Desk Trainmaster or to the nearest train dispatcher at the first opportunity. They are not, however, permitted to perform the duties of the conductor of any train they may be called upon to ride unless they are properly qualified.

(i) Conductors assigned to platform duty must pay strict attention to the cleanliness of the station platform to which they are assigned and, without interference with the performance of their primary duties, must remove discarded newspapers and other large pieces of paper therefrom, depositing same in waste receptacles provided for this purpose

TOWERMEN

Rule 109

(a) Towermen will report to trainmasters; in addition, they are subject to orders from train dispatchers, yardmasters and assistant train dispatchers.

NYCTA NUMBER 1 LINE TIMETABLE

[illegible]

(1) இதற்கு உடனாகவே உத்தரவு பிறப்பித்து அதன் கீழ் நடவடிக்கை எடுக்கப்படும்.

[illegible]

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[illegible]

APPENDIX E

TRAIN OPERATOR CHECK RIDE FORM

New York City Transit Authority
Rapid Transit Operating Department

OPERATION CHECK LIST TRAIN OPERATION

REPORTED BY _____ TITLE _____

INSPECTION DATE _____ TIME _____

DIVISION _____ LINE _____ DIRECTION _____ CAR # _____

NAME _____ PASS _____ TITLE _____

REMARKS _____

58-89-0895 40M 2/86

MARK WITH APPROPRIATE CODE

(S) Satisfactory

(U) Unsatisfactory

(R) Reinspect On Own Time

CONDUCTOR	CODE	MOTORMAN
Uniform	_____	Uniform
Appearance	_____	Appearance
Attitude	_____	Attitude
Boarding Train At Terminal	_____	Boarding Train At Terminal
Correct Side Dest Signs	_____	Correct End Signs & Markers
Use of Public Address	_____	Standing Brake Test
Door Operation	_____	Rolling Test
Observing Platform	_____	Running Brake Test
Platform Duties	_____	Judgement of Speed & Distance
Flagging Duties	_____	Speed Over Switches
Wearing Safety Glasses	_____	Speed Entering Terminals
Other Safety Equipment	_____	Reaction To Signals
	_____	Proper Operation Yard/LU Tracks
	_____	Station Stops
	_____	Overall Train Control
	_____	Coasting

PLEASE MAKE ANY EXPLANATION OR REMARKS ON REVERSE SIDE OF CARD

58-89-0895-BACK

APPENDIX F

NYTCTA MEMORANDUM ON TWO CAR REVENUE COLLECTOR TRAINS



New York City
Transit
Authority

memorandum

Date March 14, 1989

To R. Hawkins, Director Operations, Support and Reviews, R.T.O.
W. Green
 From W. Green, Assistant General Superintendent, Production Equipment, T & S
 Subject TWO CAR REVENUE COLLECTION CAR CONSIST

The primary reasons for the development of the two car revenue collector trains were:

- 1) The I.R.T. passenger fleet becoming graffiti free with less cars available for motive power.
- 2) Passenger cars not getting back to their respective yards untine for A.M. service.

The first two car consist was put into test operation on January 20, 1986 on the #5 line working out of East 180th Street Yard on a daily basis. This test was to determine the ability of a two car consist to negotiate 3rd rail gaps, hills, and river tubes on the I.R.T. and overall operation on a daily basis. This test was successfully concluded on March 31st, 1986.

Shortly after March 31st, 1986 all collectors on the I.R.T. were reduced to a two car train consisting of one revenue collection car and one locker car (R/C - L/C), self propelled. Shortly thereafter all revenue collectors to include those on the B1 and B2 divisions were running systemwide as two car units.

To my knowledge R.T.O. Signal Towers have never reported a problem of not being able to identify the two car consist on the right-of-way. Please bare in mind that there are several other vehicles that move across the system as single units, and they also are easily identified in signal towers and on circuits.

APPENDIX G
EMERGENCY RESPONSE

NTSB Injury Table

Injuries	Crews		Passengers		
	No. 428	No. 3A	No. 428	No. 3A	
Fatal	0	0	0	0	0
Serious	0	1	0	0	1
Minor	1	1	38	0	40
None	1	0	462	14	477
Total	2	2	500	14	518

*This figure was based on an estimate of 500 passengers provided by the NYCTA.

AIS Injury Table.

Injury	Train Crew 428	Train Crew 3A and NYCTA Employees	Passengers Train 428
AIS-6 maximum injury, virtually unsurvivable	0	0	0
AIS-5 critical	0	0	0
AIS-4 severe	0	0	0
AIS-3 serious	0	2	0
AIS-2 moderate	1	0	0
AIS-1 minor	0	1	37
AIS-0 none	1	12	455

The NTSB injury classification conforms to 49 CFR 830.2. The Abbreviated Injury Scale (AIS) developed by the Association for the Advancement of Automotive Medicine (formerly the American Association of Automotive Medicine) is a universal system of assessing impact trauma severity. The injury scales for this accident were coded according to the 1985 revision of the AIS coding manual.

APPENDIX G

The following agencies and personnel responded to the accident scene:

New York City Fire Department

3 Engine Companies (4 firefighters each)	12
3 Ladder Companies (3 firefighters each)	9
5 Ambulances (3 EMTs each plus 2 supervisors)	6
Total	38

New York City Transit Police

Uniformed Officers	8
Detectives	4
Total	12

New York City Transit Authority

General Employees	33
Emergency Services Personnel	7
Total	40

Area Medical Facilities

List of New York City Medical Facilities which Assisted in treating the Injured:

<u>Medical Facility</u>	<u>Number of Patients</u>
New York Hospital	4
Metropolitan Hospital	4
Lincoln Hospital	2
Harlem Hospital	3
Jacobs Medical Center	5
North Central Medical Center	1
Doctors Hospital	1
Saint Lukes Hospital	1
Roosevelt Hospital	1
Lennon Hill Medical Center	2
Bronx North Medical Center	17