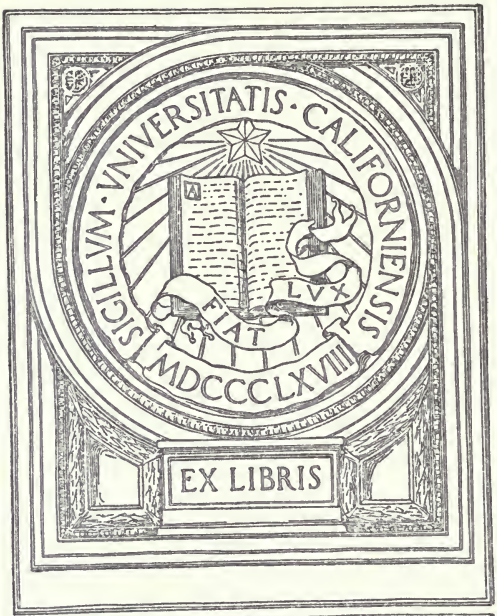
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Route No. 57
Sections Nos. 1 and 2

PUBLIC SERVICE COMMISSION
FOR THE FIRST DISTRICT

SPECIFICATIONS

FOR

Construction of

UTICA AVENUE

RAPID TRANSIT RAILROAD

ROUTE No. 57
SECTIONS Nos. 1 and 2

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N.Y.

PUBLIC SERVICE COMMISSION
FOR THE FIRST DISTRICT

SPECIFICATIONS

FOR

Construction of

UTICA AVENUE

RAPID TRANSIT RAILROAD

ROUTE No. 57

SECTIONS Nos. 1 and 2

SPECIFICATIONS FOR CONSTRUCTION OF UTICA AVENUE RAPID TRANSIT RAILROAD

SECTION No. 1. These specifications are for the construction of the Utica Avenue Rapid Transit Railroad, which is to begin at a point under Eastern Parkway, in the Borough of Brooklyn, about two hundred and five (205) feet west of the westerly building line of Utica Avenue and is to curve thence southerly under Eastern Parkway into Utica Avenue and is to extend thence southerly under, along and over Utica Avenue to a point about twenty (20) feet south of the point of intersection of the westerly building line of Utica Avenue and the northerly building line of Flatbush Avenue. The said Railroad is to be partly a subsurface railroad having two tracks, partly a reinforced concrete railroad in open cut and embankment having two tracks and partly an elevated railroad having three tracks. The detailed plans for the construction of said Railroad are described in Section No. 2.

SECTION No. 2. For convenience in preparing the detailed plans for the construction of said Railroad the said Railroad has been divided into two parts to be known respectively as Section No. 1 and Section No. 2. Section No. 1 begins at a point under Eastern Parkway about two hundred and five (205) feet west of the westerly building line of Utica Avenue and curves thence southerly under Eastern Parkway into Utica Avenue and extends thence southerly under, along and over Utica Avenue to a point about two hundred and thirty (230) feet south of the southerly building line of Clarendon Road. Section No. 2 begins at a point over Utica Avenue about two hundred and thirty (230) feet south of the southerly building line of Clarendon Road and extends thence southerly over Utica Avenue to a point about twenty (20) feet south of the point of intersection of the westerly building line of Utica Avenue and the northerly building line of Flatbush Avenue.

The detailed plans for Section No. 1 bear the general title:

**DETAILED PLANS
FOR CONSTRUCTION OF UTICA AVENUE
RAPID TRANSIT RAILROAD
ROUTE NO. 57—SECTION NO. 1
DRAWING NO.**

and are designated and numbered as follows:

A-1 to A-5 inclusive, B-386 to B-389 inclusive, C-1 to C-27 inclusive, F-501 to F-524 inclusive, F-524A, F-525 to F-536 inclusive, C-601 to C-609 inclusive and T-1 to T-6 inclusive, T-1001-4, T-1002-3, T-1003-4, T-1004-1, T-1005-3, T-1006-5, T-1007-2, T-1008-3, T-1011-4, T-1012-4, T-1013-4, T-1015-4, T-1018-2, T-1021-4, T-1024-2, T-1026-1, T-1030-1, T-1032-2, T-1033-2, T-1035-2, T-1039-1, T-1045-1, T-1046-2, T-1048-2, T-1050-3, T-1051-3, T-1053-1, T-1054-1, T-1055-1, T-1060-7, T-1061-3, T-1069-1, T-1070-1, T-1102-2, T-1115-4, T-1118-4, T-1120-4, T-1140-1, T-1145-2, T-1148-1, T-1165-4, T-1168-3, T-1170-3, and are dated February 25, 1916.

The detailed plans for Section No. 2 bear the general title:

**DETAILED PLANS
FOR CONSTRUCTION OF UTICA AVENUE
RAPID TRANSIT RAILROAD
ROUTE NO. 57—SECTION NO. 2
DRAWING NO.**

and are designated and numbered as follows:

A-6 to A-11, inclusive, C-28 to C-48, inclusive, F-537 to F-568 inclusive, F-568A, F-569 to F-580, inclusive, C-610, T-7 to T-13, inclusive, T-1001-4, T-1002-3, T-1003-4, T-1004-1, T-1005-3, T-1006-5, T-1007-2, T-1008-3, T-1011-4, T-1012-4, T-1013-4, T-1015-4, T-1018-2, T-1021-4, T-1024-2, T-1026-1, T-1028-1, T-1030-1, T-1032-2, T-1033-2, T-1035-2, T-1039-1, T-1045-1, T-1046-2, T-1048-2, T-1053-1, T-1054-1, T-1055-1, T-1060-7, T-1061-3, T-1069-1, T-1070-1, T-1102-2, T-1113-3, T-1116-4, T-1118-4, T-1126-3, T-1140-1, T-1146-2, T-1148-1, T-1166-4, T-1168-3, T-1176-2, and are dated March 25, 1916.

SECTION No. 3. The following words and expressions used in these specifications shall, except where by the context it is clear that another meaning is intended, be construed as follows:

1. The word "City" to mean The City of New York and any other corporation or division of government to which the ownership, rights, powers and privileges of The City of New York under the Rapid Transit Act (being Chapter 4 of the Laws of 1891 as amended) shall hereafter come, belong or appertain.

2. The word "Commission" to mean the Public Service Commission for the First District and any other board, body, commission, official or officials to which or to whom the powers now belonging to the said Commission in respect of the location, construction, equipment, maintenance and operation of Rapid Transit Railroads under the provisions of the Rapid Transit Act shall, by virtue of any act or acts, hereafter pass or be held to appertain.

3. The word "Contractor" to mean any and every person, firm or corporation contracting to build the Railroad or any part thereof and any successor, executor, administrator and assign and any and every other person, firm or corporation who or which shall at any time be liable in the place or for any such person, firm or corporation contracting to build the Railroad or any part thereof. For convenience the Contractor is hereinafter referred to as if the Contractor were an individual. The word "he" shall, as the sense may require, include "she", "it" and "they"; the word "him" shall include "her", "it" and "them"; and the word "his" shall include "her", "its" and "their".

4. The word "Engineer" to mean the Chief Engineer or Acting Chief Engineer, for the time being, of the Commission or his duly authorized representative and any successor or successors duly appointed or any deputy or substitute for him who shall be appointed by the Commission or by its authority.

5. The word "Inspector" to mean any representative of the Engineer designated by him to act as inspector.

6. The word "Railroad" to mean the said Utica Avenue Rapid Transit Railroad with its appurtenances which the Contractor is to construct.

7. The word "Works" to mean all the matters and things to be furnished or done by or on the part of the Contractor.

8. The word "notice" to mean a written notice. Wherever

in the specifications or upon the drawings the words "directed", "required", "permitted", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation or prescription of the Engineer is intended, and similarly the words "approved", "acceptable", "satisfactory" or words of like import shall mean approved by or acceptable or satisfactory to the Engineer.

9. The word "drawings" to mean and include the detailed plans for the Railroad mentioned in Section No. 2 of these specifications and any working plans or drawings for the Railroad which may be issued by the Commission or by its authority.

SECTION No. 4. The Railroad is to be constructed for actual use and operation as an intraurban railroad of the highest class adapted to the necessities of the people of New York in the best manner, according to the best rules and usages of railroad construction, and in the event of any doubt as to the meaning of any portion of these specifications or of said detailed plans, the same shall be interpreted as calling for the best construction, both as to materials and workmanship, capable of being supplied or applied. All the clauses of these specifications and all parts of said detailed plans are, therefore, to be understood, construed and interpreted as intending to produce the results hereinbefore stated.

SECTION No. 5. These specifications and said detailed plans are intended to be explanatory of each other and to co-operate. Any work shown on said detailed plans but not mentioned in these specifications and any work mentioned in these specifications but not shown on said detailed plans is to be done in the same manner as if mentioned in these specifications and set forth on said detailed plans to the true intent and meaning of said detailed plans and these specifications or either of them.

SECTION No. 9. These specifications are grouped in subdivisions as follows:

GENERAL PROVISIONS

PART FIRST—GENERAL CONSTRUCTION

PART SECOND—STATION FINISH WORK

PART THIRD—TRACK WORK

SUBDIVISION 1

Brief Description of the Work

Section No. 10. The Railroad is to be partly a two-track underground railroad or subway, partly a two-track reinforced concrete railroad in open cut and embankment between retaining walls and partly a three-track elevated railroad.

Section No. 11. In order to construct the Railroad it will be necessary to take up and relay the sidewalk and roadway pavement or other surface material and to protect, support and maintain all buildings and other structures, including their foundations, and all railroads, water mains, gas pipes, electric subways, poles and wires, vaults, including vaults of abutting property, and other surface, subsurface and overhead structures with their appurtenances and connections, as the same may be met along the route; to build sewers both along the route and other streets; to make or remake the necessary manholes, catch basins and other sewer connections therewith; to move, alter, readjust or rebuild water mains, gas pipes, electric subways, poles and wires, vaults, including vaults of abutting property, and other surface, subsurface and overhead structures with their appurtenances and connections; to maintain, protect, support and preserve in place certain of the trees in Eastern Parkway (including a certain amount of soil around and under the trees); and to do all such additional and incidental work as may be necessary for the completion of the Railroad and the reconstruction and restoration of the street pavements and other surfaces and of all surface, subsurface and overhead structures and of all abutting property and buildings which may have been affected, disturbed or injured by the Contractor in the progress of the work of construction to as useful, safe, durable and good a condition as existed before construction was begun. All such work of every description, including the maintaining, protecting and securing wherever necessary of all buildings and structures of whatsoever nature, monuments, and railroads affected by or interfered with during the construction of the Railroad, is part of the work which the Contractor is to perform.

Section No. 12. In order to provide for a frequent renewal of air in the subsurface portion of the Railroad, a chamber for the installation of necessary ventilating devices shall be built in connection therewith. This chamber shall be generally of the

form and dimensions shown on the drawings, varying somewhat with the requirements of local conditions. It will be so arranged that the air will discharge through gratings placed in the sidewalk in the roof of the chamber. If, owing to local conditions, it becomes necessary to lead the air to gratings or other outlets away from the chamber, suitable air-ways, ducts or flues shall be constructed. The chamber will be built at the place and as indicated on the drawings. The chamber will be provided with suitable steel doors and with steel ladders reaching to the street for use as exits in case of emergency.

Also in connection with the ventilation of the subsurface portion of the Railroad partition walls shall be constructed between the tracks where required by the Commission. Openings or refuge niches shall be provided in all partition walls at suitable intervals.

SECTION No. 12-a. The Contractor will be required to install electric ground connections to the Railroad structure about every half mile. Each ground connection shall consist of a two (2) inch galvanized iron pipe sixteen (16) feet long, driven its entire length into the ground close to an elevated column. The upper four (4) feet of the pipe shall be surrounded with charcoal for a distance of six (6) inches from the pipe. The upper end of the pipe shall be firmly connected both electrically and mechanically to the base of the elevated column by a copper cable of five hundred thousand (500,000) C. M. section. The cable shall be installed in such a manner as to be protected against physical injury. No insulation is necessary for the cable.

In lieu of the above ground connection, the Contractor shall, if required by the Commission, install an electric connection between the Railroad and the adjacent rail of the street surface railroad. This connection shall consist of a copper cable of five hundred thousand (500,000) C. M. section, carried in a one and one-half (1½) inch galvanized iron pipe protected by a three (3) inch covering of concrete and firmly connected both electrically and mechanically, in an approved manner, to the base of the elevated column and to the rail of the street surface railroad. The cable shall be installed in such a manner as to be protected against physical injury.

The Contractor shall do such filling between the outside walls of the reinforced concrete elevated railroad as may be necessary to form the subgrade of the Railroad. All the above filling shall be of the character and placed in the manner prescribed in Subdivision 6 for backfilling.

SUBDIVISION 2

GENERAL CLAUSES

SECTION No. 13. It is the very essence of these specifications to secure a railroad structure which (except the elevated portion) shall be free from the percolation of ground or outside water. The mixing and placing of the concrete and the placing and protection of the waterproofing shall be with this end in view.

SECTION No. 14. All materials and workmanship must be of the best class in every respect, and the Engineer shall be the sole judge of their quality and efficiency.

SECTION No. 15. All the work shall be prosecuted in the manner, according to local conditions, best calculated to promote rapidity in construction, to secure safety to life and property and to reduce to the minimum any interference with abutting property and the public travel. Decking of the streets, paving, or other surface work affecting, or affected by, street traffic shall be prosecuted during such hours as will reduce such interference to a minimum. Night work shall be conducted, in accordance with the directions of the Commission, so that annoyance to occupants of abutting property shall be reduced to a minimum, and the Commission may, if in its judgment conditions so require, direct that night work be omitted.

SECTION No. 16. If the Contractor shall not prosecute his work in such manner as to make it probable in the judgment of the Engineer that the work will be completed within the time prescribed therefor, the Contractor, if directed by the Commission, shall increase the number of shifts and the number of men in each shift to such extent as may be necessary to insure the completion of the work within the time prescribed or within the shortest possible time thereafter.

SECTION No. 17. In case of emergencies involving danger to life or property, continuous work with an increased force may be ordered by the Engineer for such time as may be necessary.

SECTION No. 18. No work shall be begun until the Commission through the Engineer shall issue to the Contractor a permit authorizing him to proceed. No permits for excavation will be

issued until the Contractor has given satisfactory assurance to the Engineer that the structural steel and other material needed for construction will be available. The Contractor must conduct his work so as to avoid advancing the excavation for the subsurface portion of the Railroad at any place ahead of the delivery on the work or on property owned or leased by the City of the structural steel required for such place, unless otherwise permitted by the Engineer. If the Contractor elects and is permitted to advance the excavation ahead of such steel delivery it will become necessary for him to support and maintain the trenches until the steel can be obtained; this he shall do entirely at his own risk. The permits shall be in such form and shall cover such portions of the work as the Commission shall prescribe.

SECTION No. 19. Before any opening is made in the surface of a street, a copy of the permit issued by the Commission shall have been filed with the Borough President not less than five (5) days unless the Engineer shall expressly direct work to begin within a less period.

SECTION No. 20. At least one (1) week before commencing work on any part of the route, whether on the Railroad or on the sewers lying off the line of the Railroad, the Contractor shall give notice in writing to the Engineer of his intention to commence such operations; and at least one (1) week before commencing or resuming manufacture of any article called for by these specifications, the Contractor shall give notice in writing to the Engineer of his intention to commence or resume such manufacture, with the name and address of the maker and the amount and description of the material to be manufactured.

SECTION No. 22. In all operations connected with the Works, all ordinances of the City and of the Board of Health and all laws of this State which are applicable to and control or limit in any way the actions of those engaged in the work or affecting the materials belonging to or used by them shall be respected and strictly complied with, and the Contractor shall further strictly comply with all applicable Federal, State and Municipal regula-

tions regarding the transportation of materials in and around the City and Harbor of New York.

SECTION No. 23. Whenever the construction of the Works shall interfere with, disturb or endanger any sewer, water pipe, gas pipe, or other duly authorized subsurface structure, the work of construction at such points shall be conducted in accordance with the reasonable requirements of the Borough President or of the Commissioner of Water Supply, Gas and Electricity or other officer or local authority having the care of and the jurisdiction or control over such subsurface structures so interfered with, disturbed or endangered.

SECTION No. 24. The Contractor shall procure all permits necessary or requisite for the underpinning of buildings and the reconstruction thereof; he shall provide for the water supply necessary for his work and any inspection in connection therewith. He shall provide all work, labor and material in connection with bagging, cutting and capping, installing circulation connections and temporary drips for gas pipes where in the opinion of the Engineer it is necessary to cut off the supply of gas, and also in connection with replacing and restoring such pipes to their original condition. He shall also provide for the shutting off and restoration of the flow in water mains where such work applies to the maintenance and support thereof as provided in Section No. 59.

SECTION No. 25. On cross streets adjacent to the subsurface portion of the Railroad, only such material may be stored as may be necessary, in case of an emergency, to sheet or to support the excavation; or a reasonable amount of such structural and other material as may be absolutely necessary to avoid delay in construction may be stored; such material must not be allowed to accumulate, but must be replenished from day to day. The amount to be so allowed shall be determined by the Engineer. Such material shall not be stored along the streets occupied by the subsurface portion of the Railroad.

SECTION No. 26. Along the streets occupied by the elevated portion of the Railroad and on cross streets adjacent thereto,

only a reasonable amount of such structural and other material as may be absolutely necessary to avoid delay in construction may be stored; such material must not be allowed to accumulate but must be replenished from day to day. The amount to be so allowed shall be determined by the Engineer.

SECTION No. 27. In any case such material may be so stored only with the approval of the Engineer, revocable at any time; and if so ordered, such material shall be removed immediately by the Contractor at his own expense on receipt of the order or within a period of time to be therein stated.

SECTION No. 28. Wherever the work is being carried on, free access must be given to every fire hydrant and fire alarm box, and when required, hydrants shall be extended by suitable tube or piping to an accessible point as approved by the Engineer and to the satisfaction of the Chief of the Fire Department. Materials must not be piled at any time or place within ten (10) feet of any fire hydrant or fire alarm box; and where materials are unavoidably piled or placed in the vicinity of a fire hydrant or fire alarm box, and to such height as to prevent the same from being readily seen, the position of such hydrant or fire alarm box shall be indicated by suitable signals, both day and night.

The Contractor shall guard, maintain and protect the wires, cables, ducts, manholes, posts and poles, signals and fire alarm boxes of the Fire Department. He shall not cause the interruption of the Fire Department Fire Alarm Telegraph service. No Fire Department wire, cable, duct, manhole, post or pole, signal or fire alarm box shall be disturbed except in the presence of a representative of the Bureau of Fire Alarm Telegraph. In case any such wire, cable, duct, manhole, post or pole, signal or fire alarm box shall be disturbed, it shall be restored to its original condition by the Contractor.

SECTION No. 29. The Contractor shall keep the work, streets and all public places occupied by him clear of all refuse and rubbish that may accumulate directly or indirectly from his work and shall leave them in a neat condition; but this is in no way to be construed as placing upon the Contractor the usual duties of the Street Cleaning Department.

SECTION No. 30. Where access to any adjacent property is temporarily cut off, owing to the occupancy of the street by the Contractor, he must render every assistance to the owner or occupant in handling such materials of any description, including all material to be removed by the Department of Street Cleaning, as may have to be taken to or removed from such property; such material shall be taken to or from the nearest accessible point that in the opinion of the Engineer is convenient for handling.

SECTION No. 31. Waste material of any character will under no conditions be permitted to remain on the streets, but must immediately on its becoming unfit for use in the work be carted away and disposed of by the Contractor; nor shall such materials be allowed to accumulate in the trenches.

SECTION No. 32. Necessary conveniences, properly secluded from public observation, shall be constructed and maintained by the Contractor wherever needed for the use of his employees, to the satisfaction of the Engineer and the sanitary authorities.

SECTION No. 33. The Contractor shall during the performance of the work take all necessary precautions and place proper guards and fences for the prevention of accidents and shall put up and keep at night suitable and sufficient lights.

SECTION No. 34. The using of fences and buildings during construction for advertising purposes, other than the name and address of the Contractor, is forbidden; all temporary buildings and fences erected by the Contractor shall be neat in appearance and shall be painted as directed by the Engineer.

SECTION No. 35. Barricades and bridges shall be erected by the Contractor where necessary for the protection of the work or use of the public; they shall be substantial in character and neat in appearance.

SECTION No. 36. The Contractor shall, if required by the Commission, furnish in accordance with drawings to be prepared by the Commission, a building or rooms for the Engineer's office

at a place to be determined by the Commission, together with the equipment thereof, such as lighting and heating fixtures, plumbing, instrument racks, lockers and such other facilities as may be required by the Commission.

SECTION No. 38. During the progress of the work the Commission will give, through the Engineer, to the Contractor, suitable points, marks or benches, indicating the line and grade of the Railroad and of the sewers, such points or bench marks to be established at such intervals as the Engineer deems necessary to enable the Contractor to perform his work. The principal lines and grades will be given by the Engineer, who may change them from time to time as may be authorized and directed by the Commission. The stakes and marks given by the Engineer shall be carefully preserved by the Contractor, who shall give to the Engineer all necessary assistance and facilities for establishing benches and plugs and for making measurements.

SECTION No. 39. Orders and directions may be given orally by the Engineer to, and shall be received and promptly obeyed by, the Contractor or his representative or any superintendent, overseer or foreman of the Contractor who may have charge of the particular work in relation to which the orders or directions are given, and a confirmation in writing of such orders or directions will be given to the Contractor by the Engineer if so requested. The Contractor or his duly authorized representative shall be present at all times on the work to receive orders and directions from the Engineer.

SECTION No. 40. Any imperfect construction which may be discovered before the final acceptance of the work shall be corrected immediately upon the requirement of the Engineer, notwithstanding that it may have been overlooked by the Inspector.

SECTION No. 41. All work of whatever kind which during its progress and before its final acceptance shall become damaged from any cause shall be broken up or removed and shall be replaced by good and sound work.

SECTION No. 42. If any material brought on the ground for use in the work or selected for the same shall be condemned by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove such material.

SECTION No. 43. The Contractor shall employ only competent, skillful and faithful men to do the work. Whenever the Engineer shall notify the Contractor in writing that in his opinion any man on the work is incompetent, unfaithful or disorderly, such man shall be discharged from the work and shall not again be employed on it.

SUBDIVISION 3

GENERAL MANNER OF PROSECUTION AND MAINTENANCE OF TRAFFIC

SECTION No. 44. No building shall, without the consent of the occupant and without notice to the Engineer, be deprived of means of access thereto; and where streets are open, suitable bridges shall be built and maintained to permit owners and occupants to reach their premises. Where necessary, proper and easy means for passengers to reach and leave street cars shall be maintained.

SECTION No. 46. Generally, the Contractor will be permitted to conduct his work in the most expeditious manner possible, having due regard for the safety of persons and property and facilities for traffic and under such instructions as the Engineer may give from time to time.

SECTION No. 47. All necessary facilities shall be furnished by the Contractor for the benefit of street traffic, both on longitudinal and cross streets.

SECTION No. 48. In order to minimize interference with traffic and inconvenience to abutting property owners, during the construction of the Railroad, on all parts of the subsurface portion of the work the streets and sidewalks (including the southerly roadway and sidewalk of Eastern Parkway at and near Utica Avenue) shall be decked or covered over in a substantial manner, and every precaution must be taken to keep traffic free from interruption.

SECTION No. 49. The street intersections for the subsurface portion of the Railroad, except where working shafts are located, shall be kept at all times open for traffic for their full width. Where the decking is temporarily removed from any part of the street the opening shall be protected by suitable fencing and bridging. In all cases the Contractor shall at all times keep all the street crossings on the lines of the sidewalks in a clean and neat condition, bridging gutters and low places where water might collect.

SECTION No. 50. The Commission will insist upon the close observance of the above requirements, and no departure there-

from will be allowed, except in such special cases as may be necessary and then only upon the written permission of the Commission and for such time as the Commission may allow.

SECTION No. 51. Wherever the excavations are decked, or where gases are liable to accumulate, suitable openings shall be provided for proper ventilation.

SECTION No. 52. Wherever the excavations are decked, all gas pipes the services of which cannot temporarily be dispensed with shall be by-passed, if directed by the Engineer, temporary pipes to take their place being laid upon, above or below the street or sidewalk surface. Such work shall include all excavation, backfilling, temporary paving (including maintenance of same), and the restoration of the permanent paving both upon the completion of the by-passing installation and upon the restoration of the original system, all bagging, cutting and capping and installing circulation connections, and all other work, labor and material of whatever character necessary to provide a temporary and independent system of gas supply to take the place of the system originally in the street; connecting such temporary system with the mains in the intersecting streets where necessary; transferring all house and lamp services to such temporary system where necessary; removing and disposing of the material of such temporary system, restoring the original system and its connections and restoring all services. All by-passing pipe laid upon or below the street or sidewalk surface shall be wrought iron of a quality and manufacture to be approved by the Engineer. If laid on a trestle or suspended from cables the pipes shall be flanged, or of other approved connection, and sizes twenty (20) inches in diameter or less shall be rolled wrought-iron pipe.

SECTION No. 53. Temporary pipes, if laid upon or above the street or sidewalk surface, shall be neatly and substantially placed in a manner to cause the minimum of inconvenience to the abutting property owners and to the public. Where by-passing pipes are to cross a street overhead, the trestles or cable suspension shall be of such a height as to give a minimum clear head room underneath the pipe and its supports of fourteen (14) feet.

The trestle or cable suspension to support by-passing pipes shall be of a design approved by the Engineer and shall be painted an approved color.

SUBDIVISION 4

Street Railroad Tracks, Mains and Other Surface, Subsurface and Overhead Structures

Section No. 55. Notice shall be given by the Contractor to all individuals, companies and the proper City officials, owning or having charge of surface, subsurface or overhead structures along any part of the work, of his intention to commence operations along such part of the route, at least one (1) week in advance, and the Contractor shall file with the Engineer at the same time a copy of said notice; and he shall co-operate with the proper parties, officers or officials in charge of such structures and shall furnish them with all reasonable facilities to inspect the methods of caring for their property.

Section No. 56. In the rearrangement of surface, subsurface or overehad structures required to be removed and relaid or reconstructed in order to avoid interference with the Railroad structure, Railroad ducts or Railroad duct manholes or in order to avoid interference with the operation of the Railroad, a tentative drawing will be made by the Engineer, which will be submitted to the parties interested; if any reasonable changes are then requested by any of the said parties within ten (10) days after the submission of the tentative drawing, such changes will then be made if in the judgment of the Engineer they will best conserve the interest of all parties concerned; a further drawing will then be made, which, upon the approval of the Engineer, will be final. If no changes are so requested in said tentative drawing, such drawing shall be final.

Section No. 57. Whenever it becomes necessary to cut, move, change, or reconstruct any surface, subsurface or overhead structures, or connections therewith, such work shall be done according to the reasonable satisfaction of the owners of such structures.

Section No. 58. All work of reconstruction or alteration shall be done with reasonable dispatch, and facilities shall be provided so that said work will interfere as little as possible with the practical working and use of such structures.

SECTION No. 59. The Contractor shall at all times, by suitable bridging or other supports, maintain and support in an entirely safe condition for the usual service and to the reasonable satisfaction of the owners, all surface, subsurface and overhead structures and all their appurtenances encountered or affected during the prosecution of his work; if the maintenance of such usual service makes it necessary, the Contractor shall temporarily remove and relay or reconstruct any such surface, subsurface or overhead structure and shall restore the same or reconstruct the same in a new location prior to the completion of the Works. Also, in order that access may be had in emergencies to gates or valves on water or gas mains and to electric manholes, where such gates or valves and manholes are decked over, trap doors of a suitable size shall be provided in the decking. Wherever an electric manhole has been removed it shall be replaced by a temporary manhole, which shall be so constructed as to reasonably provide the usual facilities, and the cables shall be supported by temporary racks. Wherever possible and as determined by the Engineer reasonable, the ducts shall be supported and maintained; but whenever it becomes necessary to remove the ducts from the cables the cables shall be protected by a satisfactory boxing. All surface, subsurface and overhead structures and all their appurtenances and all surfaces of whatever character along the line of the work shall be protected from injury, and the Contractor shall fully restore such surface, subsurface and overhead structures and all their appurtenances and all such surfaces to, and shall leave them in, as useful, safe, durable and good a condition as existed before construction was begun.

SECTION No. 63. The Contractor shall maintain and support both temporarily and permanently, in a manner that will cause the minimum interference with traffic, and in a safe condition all street surface railroads, including ducts, cables, poles, and all other appurtenances of such railroads; he shall rebuild either in their original or in new locations all parts of such surface railroads, including ducts, cables, poles, and all other appurtenances of such railroads, whose reconstruction or rebuilding may be necessitated by the construction of the work; and he shall construct span-wires and trolley-wire

troughs or other insulating protection under the Railroad structure. The Contractor will be required to support street surface railroads upon compacted backfill unless the Commission shall order masonry piers.

Where the elevated portion of the Railroad is erected over or adjacent to a street surface railroad, trolley trough or other protection for the trolley wire, including all fixtures and appurtenances, shall be furnished and installed as shown on the drawings and in accordance with these specifications. All trolley line material and construction, including trough, fixtures, and all appurtenances, must be satisfactory to the Brooklyn, Queens County & Suburban Railroad Company or other company owning the street surface railroads affected.

From Carroll Street to Montgomery Street and at the East New York Avenue station the street surface railroad tracks will have to be relocated by the Contractor and placed alongside of the Railroad. At these locations the trolley wire shall be supported by approved brackets attached to the Railroad structure or by other means satisfactory to the company owning the street surface railroad. Where the street surface railroad tracks pass from under the Railroad structure the trough shall be continued a sufficient distance to give adequate protection.

All steel work of the Railroad lower than twenty-six (26) feet above the top of rail of the street surface railroad and so located that a trolley pole can make contact between the trolley wire and such steel work will require protection.

Continuous trough shall be provided under the following conditions: Where there is an abrupt change in the height of the trolley wire; where the construction of the Railroad (except at towers) is such that the trolley wire is fifteen (15) feet or less above the top of rail of the street surface railroad; where longitudinal girders or other steel work of the Railroad approximately parallel to the trolley wire require protection. At tower construction the lower chord of the cross-bracing shall be protected by a short trough unless otherwise ordered by the Engineer.

At locations where continuous trough is not necessary, cross girders less than twenty (20) feet above top of rail shall be protected by short trough; and intermediate cross braces

which require protection shall be surrounded by suitable spruce blocks held in place by heavy iron straps.

Where cross girders of the Railroad are twenty (20) feet or more above top of rail of street surface railroad and continuous trough is not required, span wire construction shall be used. Span wire shall be attached to the Railroad columns in an approved manner and the cross girders of the Railroad protected by substantial flash boards of an approved design.

Before erection, the trough, supports, and all wood used to protect iron work shall be painted with one (1) coat of pure white lead and boiled linseed oil and all strap iron shall receive one (1) coat of red lead paint; the entire construction shall be painted over after erection with one (1) coat of an approved paint to match the Railroad structure.

Trolley feeders shall be restored on suitable side arm brackets attached to existing trolley poles or supported on insulators of a design approved by the Engineer mounted on cross arms hung from the Railroad structure by steel straps (stiffened with oak spacers) and clamps in the position designated by the Engineer. Where such feeders are above platforms, but less than ten (10) feet above the platform level a minimum horizontal clearance of six (6) feet from the edge of the platform shall be maintained. In all other cases the minimum horizontal clearance shall be two (2) feet.

SECTION No. 63-a. Along the line of the work there will be encountered at various points poles and wires which it will be necessary to relocate in order to avoid interference with the construction or the operation of the Railroad, which relocations shall be made in accordance with the drawings or as directed by the Commission.

The Contractor shall remove and relocate in a safe and permanent position all wires, cables and poles at stations and between stations which would interfere with the construction or the operation of the Railroad or which would interfere with the completion or with the use of the stations or station approaches or which infringe upon the limit lines hereinafter mentioned, to the reasonable requirements of the several owners and as directed by the Commission.

All wires and feeders that cross the Railroad structure

either above or below the rail, except trolley wires and trolley feeders, shall be either at a height of not less than twenty-two and one-half (22½) feet above the base of rail, or below the longitudinal girders and properly insulated, or if arrangements can be made by the Contractor with the owner and operator of such wire or cable, such wire or cable may at the option of the Contractor be placed in suitable conduit below the street surface. All wires and cables parallel with the Railroad structure, except trolley wires and trolley feeders, shall at stations or mezzanines be at a height of not less than eight (8) feet above the roof of stations and station mezzanines and ten (10) feet above the station platforms; and between stations not less than ten (10) feet above any transverse girder, or if arrangements can be made by the Contractor with the owner and operator of such wire or cable, such wire or cable may at the option of the Contractor be placed in suitable conduit below the street surface. Such parallel wires at heights less than above provided, but at or above the level of transverse girders, may be restored with a minimum horizontal clearance of six (6) feet.

SECTION No. 64. In the event of the owners or the City desiring to make any addition, alteration or extension to their structures or to do any work to or in connection with surface, subsurface or overhead structures owned by them or it or to lay any new structure in or across a street occupied by the Works, at the time this work is in progress, the Contractor shall give said owners or the City all reasonable opportunity to perform such work; provided such work or alteration for the benefit solely of the owners of such structures does not cause the Contractor any serious loss or delay, as shall be determined by the Commission.

SUBDIVISION 5

Excavation

Section No. 65. Special care must be taken to avoid damage wherever excavation under cover is being done or where open excavation is permitted. The width of such excavation shall not exceed the width actually necessary, in the opinion of the Engineer, for the proper prosecution of the work. All excavations shall be of such width (except where trees are to be maintained in place), in addition to that of the Railroad, as shall be necessary, in the opinion of the Engineer, for the proper and expeditious progress of the work, and to permit the laying and readjusting of all sewers, mains, subways and other subsurface structures encountered along the route and contiguous to the Railroad.

Section No. 66. Excavation shall be carried to such depth as may be necessary to permit the laying of such concrete bed, special foundation or drain pipes as may be deemed necessary by the Commission.

Section No. 67. The sides of the excavations shall be secured against slips by suitable sheet piling or sheeting, held in place by braces, shores or waling timbers, special precautions being taken where there is additional pressure due to the presence of buildings or other structures and where trees are to be maintained and supported in place. Where a movement of the ground might cause the settlement of an adjacent building, the sheeting must be started, if near the building, before the elevation of the bottom of the foundation of the building is reached; if away from the building, at such depth of the excavation as the Engineer may permit; and the excavation must not be made in advance of or below the bottom of the sheeting.

Section No. 68. Sheeting shall be driven wherever possible, but when it is placed against the sides of the excavation, the spaces or voids back of the sheeting must be immediately and carefully filled with suitable material to prevent as far as possible the natural ground back of the sheeting from moving.

SECTION No. 69. (1) The Contractor shall secure buildings adjacent to the excavation, either in accordance with Sections Nos. 67 and 68, in the case of buildings supported on firm soils when a slope represented by one (1) foot vertical to two (2) feet horizontal, inclined downward from the bottom outer edge of any building foundation, intersects or passes beneath the bottom outer edge of the completed Railroad structure; or,

(2) When compliance with the provisions of Sections Nos. 67 and 68 is not sufficient to secure adjacent buildings or when necessary to prevent improper pressure against the Railroad structure when completed, the Contractor shall safely and permanently underpin adjacent buildings the foundations of which are above the bottom of the adjacent excavation for the Railroad. By underpinning is meant such method of construction as will transmit the foundation loads directly through the underpinning structure to such lower level as is necessary to secure the buildings and which will relieve the adjacent ground from improper lateral pressures. The underpinning shall be designed to furnish a safe and permanent independent support for each building. To accomplish this result, the Contractor shall use such methods of underpinning, pneumatic or otherwise, as special conditions may require and the Engineer shall approve; or

(3) The Contractor shall, subject to and only with the approval of the Engineer, in lieu of underpinning, construct such form of permanent construction as may be necessary to maintain, protect and secure the adjacent buildings against displacement, provided the safety of the completed Railroad structure will not be endangered by improper pressures from such form of construction and such adjacent buildings.

Before the work is proceeded with, the Contractor shall submit to the Engineer for approval drawings in duplicate indicating the proposed typical and special methods of underpinning or of maintaining, protecting and securing the adjacent buildings.

The Contractor shall, where necessary, underpin or maintain, protect and secure vaults, area ways, retaining walls, fences, stoops or porches. If ordered by the Engineer, the Contractor shall dig test pits alongside the building foundations to determine the necessity for underpinning or for maintaining, protecting and securing a building.

SECTION No. 72. All timber used for sheeting, shoring, bracing, decking or other temporary purposes shall be sound and free from any defects that may impair its strength. The top or wearing surface of all decking used for carriageways shall be of hard, yellow pine (unless otherwise permitted), sound, straight, and free from all shakes and large, loose knots. All sheeting and timber used temporarily shall be put in place by skilled mechanics, keyed tight by wedges where necessary, and so arranged as to be withdrawn readily without endangering the adjoining soil.

SECTION No. 73. The Contractor shall restore, as far as possible, all walls and other parts of vaults, areas and coal holes of abutting property along the line of the Railroad which have been removed on account of the construction of the Railroad.

SECTION No. 74. Wherever vaults of abutting property are broken through or otherwise disturbed, the Contractor shall provide all materials for and erect a six (6) inch hollow tile wall laid in Portland cement mortar, as a temporary partition, on or about the building line or as directed, that will afford proper protection to the owner or occupant of the adjoining premises. Upon the completion of the restoration of the vault such wall shall, unless otherwise directed, be immediately removed and disposed of by the Contractor.

SECTION No. 77. Whenever material requiring blasting is encountered in any excavation, all necessary precautions must be exercised by the Contractor, as required by the ordinances of the City relative to blasting. Explosives shall be used only of such character and strength as may be permitted by the Commission, and the right is reserved for the Engineer to direct that in special cases ordinary blasting powder only, in small charges, shall be used. Blasting shall not be done between the hours of 11 P. M. and 7 A. M. without the express permission of the Commission and then only under such restrictions as it may impose.

SECTION No. 78. The Contractor shall provide such magazines and magazine houses for the storage of explosives in

such localities and in such manner as may be approved by the proper municipal authorities in charge of such matters. No larger quantity of explosives shall be kept on the line of the work than will be actually required for the twelve (12) hours of work next ensuing, and it shall be kept under lock, the key to which shall be in the hands of only the foreman or other equally trustworthy person. The amount of explosives kept in any one place shall not exceed the limit permitted by any ordinance of the City or as may be determined by the Commission. Caps and exploders shall not be kept in the same place with dynamite and other explosives. During freezing weather special precautions shall be taken as to the care and manipulation of dynamite.

SECTION No. 79. Whenever any subsurface structure is encountered in or alongside any excavation, right is reserved to direct that all material within five (5) feet of the same shall be removed by means other than blasting.

SECTION No. 81. Any excess excavation in the bottom of the trench below the net line of excavation shall be replaced by a compacted backfill between supporting walls and columns and by concrete underneath supporting walls and columns. (See Section No. 93.)

SECTION No. 83. Whenever water is encountered in trenches, it shall be removed by bailing or pumping, great care being taken when pumping that the surrounding particles of soil be not disturbed or removed. If necessary to prevent such disturbance, the pumping shall be done by a series of driven wells whose points are protected by fine wire cloths, the rate of flow at each well being made so slow as not to remove the particles of soil; or the pumping shall be done by other means approved by the Engineer. The discharge from all pumps shall be conducted into the adjacent sewers, and the discharge pipes shall be so arranged as to be readily inspected at all times to ascertain if the water is free from particles of soil.

SECTION No. 84. All carts, buckets and other vehicles used by the Contractor for the removal of material shall be tight

and so arranged and so loaded as not to spill. Whenever a cart, bucket or other vehicle so used is leaky or unsuitable, it shall be immediately withdrawn from the work on notification by the Engineer.

SECTION No. 85. Excavated material shall be removed expeditiously and disposed of, in any place selected by the Contractor, subject to the ordinances and regulations of the City authorities governing the disposal of such material and the regulations of the United States Government as to the disposal or dumping of material in and about or near the Harbor of New York.

SECTION No. 87. Excavation includes the excavation of all materials of whatever nature encountered in the trenches, including boulders.

SUBDIVISION 6

BACKFILLING

SECTION No. 93. The trenches at the sides of and over the top of the Railroad and wherever backfilling is necessary, including any void spaces of vaults or other structures below the ordered net lines of excavation which it may be necessary to fill or grade in order to provide the sub-grade for the Railroad, shall be backfilled with sand, gravel or other good, clean earth, free from perishable material and from stones exceeding six (6) inches in diameter, and not containing in any place a proportion of stone of or below that size exceeding one (1) part of stone to five (5) parts of earth. The filling shall be compacted by flooding with water or by ramming in layers not exceeding six (6) inches in depth, as required by the Engineer.

SECTION No. 94. Whenever pipes, sewers or other subsurface structures are met, the filling shall be carefully packed, rammed and tamped under and about such subsurface structures, special tools being used for the purpose. No filling of trenches with frozen earth will in any case be permitted nor will any filling be permitted over frozen material.

SECTION No. 95. As fast as the work of filling permits, sheeting and other timber supporting the sides of the excavation shall be carefully withdrawn and the spaces left by the removal of such material carefully backfilled, but if directed by the Engineer, the sheeting shall be left in place.

SUBDIVISION 7

Piling and Timbering

Section No. 97. If, in the judgment of the Engineer, the ground is of such character as to require piling, the Contractor shall drive such piles as the Commission directs. The piles shall be of good, sound pine or spruce, or other acceptable timber, straight and free from shakes; they shall be not less than twelve (12) inches in diameter at the butt end, nor less than six (6) inches in diameter at the point, and shall be driven to the satisfaction of the Engineer and by means of a steam hammer driver if so required by him. If necessary, the points of the piles shall be protected by proper shoes, and the butts by rings or caps. Piles shall not be spliced unless permitted by the Engineer, and then in such manner as he directs. Piles shall be carefully cut off to the grade given by the Engineer.

Section No. 98. Piles shall be driven in the position and manner and to the depth ordered; if driven in a wrong position or injured in any way by driving they shall be withdrawn and replaced by others. After being driven they shall be cut off to a true plane for proper adjustment with capping timber or masonry.

Section No. 100. If, in the judgment of the Engineer, special conditions so require, the Commission may direct that piles of reinforced concrete of a form of construction approved by the Commission shall be used.

Section No. 102. Timber grillage foundations shall be built if so directed by the Commission.

Section No. 103. All foundation timber shall be of pine or spruce, or other timber acceptable to the Commission, sound and free from shakes. It shall be of such dimensions, and laid in such manner, as the drawings shall require, and shall be held in place by bolts, spikes or good seasoned oak or locust treenails.

SUBDIVISION 8

Cement

Section No. 105. All cement used in the work shall be true Portland cement, by which is meant the finely pulverized product resulting from the calcination to incipient fusion of a properly proportioned intimate mixture of argillaceous and calcareous earths or rocks, to which no addition greater than three per centum (3%) has been made subsequent to calcination.

Section No. 106. Before any cement is furnished, the brand shall receive the approval of the Engineer. Cement, to be acceptable, shall be of a well-known brand which has been in successful use for large engineering works in America for at least five (5) years, and which has an established reputation for uniform character. Preference will be given to cements which, by their records, show a tendency to maintain high strength of mortar with increased age.

Section No. 107. Cement shall be subject to inspection at the place of manufacture or on the work, and to such tests as may be ordered by the Engineer. The Engineer or his representatives shall have access at all times and places to inspect the methods of manufacture, storage and protection, and shall have liberty to inspect the daily laboratory records of tests and analyses at the cement works.

Section No. 108. In general, tests will conform to the methods recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers. Unless otherwise directed, samples will be taken at the place of manufacture by a representative of the Engineer, and sent to the Commission's laboratory, where the tests will be made. If required, tests will be made on the individual samples, without intermixing.

Section No. 109. The cement shall have a specific gravity of not less than 3.10 nor more than 3.25 after being thoroughly dried at a temperature of 212 degrees Fahr. The color shall be uniform, bluish gray, free from yellow or brown particles.

SECTION No. 110. Chemical analyses of cement made from time to time shall show a reasonably uniform composition. Cement shall contain not more than one and three-fourths per centum (1¾%) of sulphuric anhydride (SO_3) nor more than four per centum (4%) of magnesia (MgO).

SECTION No. 111. The fineness of the cement shall be such that it shall leave by weight a residue of not more than eight per centum (8%) on a 100-mesh sieve and not more than twenty-five per centum (25%) on a 200-mesh sieve, the wires of the sieves being respectively 0.0045 and 0.0024 inch in diameter.

SECTION No. 112. It shall develop initial set in not less than thirty (30) minutes unless a more quickly-setting cement is specifically required, and shall develop hard set in not less than one (1) hour nor more than ten (10) hours.

SECTION No. 113. Pats of neat cement, after remaining one (1) day in moist air, shall be kept in air or water of normal temperature for at least twenty-eight (28) days, or shall be exposed to an atmosphere of steam, above boiling water, in a loosely closed vessel for at least five (5) hours; and the separate pats under any of these conditions, shall remain hard without any indications of checking, cracking, distortion, disintegration or blotching.

SECTION No. 114. Neat cement briquettes shall have at the end of one (1) day in moist air a breaking strength, per square inch of sectional area, of not less than one hundred and fifty (150) lbs.; at the end of seven (7) days—one (1) day in air, six (6) days in water—of not less than five hundred (500) lbs.; at the end of twenty-eight (28) days—one (1) day in air, twenty-seven (27) days in water—of not less than six hundred (600) lbs. The strength at twenty-eight (28) days shall be not less than that at seven (7) days.

Mortar briquettes, composed of one (1) part of cement and three (3) parts of Standard Ottawa sand, by weight, shall have at the end of seven (7) days—one (1) day in air, six (6) days in water—a breaking strength, per square inch of

sectional area, of not less than two hundred (200) lbs.; and at the end of twenty-eight (28) days—one (1) day in air, twenty-seven (27) days in water—of not less than three hundred (300) lbs. The strength at twenty-eight (28) days shall show an increase of not less than fifty (50) lbs. over the strength at seven (7) days.

SECTION No. 115. Tests will be made from time to time extending over longer periods than twenty-eight (28) days. If such tests show a tendency to unsoundness or unusual reduction in strength with increased age, the Engineer shall have the right to prohibit the further use of that brand and to require that another brand be substituted.

SECTION No. 116. All cement shall be held in storage to allow ample time for tests to be made before the cement is required for use in the work.

SECTION No. 117. Cement shall be packed and delivered in canvas sacks or other strong, well-made packages, plainly marked with the manufacturer's brand, and sealed in an approved manner. The weights of such packages shall be uniform.

SECTION No. 118. The Contractor shall at all times keep in store on the work, or at some point convenient thereto, an abundant supply of cement, so as to guard against possible shortage. It shall be stored in a weather-tight building, with a tight floor a proper distance above the ground, and with sufficient floor space to admit of storing each lot of cement, of not more than two hundred (200) barrels, or its equivalent, separately, so as to facilitate identification of each individual lot in case of necessity for further tests or rejection. Cement that has become partially set or otherwise damaged shall not be used.

SUBDIVISION 9

MORTAR

SECTION No. 119. All mortar shall be prepared from cement and sand approved by the Engineer. These ingredients shall be thoroughly mixed dry in the proportions specified below; sufficient water shall then be added to produce a stiff paste. Water used in mortar, grout or concrete shall be clean, fresh water. Salt water will not be permitted. The mortar shall be freshly mixed for the work in hand, in proper boxes made for that purpose, and no mortar shall be used that has stood beyond such limit of time as may be determined by the Engineer.

Sand used for mortar shall be clean and shall be graded from fine to coarse to the satisfaction of the Engineer. It shall contain no grains which will not pass a one-fourth (¼) inch mesh sieve nor more than six per centum (6%) by weight which will pass a 100-mesh sieve. Sand shall be of such quality that mortar composed of one (1) part Portland cement and three (3) parts sand by weight will have a tensile and compressive strength equal to mortar of the same consistency made from one (1) part of the same kind of cement and three (3) parts of standard Ottawa sand.

SECTION No. 120. For purposes of mixture, three hundred and seventy-five (375) pounds of Portland cement shall be estimated at three and one-half (3½) cubic feet of volume. The proportions for brick and stone masonry shall be one (1) part cement to two (2) parts sand; for pointing, one (1) part cement to one (1) part sand; for concrete masonry, as specified under the head of concrete; and for other classes of work, as directed by the Engineer.

SECTION No. 121. If required by the Engineer, a grout consisting of one (1) part sand and one (1) part of Portland cement shall be pumped in under pressure, so as completely to fill all the voids in or behind the masonry.

SUBDIVISION 10

Masonry

Section No. 123. All masonry, except as otherwise specified, shall be laid in Portland cement mortar, and shall be built to the forms and dimensions shown on the drawings, or as directed by the Commission from time to time; and the system of joining or bonding ordered by the Engineer shall be strictly followed.

Section No. 124. Care must be taken that no water shall interfere with the proper laying of masonry in any of its parts.

Section No. 125. During freezing weather no masonry shall be built unless properly protected against frost, and masonry shall not be built in exposed places where in the opinion of the Engineer it is impracticable to give such protection. During freezing weather or when there is frost in the materials to be used in the masonry, the materials shall be heated. The Contractor shall provide such appliances, subject to the approval of the Engineer, as are necessary for the heating of the sand, stone and other materials.

Section No. 126. During freezing weather all masonry shall be protected by a suitable covering of salt hay, canvas, tarpaulin or by such material or in such ways as may be necessary to insure it against freezing.

Section No. 127. During hot weather all masonry, especially concrete, shall be kept wet by sprinkling and properly covered until it has become thoroughly set and hardened.

Section No. 128. Unless otherwise permitted, every joint that is to be pointed shall be raked out, within two (2) days after being laid, to a depth of at least two (2) inches.

Section No. 129. Pointing of the face joints of masonry shall be thoroughly made with cement mortar mixed in the proportion of one (1) part of cement to one (1) part of sand, except where otherwise specially provided.

SECTION No. 130. No pointing shall be done in freezing weather, and masonry laid between December 1st and April 1st shall not be pointed until permitted by the Engineer.

SECTION No. 131. Any masonry which is found to be defective from any cause whatsoever, before the final completion and acceptance of the work, must be removed and properly rebuilt, or if damaged during such time must be properly repaired.

SECTION No. 132. All stone before being laid shall be thoroughly cleaned and if so directed by the Engineer shall be washed.

SUBDIVISION 11

Concrete*

Section No. 133. The concrete shall be composed of gravel or broken stone, or a mixture of both, free from all dust and dirt, mixed with the proportion of mortar specified below. The water used in mixing concrete must be clean, fresh water. Salt water will not be permitted.

Section No. 134. Sand for concrete shall be of the kind herein specified for mortar.

Section No. 135. Stone for concrete shall be sound, clean gravel or sound, hard, broken limestone or trap rock, or a mixture of such gravel and broken stone. If a mixture of gravel and broken stone is used, the Engineer may require that the gravel and broken stone be stored separately on the work and mixed in single batches as needed.

Section No. 136. The gravel or broken stone or the mixture of gravel and broken stone shall be graded from fine to coarse, and that which is all of one size, or practically so, shall not be used. It shall be screened or washed so as to remove all dust, and it shall contain no pieces that will pass through a hole three-eighths (⅜) of an inch in diameter, and no pieces that will not pass through a hole one and three-fourths (1¾) inches in diameter. Broken stone or gravel for concrete, graded as above, but between three-eighths (⅜) and three-fourths (¾) of an inch in diameter, may be required for use in special parts of the work.

Section No. 137. In concrete where the thickness is thirty (30) inches or more, if permitted by the Engineer, the Contractor may imbed pieces of clean, sound stone whose greatest diameter does not exceed twelve (12) inches and whose least diameter or thickness is not less than three-fourths (¾) of the greatest diameter. These stones shall be set by hand in the concrete as the layers are being rammed, and shall be so

* See also Subdivision 24 of Part First and Subdivision 5 of Part Second.

placed that each stone is completely and perfectly imbedded. No two (2) stones shall be within six (6) inches of each other and no stones shall be within four (4) inches of an exposed face, nor shall any such stone be placed nearer than six (6) inches to any reinforcing metal built in the concrete.

SECTION No. 138. The proportions of sand and stone (or gravel) used in making concrete shall be by volume as cast into the measuring box.

SECTION No. 139. Concrete shall be as follows: in the floor, sidewalls and roof of the subsurface portion of the Railroad and in the reinforced concrete elevated Railroad, also station concrete, one (1) part of cement, two (2) parts of sand and four (4) parts of stone; for column foundations for the elevated portion of the Railroad one (1) part of cement, two and one-half (2½) parts of sand and five (5) parts of stone. For those portions of the reinforced concrete elevated Railroad which are to have a natural concrete finish treated as required, gravel shall be used in making the concrete.

SECTION No. 140. Protective concrete outside of waterproofing lines shall consist of one (1) part of cement, two (2) parts of sand and four (4) parts of stone.

SECTION No. 141. Whenever practicable, concrete shall be machine mixed. A rotary machine of a pattern approved by the Engineer, and mixing only one batch at a time, shall be used. Concrete shall not be mixed on the surface of the street or decking on the line of the work unless specifically permitted, but the mixing shall be done as close as practicable to the work, so as to avoid too great a lapse of time between the mixing and the placing of the concrete in the forms.

SECTION No. 142. When concrete is mixed by hand the stone or gravel shall be spread on a platform in a bed about six (6) inches thick, and shall be thoroughly wet. Sand shall be spread on a platform and the requisite portion of cement spread on the sand. After thoroughly mixing the cement and sand, the dry mixture thus formed shall be spread evenly over the bed of stone wet as above, and the whole turned over until

thoroughly mixed, but not less than four (4) turnings on the mixing board will be allowed in any case, water being added as necessary. Care shall be taken to keep the bed of concrete wet and avoid piling.

SECTION No. 143. Concrete shall be placed immediately after mixing, in layers of such thickness as may be directed by the Engineer, and shall be thoroughly compacted throughout the mass by ramming or spading, special tamping bars or tools being used as approved by the Engineer. The amount of water used in making the concrete shall be as approved by the Engineer. If a small amount of water has been used in mixing, ramming shall be continued until the water flushes to the surface; as a rule, however, concrete shall be placed wet.

SECTION No. 144. The surface of concrete to which waterproofing is to be applied shall be made smooth at the time of placing and shall be carefully protected from injury by barricades or otherwise until thoroughly set.

SECTION No. 145. Concrete shall be allowed to set for twelve (12) hours, or more, if so directed, before any work shall be laid upon it. No walking over or working upon the concrete will be allowed while it is setting. Concrete shall not be flooded with water before it has thoroughly set.

SECTION No. 146. Before laying concrete on earth the earth shall be rammed as directed.

SECTION No. 147. Wherever a section of concrete is necessarily left unfinished, leaving a surface which will be hard set before additional concrete can be laid, care shall be taken to flush the cement to such surface, and such dovetails or grooves shall be formed as may be necessary to insure a good bond with the new work. If deemed necessary by the Engineer, the joints shall be reinforced with steel bars or dowels.

SECTION No. 148. In all cases of joining old with new work the old surfaces shall be thoroughly cleaned and wet and, if required, a coating of mortar or cement shall be applied before placing the concrete.

SECTION No. 149. Suitable forms shall be provided by the Contractor to support the concrete while it is being placed. These forms shall be immediately replaced by new ones as soon as they commence to lose their proper shape. Before being used they shall be carefully cleaned of cement and dirt in order to insure a perfectly smooth surface on the concrete which is to remain exposed. The forms (except for elevated railroad column foundations) shall be made of wood, kept carefully planed, or made of metal sufficiently thick to enable them to retain their shape without the use of wood. Forms for elevated railroad column foundations shall be made of wood or metal.

SECTION No. 150. No forms made of wood covered with sheet iron will be permitted.

SECTION No. 151. The joints in forms shall be water-tight. If forms are made of wood, the boards shall be tongued and grooved where required by the Engineer.

SECTION No. 152. Every precaution shall be taken to construct the forms in such a manner as will insure a smooth and even surface on concrete which is to remain exposed.

SECTION No. 153. Forms shall be set true to line, firmly secured, and shall be so tight as to prevent water in the mortar from escaping; they shall be thoroughly wet before the concrete is placed and shall be removed as soon after the concrete has been placed as in the judgment of the Engineer may be done with safety to the work. Immediately on the removal of the forms the faces that will remain exposed shall be carefully examined and any irregularities of the surface corrected; projections shall be removed and voids shall be filled with mortar. If, however, the voids are such as to indicate an excessive loss of mortar, portions of the concrete shall be cut out to the fullness of such defects and this space shall be refilled with a rich concrete or mortar in such proportions and in such manner as the Engineer may direct.

SECTION No. 154. Where reinforcing steel or wire mesh is used, efficient means shall be provided to maintain it in the

exact position it is to occupy in the completed work, and to prevent it from becoming dislodged or moved in any manner while concrete is being placed.

SECTION No. 155. Exposed faces of concrete shall be left with the natural concrete finish, the object in view being to obtain a generally smooth finished surface of uniform color. Immediately following the removal of the forms, the removal of the projections and the filling of voids as provided above, the exposed surfaces shall be rubbed down in such a manner, approved by the Engineer, as will insure this result.

The preceding paragraph of this Section does not apply within station limits.

SECTION No. 156. It is intended to obtain concrete impervious to water; the concrete shall be mixed and deposited with this end in view.

The surfaces of drip-pans under ventilating openings and other surfaces which require special provision for drainage shall be troweled.

SUBDIVISION 12

Brick Masonry

Section No. 159. Bricks for masonry shall be of the best quality common bricks, burned hard entirely through, regular and uniform in shape and size and of compact texture.

Section No. 160. Hollow terra cotta blocks or bricks may be required on the outside of walls of the structure or at such other places as the Commission may direct. They shall be of the best porous terra cotta as approved by the Engineer, and shall be of such thickness and shall be laid in such manner as hereinafter specified or as the Engineer may direct.

Similar terra cotta blocks or bricks may be required by the Commission in station work.

Section No. 161. All brick masonry shall be laid in mortar of the quality described in Subdivision 9 of this Part, except that in exposed locations coloring matter shall be added, if required by the Engineer. The bricks shall be laid to line with joints in the face work not exceeding one-fourth (¼) of an inch in the beds, and three-eighths (⅜) of an inch on ends; the bricks shall be thoroughly wet before laying and shall be completely imbedded in mortar under the bottom and on the sides and ends at one operation, care being taken to have every joint full of mortar.

All exterior surfaces shall be smooth and regular.

Section No. 162. The inside faces of all arches and other exposed parts shall have all the mortar scraped off and washed clean immediately after the centers have been struck, and shall be pointed and left in neat condition.

Section No. 163. All bricks of whatever nature shall be carefully culled and if necessary gauged before laying. No "bats" shall be used except in large masses of brickwork, where a moderate proportion, to be determined by the Engineer, may be used, but nothing smaller than half bricks.

Section No. 164. All unfinished work shall be racked back or toothed, as directed by the Engineer, and before new

work is joined to it the faces of the brick in the old work shall be scraped entirely clean, scrubbed with a stiff brush and shall be well moistened.

SECTION No. 165. Where necessary to make a neat joint in connection with steel framework, or at corners, curves, or other similar places, special bricks of proper shape shall be furnished and used. All centers and forms shall be made to fit the curves of the work; they shall be put up and removed in a manner satisfactory to the Engineer.

SUBDIVISION 13

Stone Masonry

Section No. 167. Rubble stone masonry may be required by the Commission for supporting the street railroads over the roof of the Railroad where permanent supports are necessary and at such other places as the Commission may require.

Section No. 168. Rubble stone masonry shall be made of sound, clean stone of suitable size, quality and shape for the work in hand and shall be laid in mortar mixed in the proportion of one (1) part of cement to three (3) parts of sand. All beds and joints shall be well filled with mortar and the work shall be thoroughly bonded.

Section No. 169. In connection with the construction of sewers, or wherever else directed by the Commission, dry rubble masonry shall be used. It shall consist of sound, clean stone not less than three (3) inches thick and one (1) cubic foot contents laid on natural beds with such spalls as are required for leveling and bonded to give the greatest degree of strength.

Section No. 171. In case, during the progress of the work, stone masonry of a different class from that specified above shall be required by the Commission, such masonry shall be constructed according to specifications applicable to the best work of such class.

SUBDIVISION 14

WATERPROOFING

SECTION No. 172. In general, waterproofing of the subsurface portion of the Railroad will be limited to the roof and to those surfaces where water is encountered; waterproofing of the reinforced concrete portion will be limited to the backs of retaining walls and to expansion joints in the retaining walls; waterproofing of the elevated portion will be limited to the track floors and platforms over mezzanines at stations. At other places free drainage shall be provided by pipe drains, hollow tile or broken stone. The entire surface of the back of the retaining walls adjacent to embankment, and the ends of retaining walls at expansion joints shall receive one thick, uniform coat of pitch.

SECTION No. 173. The protective masonry shall be concrete, common bricks or hollow terra cotta blocks as directed by the Commission, laid as herein elsewhere provided, and shall be not less than four (4) inches in thickness.

SECTION No. 174. In places where permanent sheeting is placed at the waterproofing line, the waterproofing, if permitted by the Engineer, may be applied against the sheeting.

SECTION No. 175. All surfaces to which waterproofing is to be applied shall be made as smooth as possible; on these surfaces there shall be spread hot melted pitch in a uniformly thick layer; on this layer of pitch, where required, shall be laid a treated woven fabric of such material as may be approved by the Engineer; this process shall be repeated until such number of layers as may be required by the Engineer have been placed and a final coat of pitch shall then be applied.

SECTION No. 176. The term "ply" as used in these specifications shall mean a layer of treated woven fabric (except the dry-ply), both sides of which shall be coated with pitch at the time of laying.

SECTION No. 177. The number of plies of waterproofing

over the roof of the subsurface portion of the Railroad shall in no case be less than three (3).

SECTION No. 178. On the sides and bottom of the subsurface portion of the Railroad structure where water is encountered, one (1) ply of waterproofing, as described above, shall be used with one or more layers of brick laid in asphalt mastic; the number of layers of brick shall be determined by the Engineer.

In any case where brick laid in asphalt mastic is not used, the number of plies shall be as local conditions require and as directed by the Engineer.

SECTION No. 179. The quality of brick shall be the same as provided in Subdivision 12. The brick shall be properly dried and shall be heated before laying. Each brick when laid shall be entirely surrounded with asphalt mastic.

SECTION No. 181. Six (6) plies of waterproofing may be substituted for brick in asphalt mastic, if approved by the Engineer.

SECTION No. 182. Asphalt mastic may be mixed by hand or in an approved mixing machine and shall contain not less than one-third (1/3) asphalt, the other ingredients to be sand and limestone dust or sand and cement. The ingredients shall be in proportions governed by local requirements and weather conditions. In melting and mixing the mastic its temperature shall not exceed 350 degrees Fahr. All packages containing asphalt shipped to the work must be distinctly labeled with the manufacturer's name and the brand or number of the mixture.

SECTION No. 183. Any masonry that is found to leak at any time prior to the completion of the work and final acceptance thereof by the Commission shall be cut out and the leak stopped.

SECTION No. 184. Pitch shall consist of either coal-tar or asphalt as the Engineer shall elect; it shall be delivered on

the work in packages that are plainly marked with the manufacturer's brand, indicating the grade and quality of the material.

SECTION No. 185. Coal-tar, except for the elevated portion of the Railroad, shall be straight-run pitch containing not less than twenty-five per centum (25%) and not more than thirty-two per centum (32%) of free carbon, and shall soften at approximately 70 degrees Fahr. and melt at 120 degrees Fahr. by the cube-in-water method, shall have a penetration of between 115 and 135 and shall lose not over eight per centum (8%) by weight when tested as provided below for asphalt, being a grade in which distillate oils distilled therefrom shall have a specific gravity of 1.05.

Coal-tar for the elevated portion of the Railroad shall be straight-run pitch containing not less than twenty-five per centum (25%) and not more than thirty-two per centum (32%) of free carbon and shall soften at approximately 100 degrees Fahr. and melt at 150 degrees Fahr. by the cube-in-water method, being a grade in which distillate oils distilled therefrom shall have a specific gravity of 1.05.

SECTION No. 186. Asphalt for waterproofing shall consist of fluxed natural asphalt, or asphalt prepared by the careful distillation of asphaltic petroleum, subject to the approval of the Engineer, but however prepared, it shall comply with the following requirements:

The asphalt shall contain in its refined state not less than ninety-five percentum (95%) of bitumen soluble in cold carbon disulphide, and at least ninety-eight and one-half per centum (98½%) of the bitumen soluble in cold carbon disulphide shall be soluble in cold carbon tetrachloride. The remaining ingredients shall be such as not to exert an injurious effect on the work.

The asphalt shall not flash below 350 degrees Fahr. when tested in the New York State Closed Oil Tester. When twenty (20) grams of the material are heated in a gas oven for five (5) hours at a temperature of 325 degrees Fahr. in a tin box two and one-half (2½) inches in diameter it shall lose not over three per centum (3%) by weight, nor shall the penetration at

77 degrees Fahr. after such heating be less than one-half (½) of the original penetration.

The melting point of the material shall be between 115 degrees and 135 degrees Fahr. as determined by the Kraemer and Sarnow method.

The consistency shall be determined by the penetration which shall be between 75 and 100 at 77 degrees Fahr.

A briquette of the solid bitumen of cross section of one square centimeter shall have a ductility of not less than twenty (20) centimeters at 77 degrees Fahr., the material being elongated at the rate of five (5) centimeters per minute (Dow moulds.)

All tests herein specified must be conducted according to methods approved by the Engineer.

Penetrations indicated herein refer to the depth of penetration in hundredth centimeters of a No. 2 cambric needle weighted to one hundred (100) grams at 77 degrees Fahr acting for five (5) seconds.

SECTION No. 187. The fabric to be used shall be a woven fabric which shall have been treated with pitch before being brought on the work. The fabric and the material used in its treatment shall be approved by the Engineer.

SECTION No. 188. All concrete shall be dry before waterproofing is attached. If, in the judgment of the Engineer, it is impracticable to have the concrete dry, then there shall be first laid a layer of treated felt of approved quality, on the upper surface of which shall be spread the first layer of pitch.

Each layer of pitch shall completely and entirely cover the surface on which it is spread without cracks or blow holes.

SECTION No. 189. The fabric shall be rolled out into the pitch while the latter is still hot, and pressed against it so as to insure its being completely stuck over its entire surface, great care being taken that all joints are well broken by overlapping, and that, unless otherwise permitted, the ends of the rolls of the bottom layers are carried up on the inside of the layers on the sides, and those of the roof down on the outside

of the layers on the sides so as to secure a full lap of at least one (1) foot. Especial care shall be taken with this detail.

SECTION No. 190. When concrete is laid over or next to the waterproofing material, care shall be taken not to break, tear or injure in any way the outer surface of the pitch.

SECTION No. 191. None but competent men, especially skilled in work of this kind, shall be employed to lay the waterproofing.

Steel and Iron

Section No. 193. Steel shall be made by the open hearth process.

Section No. 194. The chemical and physical properties of finished material shall conform to the following limits:

Properties.	Structural Steel.	Rivet Steel.	Steel Castings.
Phos. (Max.)	.04%	.04%	.05%
Sulph. "	.05%	.04%	.05%
Mn. "	.60%	.60%	.80%
Si. "	.10%	.10%	.35%
Ult. Str.	60000±4000	50000±4000	65000 (Min.)
Yield Point (Min.)	55% Ult.	55% Ult.	35000
Elongation, Min. % in 8 inches	1500000 / Ult. Ten. Str.	1500000 / Ult. Ten. Str.	
Elongation, Min. % in 2 inches			20%
Fracture	Silky.	Silky.	Silky, or Fine granular
Cold Bends without Fracture	180° flat.	180° flat.	120° (d.=3t.)

Section No. 195. The yield point shall be that strain beyond which the elongation ceases to be proportional to the weight imposed, and may be indicated by drop of beam. The speed of testing shall be governed by the Inspector.

Section No. 196. Sufficient discard shall be made to insure sound material free from piping or excessive segregation. The material shall be finished straight and smooth, and shall be free from all seams, flaws, cracks, defective edges or other defects. Any imperfection which may develop during the progress of the work will be sufficient cause for rejection.

Section No. 197. Steel castings shall be true to pattern and free from injurious imperfections.

SECTION No. 198. Sample pieces for tensile and bending tests of plates, shapes and bars shall be cut from such portions of the finished product of each melt as the Inspector may designate, and shall be stamped by him; they shall have both faces rolled and both edges milled to the usual form of a standard test specimen,—one and one-half (1½) inches wide on a gauged length of nine (9) inches,—or with both edges parallel. The area of the minimum section shall be not less than one-half (½) square inch.

SECTION No. 199. Angles three-fourths (¾) of an inch and less in thickness shall open flat, and angles one-half (½) of an inch and less in thickness shall bend shut, cold, under blows of a hammer, without sign of fracture. This test shall be made only when required by the Inspector.

SECTION No. 200. Rivet rods shall be tested as rolled.

For rollers and pins the specimens shall be cut from the finished bar so that the center of the specimen shall be one (1) inch from the outside of the bar. The form and dimensions shall be the same as those specified for steel castings.

SECTION No. 201. For steel castings the test piece shall be turned to a uniform minimum section of one-half (½) inch diameter, for a length of at least two and one-half (2½) inches. Specimens for bending shall be one (1) inch by one-half (½) inch in section.

SECTION No. 202. Rivet steel, when nicked and bent around a bar of the same diameter as the rivet rod, shall give a gradual break and a fine, silky, uniform fracture.

SECTION No. 204. For steel castings the number of tests will depend on the character and importance of the castings. Specimens shall be cut cold from coupons molded and cast on some portion of one or more castings from each melt. The coupons shall be annealed with the castings before being cut off.

SECTION No. 205. At least one tensile and one bending test shall be made from each melt of steel as rolled. In case steel

differing three-eighths (⅜) of an inch or more in thickness is rolled from one melt, a test shall be made from the thickest and from the thinnest material rolled. Rolled steel shall be tested in the condition in which it comes from the rolls.

Material which, subsequent to tests at the mills and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected at the shop and shall be replaced by the manufacturer.

If the above tests do not fulfill the requirements of these specifications, duplicate tests may be made at the discretion of the Inspector, he selecting and stamping the duplicate test pieces. If these retests meet all the rquirements, the melt shall be accepted.

SECTION NO. 206. A variation in weight or cross section of any piece of steel of more than two and one-half per centum (2½%) from that specified shall be sufficient cause for rejection, except in case of sheared plates exceeding one hundred (100) inches in width, where the variation may be five per centum (5%).

SECTION NO. 207. Every finished piece of steel shall have the melt number and the name of the manufacturer stamped or rolled upon it. Bars for reinforcing concrete, rivet and lattice steel, and other small parts, may be bundled, with above marks on an attached metal tag.

SECTION NO. 208. The Contractor shall furnish such standard test pieces as may be necessary to determine the uniform quality of the material and also the use of a reliable testing machine, with the necessary labor for testing.

SECTION NO. 209. Chemical determinations of the percentages of carbon, phosphorus, sulphur and manganese shall be made by the manufacturer from a test ingot, so taken, during the casting of each melt of steel, as fairly to represent the melt. Two (2) copies of such analyses shall be furnished to the Engineer or the Inspector.

SECTION NO. 210. The Engineer shall be furnished with complete copies in triplicate of all mill orders, and no material

shall be rolled nor work done before the Engineer has been notified so that he may arrange for the inspection.

The Engineer shall be furnished with complete copies of shipping invoices, in triplicate, with each shipment. Each invoice shall show the scale weight of each individual piece.

Wrought Iron

Section No. 211. All wrought iron shall be double rolled, tough, fibrous and uniform in character. It shall be thoroughly welded in rolling and shall be free from surface defects.

Section No. 212. The methods specified for testing rolled steel shall apply generally to wrought iron. Standard test specimens shall show an ultimate strength of at least fifty thousand (50,000) lbs. per square inch, and an elongation of at least eighteen (18) per centum in eight (8) inches, with fracture wholly fibrous. Specimens shall bend cold with the fibre, through one hundred and thirty-five (135) degrees, without sign of fracture, with inner radius not to exceed the thickness of the piece tested. When nicked and bent the fracture shall show at least ninety per centum (90%) fibrous.

Cast Iron

Section No. 213. Cast iron shall be tough, gray iron made by the Cupola process and shall contain not more than six-tenths per centum (0.6%) of phosphorus and not more than twelve one-hundredths per centum (0.12%) of sulphur. No mill cinder iron, white or burnt iron or inferior scrap of any kind will be permitted in the composition.

Section No. 214. The quality of the iron entering into castings shall be determined by means of the "Arbitration Bar." This is a bar one and one-fourth (1¼) inches in diameter and fifteen (15) inches long, cast under the same circumstances as those which attended the casting of the full-sized piece. This bar shall sustain at the center, when resting upon two dull knife edges twelve (12) inches apart, a load of three thousand (3000) pounds with a deflection of at least one-tenth (0.10) of an inch before rupture.

Two (2) sets of two (2) bars shall be cast from each heat; one set from the first and the other set from the last iron entering into the castings. Each set of two bars is to be made in a single mold.

SECTION No. 215. Castings shall be sound, true to pattern, free from cracks, flaws and excessive shrinkage, and shall have smooth, clean surfaces. They shall be neatly chiseled and wire-brushed before leaving the foundry. Castings which do not accurately conform to dimensions on the drawings will be rejected. Each casting shall have its distinguishing letter or number cast on it at the place indicated on the drawings.

WORKMANSHIP

SECTION No. 216. The workmanship shall be equal to the best practice in modern bridge works.

Shearing and chipping shall be neatly and accurately done and all portions of the work exposed to view neatly finished. All nuts exposed to view on the final structure shall be hexagonal. Lattice bars shall have neatly rounded ends, concentric with rivet holes.

SECTION No. 217. Rods and bars to be used for reinforcing concrete shall be deformed as approved by the Engineer; plain bars will not be used.

SECTION No. 218. Bent rods shall be bent uniformly to template in a machine or press approved by the Engineer. They may be bent either at the shop or on the work. In special cases bending hot and annealing may be required.

SECTION No. 219. All material shall be straightened in the shop before being worked in any way and again straightened after punching and before assembling, if required by the Engineer or Inspector.

SECTION No. 220. The size of rivets called for on the drawings shall be understood to mean the actual size of the cold rivet before heating.

SECTION No. 221. All holes shall be accurately spaced and punched. The diameter of the punch shall be not more than one-sixteenth (1/16) inch greater than the diameter of the rivet. The diameter of the die shall be as small as may be required to punch a clean hole.

SECTION No. 222. Punching shall be accurately done. Drifting to enlarge unfair holes will not be allowed. If the holes must be enlarged to admit the rivet they shall be reamed. Poor matching of holes will be cause for rejection.

SECTION No. 223. Where sub-punching and reaming are required, the punch used shall have a diameter not less than three-sixteenths (3/16) of an inch smaller than the diameter of the rivet. Holes shall then be reamed to a diameter not more than one-sixteenth (1/16) of an inch larger than the nominal diameter of the rivet. All reaming shall be done with twist drills after the material is assembled and firmly bolted together. The use of lubricants in reaming will not be permitted.

SECTION No. 224. All material over seven-eighths (7/8) of an inch thick shall be drilled from the solid. Material over five-eighths (5/8) of an inch and not exceeding seven-eighths (7/8) of an inch in thickness shall be sub-punched and reamed.

SECTION No. 225. Sheared edges of plates, exceeding five-eighths (5/8) of an inch in thickness in main members, shall be planed at least one-eighth (1/8) of an inch.

SECTION No. 226. All burrs on rivet holes shall be removed.

SECTION No. 227. Riveted members shall have all parts well pinned up and firmly drawn together with bolts, before riveting is commenced. Contact surfaces shall be painted.

SECTION No. 228. Rivets when driven shall completely fill the holes, and shall be machine driven wherever possible. They shall have full concentric heads or they shall be counter-

sunk when so required. Rivet heads shall not be flattened to less than one-half (½) the diameter of the rivet on the line of the shank, unless countersunk. Loose, burnt or otherwise defective rivets shall be cut out and replaced. In cutting out defective rivets, great care shall be taken not to injure the adjacent material. If necessary they shall be drilled out.

Distances from center of rivet to edge of sheared plates shall be not less than 1¼″ for ¾″ rivets and 1⅜″ for ⅞″ rivets; distances from center of rivets to a rolled edge shall be not less than 1⅛″ for ¾″ rivets and 1¼″ for ⅞″ rivets. The minimum pitch for ¾″ rivets shall be 2½″ and for ⅞″ rivets 2⅞″. When material is sub-punched and reamed the pitch for ¾″ rivets may be made 2¼″ and for ⅞″ rivets 2⅝″.

Section No. 229. Generally the use of bolts instead of rivets will not be permitted, but when used in special cases the holes shall be reamed parallel, and the bolts turned to a driving fit, with the threads entirely outside of the holes. Washers not less than one-fourth (¼) inch thick shall be used under the nuts. Bolts must be thickly coated with red lead paint before insertion, so as to seal the hole against moisture.

Section No. 230. All holes for field rivets, excepting those in connections of lateral and sway bracing, shall be sub-punched and accurately drilled to an iron template, fitted with bushings or reamed and match marked while the connecting parts are temporarily assembled in the shop. In case of splices of upper chords or other compression members, the abutting ends shall be brought to a forcible bearing.

Section No. 231. Finished members shall be true and free from twists, bends or open joints. Ends of floor beams and stringers shall be faced square and true.

Pins and rollers shall be turned accurately to gauge and shall be straight and smooth and entirely free from flaws. Pin-holes shall be bored true to gauges, smooth and straight; at right angles to the axis of a member and parallel to each other unless otherwise called for. The boring shall be done after the member is riveted up.

SECTION No. 232. Rods and bars which are to receive a thread shall be properly upset. Where threads are cut on steel, they shall be properly filleted.

SECTION No. 233. Steel, except in minor details, which has been partially heated, shall be properly annealed. All steel castings shall be annealed. Welds in steel will not be allowed.

SECTION No. 234. All abutting surfaces shall be accurately planed or faced, so as to insure even bearings, except where otherwise noted on the drawings.

SECTION No. 235. Stiffeners of plate girders shall be faced on the ends and brought to a true contact bearing with the flange angles. Web splice plates and fillers under stiffeners shall be cut to fit within one-eighth (⅛) of an inch of flange angles.

SECTION No. 236. Web plates must not project beyond the flange angles nor be more than one-fourth (¼) of an inch back of face of angles.

SECTION No. 237. Expansion bed plates shall be planed true and smooth. The bottom of the shoes shall be planed exactly parallel to the center line unless otherwise shown. The finishing cut of the planing tool shall be fine and shall correspond with the direction of expansion.

SECTION No. 238. Nuts, bolts, rivets and other similar material shall be boxed.

SECTION No. 239. The scale weight shall be plainly marked upon every piece and box.

SECTION No. 240. Free access and information shall be given by the Contractor for a thorough inspection of material and workmanship.

SECTION No. 241. The Inspector shall make detailed reports

of his inspection to the Engineer and may notify the Contractor of any defects in the material or workmanship, but all acceptances made by him shall be considered temporary, and his inspection shall in no way relieve the Contractor of full responsibility for the character and accuracy of the work.

SECTION No. 242. The Contractor shall be responsible for all errors which can be discovered by checking or examining the drawings.

SECTION No. 243. The Contractor shall furnish for the use of the Inspector a suitably equipped office at the mills and at the shops.

SECTION No. 244. All parts shall be carefully loaded, unloaded and protected from injury during transportation by such means as will be satisfactory to the Inspector. Trucks for transporting steel shall be of the underslung or other approved design and shall be equipped with skids and jacks. Steel and iron shall be lowered gently and not dropped. After delivery of materials at the work the Contractor will be required to store such materials on skids at least twelve (12) inches above the ground and to keep such materials in good condition. Any piece showing injurious effects of rough handling at any stage before the final acceptance of the work may be rejected.

SPECIAL WIRE FORMS

SECTION No. 247. Special wire forms, of a type and weight to be approved by the Engineer, shall be furnished and placed around the flanges of beams and girders which are to be completely encased in concrete, and at other places as may be required, in order to hold the concrete in place.

SUBDIVISION 16 * *

PAINTING

SECTION No. 249. All metal work, except as otherwise herein provided, shall be painted with three (3) coats of paint, as follows: Shop coat, second coat and finishing coat.

The finishing coat for the subsurface and reinforced concrete portions of the Railroad will be a gray paint if adjacent to concrete, otherwise a black paint.

SECTION No. 250. Paint shall be subject to inspection at the place of manufacture and to such tests as may be ordered by the Engineer. The Engineer shall have access, at all times, to all places to inspect the methods of manufacture, and shall have liberty to inspect the daily laboratory records and analyses of all such paints as are subject to his inspection.

The Contractor shall furnish all facilities required for the proper inspection of the paint and its manufacture. All containers will be sealed by the Inspector at the time of inspection.

SECTION No. 251. All proportions mentioned in this specification are by weight, except when otherwise noted.

SECTION No. 252. The paint formulæ are as follows:

PAINT FORMULAE FOR SUBSURFACE PORTION OF THE RAILROAD

			Finishing Coat	
	Shop Coat	*Second Coat*	*Gray*	*Black*
Pigment	500 pounds	49%	57%	26%
Vehicle	16½ gal.	51%	43%	74%
VEHICLE FORMULAE				
Raw linseed oil	2/3 by volume	90%	92%	92%
Boiled linseed oil	1/3 by volume	....	....	....
Drier		10%	8%	8%
PIGMENT FORMULAE				
Red lead	100%	30%	....	25%
Red iron oxide	....	42%	....	....
Lampblack	....	5%	*	50%
Magnesium silicate	....	10%	....	10%
Silica	....	13%	10%	15%
Sublimed White Lead	....	....	60%	....
White Zinc	....	....	30%	....

* Use sufficient lampblack to make standard shade.

** See Subdivision 14 of Part Second for station finish painting.

The paint formulæ for the elevated portion of the Railroad are as follows:

PAINT FORMULAE

	Shop Coat	*Second Coat*	*Finishing Coat*
Pigment	500 pounds	37%	30%
Vehicle	16½ gals.	63%	70%

VEHICLE FORMULAE

Raw Linseed Oil	2/3 by volume	94%	88%
Boiled " "	1/3 " "		
Drier		6%	6%
Turpentine			6%

PIGMENT FORMULAE

Red Lead	100%	50%	
Lampblack	....	25%	40%
Magnesium Silicate	....	10%	20%
Silica	....	15%	
Chrome Yellow, medium C. P.	....		40%

For the subsurface portion of the Railroad the standard weight of second coat shall be 12 pounds 10 ounces per gallon, the standard weight of finishing coat (gray) shall be 14 pounds 6 ounces per gallon and the standard weight of finishing coat (black) shall be 9 pounds 5 ounces per gallon.

For the elevated portion of the Railroad, the standard weight of second coat shall be ten (10) pounds seven and one-half (7½) ounces per gallon and the standard weight of finishing coat shall be nine (9) pounds eleven (11) ounces per gallon.

SECTION No. 253. The shop coat of paint shall be mixed, as needed, in such quantities as can be used before it thickens in the container. Any paint which settles and thickens before use shall be rejected and a new paint mixed.

The second and finishing coats shall be furnished in a ready mixed form and shall be used without the subsequent addition of any material.

All paints shall be properly prepared, using only the specified materials in the proportions stated, with an allowable variation therefrom of not over two (2) per centum in the quantity of any material therein. The paint shall vary not more than four (4) ounces per gallon from the standard weight.

SECTION No. 254. Raw linseed oil shall conform to the specifications of the American Society for Testing Materials for the purity of raw linseed oil from North American seed, adopted August 25, 1913.

Boiled linseed oil shall conform to the proposed specifications of the American Society for Testing Materials, 1915.

When boiled linseed oil is flowed over a plate of glass and allowed to drain in a nearly vertical position, it shall dry free from tackiness in fifteen (15) hours at 70 degrees Fahr.

The drier shall be a pure oil drier consisting of lead and manganese salts dissolved in linseed oil and thinned with turpentine as follows:

Fifteen (15) pounds of manganese dioxide plus 10 pounds of varnish makers' red lead, to 50 gallons of oil, boiled to proper consistency and thinned with 50 gallons of turpentine.

Turpentine shall be gum turpentine and shall conform to the proposed specifications of the American Society for Testing Materials.

SECTION No. 255. Red lead for the shop coat shall be of the best quality, free from all adulteration and shall contain not less than 80% nor more than 90% "true red lead" (Pb_3O_4), not over 1% inert hearth materials (such as silica and alumina) and not more than 0.1% metallic lead; the remainder shall be pure lead monoxide (PbO). It must contain no organic coloring matter and when shaken up with water shall show no alkaline reaction. It shall be of such fineness that 99½% will pass through a standard 200-mesh sieve.

Red lead for the second and finishing coats shall be of the best quality, free from all adulteration and shall contain not less than 85% true red lead (Pb_3O_4), not over 1% inert hearth materials (such as silica and alumina) and not more than 0.1% metallic lead; the remainder shall be pure lead monoxide (PbO). It must contain no organic coloring matter and when shaken up

with water shall show no alkaline reaction. It shall be of such fineness that 99½% will pass through a standard 200-mesh sieve.

Dry lampblack shall be absolutely neutral and shall contain at least 98%, by weight, of pure carbon. The tinting power of lampblack used in the finishing coat shall be the same as the standard sample.

Magnesium silicate shall be a finely ground material of crystalline structure and shall equal the standard sample.

Silica shall be ground from rock crystal and water floated. It shall be 99% pure silica (SiO_2) and shall be of such fineness that 99% will pass through a standard 200-mesh sieve. It shall equal the standard sample.

Red iron oxide shall contain at least 85% ferric oxide, the remainder to consist of silicates. The oxide shall contain no soluble sulphates, no free acids, shall give a neutral reaction and shall contain not over 0.1% sulphur in any form. It shall be free from grit and shall equal the standard sample in shade, quality and tinting power.

Sublimed white lead shall be a true basic sulphate of lead containing not less than 15% combined lead monoxide (PbO), not over 5% zinc oxide (ZnO), and shall contain not more than .075% free sulphur dioxide (SO_2). Sublimed white lead shall equal in whiteness, fineness, body and covering qualities the standard sample.

White zinc shall be "American process," and shall contain at least 98%, by weight, oxide of zinc (ZnO), not more than 0.2% of sulphur in any form, nor more than .075% free sulphur dioxide (SO_2). White zinc shall equal in whiteness, fineness, body and covering qualities the standard sample.

Chrome yellow, medium, C. P., shall be ninety-eight per centum (98%) pure lead chromate or basic lead chromate. It shall be the same as the standard sample in color and strength.

Section No. 256. The paint for the second and finishing coats shall be so finely ground that it will pass each of the following tests:

(a) When a small amount is placed upon a piece of glass and the glass placed in a vertical position, there shall be no separation of the oil from the pigments for at least one (1) hour. This test is to be conducted at 70° F.

(b) Fill a ⅝ inch test tube with pure raw linseed oil to a height of 3½ inches and add paint until the height of the oil is five (5) inches from the bottom. Cork, shake well and let stand in a vertical position for two (2) hours. The opaque mass must not have settled down more than ½ inch and there must be no separation of the coarser particles in the bottom of the test tube. This test is to be conducted at 70° F.

(c) At least 98% of the extracted pigment shall pass through a standard 200-mesh sieve.

(d) When rubbed with a spatula on a piece of glass there shall be no feeling of grittiness.

SECTION No. 257. By standard 200-mesh sieve is meant the 200-mesh sieve described in the specification of the American Society for Testing Materials for Portland Cement, adopted August 16, 1909.

SECTION No. 258. The shade of the gray finishing coat and the finishing coat for the elevated railroad shall match the shade of the standard sample.

The paint shall dry under normal conditions, dust free, in 12 hours, and so as to be satisfactorily recoated in not less than 24 nor more than 48 hours.

The amount of hygroscopic moisture in the finished paint shall not exceed ½ of 1%.

There shall be no rosin in the paint as indicated by the Liebermann-Storch reaction.

SECTION No. 259. The paint shall not liver nor curdle and shall cover properly and work freely under the brush. The pigment shall remain in suspension in a satisfactory manner.

SECTION No. 260. Tests will be made against standard samples. Such analyses as are required will be made by the Engineer.

Due to the cost of inspection, the Contractor will be required to obtain paint which is made within a reasonable distance from New York, and in as large quantities as practicable. By distance from New York is meant the distance by railroad of the paint factory from Manhattan Island. The maximum factory distance is shown in the following table:

For quantities of less than 250 gallons made at one time, 25 miles.
For quantities of 250 to 500 gallons made at one time, 100 miles.
For quantities of 500 to 1500 gallons made at one time, 200 miles.
For quantities of over 1500 gallons made at one time, 700 miles.

Samples of standard ingredients and of the finished paints are on file in the office of the Commission. Paints and their ingredients shall conform to these standard samples. The Contractor shall submit separate samples of all ingredients intended for use in the paints, and upon approval of same, shall then submit two one-pint samples of paint for approval.

In those details where no special instructions are given, the paint and its manufacture shall conform to the best accepted practice.

All materials for shop coat shall be delivered, inspected and sampled in their original packages.

SECTION No. 261. All iron shall be scraped free from scale and rust, and shall receive one coat of red lead paint as herein specified, before leaving the shop. All surfaces which come in contact or are enclosed shall be painted before being assembled. All turned or faced surfaces shall receive a coat of white lead and tallow before leaving the shop. If the Engineer so directs, the shop coat will be omitted on members or parts of members to be imbedded in concrete.

Where the shop coat has become damaged before or after erection, through any cause whatever, it shall be renewed with the same kind of paint as originally used.

Structural steel and rods which are to be imbedded in concrete shall be protected from the weather before being put in place, and shall be cleaned and scale and rust removed before being incased in the concrete. Rods shall not be painted.

After erection the metal shall be thoroughly cleaned of all dirt, rust or scale by stiff wire brushes or sand blast, as directed, and afterward dusted. The Engineer may require that all steel after cleaning shall be wiped with a cloth dipped in a mixture composed of one-half (½) benzine and one-half (½) turpentine. When the above mixture has practically dried but before becoming absolutely dry, the steel shall be thoroughly and evenly painted with the second coat prescribed

herein. No paint shall be applied until the cleaning has been passed upon by the Inspector.

The finishing coat shall be applied at such time after the application of the second coat and before final acceptance of the work, as in the judgment of the Engineer shall be advisable. All steel work for the subsurface portion of the Railroad adjacent to concrete, such as flanges of roof beams and exposed surfaces of wall columns, shall be painted with the gray finishing coat. All other steel work for the subsurface portion of the Railroad shall be painted with the black finishing coat.

SECTION No. 262. Surfaces of exposed members inaccessible after erection, shall be cleaned and painted before erection.

All recesses that might contain water, or through which water could enter, shall be filled with thick paint or a waterproof cement of ground skins before receiving the final painting.

All surfaces so close together as to prevent the insertion of a brush shall be painted thoroughly by using a piece of cloth, if necessary.

SECTION No. 263. All paint shall be well brushed out so as to show a smooth, even film of uniform thickness. Round brushes shall be used exclusively in applying paint.

SECTION No. 264. Painting in rainy or freezing weather or on wet or damp surfaces will not be permitted.

SUBDIVISION 17

Drains and Pumps

Section No. 266. The subsurface portion of the Railroad must, so far as possible, be so arranged that any water finding access thereto will be led away automatically to the City sewers.

Section No. 267. Where the subsurface portion of the Railroad is on an inclined gradient and is constructed in dry, porous soil, the floor of the Railroad may be depended on to act as a conduit. At the bottom of the inclined gradient connections shall be made with a sewer or with subdrains lying beneath the Railroad and draining into the sewers.

Section No. 268. Along such parts of the subsurface portion of the Railroad where the soil is not porous, or where the floor of the Railroad cannot, in the judgment of the Commission, be used as a conduit, there shall be laid, beneath the rail level and on a continuous descending gradient, drain pipes of vitrified salt-glazed stoneware, of the quality described in these specifications for sewer pipe. These drain pipes shall be of such diameter not exceeding twelve (12) inches, as the Commission may direct. Each drain shall be laid in the concrete or directly in the soil with tight or open joints, as directed, and in such manner and in such position as, in the opinion of the Engineer, local circumstances require.

Section No. 269. Where drain pipes connect with the City sewers, the junction shall be protected by suitable traps and back-pressure valves or gate valves where necessary, to prevent back rush of water or gas from the sewers. Connections with the Railroad shall be as necessity demands and as directed by the Commission. Cross drains to connect with the main drains, also vertical drains at the sides of the Railroad, shall be placed at such places and in such manner as the Commission shall direct. These drains shall be of vitrified or cast-iron pipe as directed by the Commission.

Section No. 270. Broken stone shall be placed for the purposes of drainage as indicated on the drawings or as required by the Commission.

SECTION No. 271. At the low points of the grade of the Railroad where the invert lies below the bottom of adjacent sewers there shall be constructed sumps connected with the subdrains or the floor of the Railroad. Such sumps shall be water-tight, with a capacity of not less than eight hundred (800) gallons each.

SECTION No. 272. The Contractor shall keep the subsurface portion of the Railroad dry until the final acceptance of the work. For that purpose he shall provide such pumps as may be necessary.

SUBDIVISION 18

SEWERS

SECTION No. 278. All sewers and appurtenances shall be built of the materials, to the sizes and dimensions, on the lines and grades, at the depths, with the connections and in the manner called for by these specifications and shown on the drawings.

SECTION No. 279. If, in the opinion of the Commission, it is impracticable during the progress of the work to construct any sewers, manholes, or other appurtenances according to the drawings, owing to the presence of unknown subsurface structures or other contingencies, the Contractor shall construct such sewers, manholes or appurtenances in the location given by and according to the directions of the Commission.

SECTION No. 280. The general clauses relating to excavation, backfilling, cement, mortar, masonry, waterproofing, piling, timber work of all kinds, care of streets and public places, maintenance of surface, subsurface and overhead structures, protection of persons and property, repaving or restoring of the surface of the street or other public places, authority of the Engineer to examine and condemn materials, and the power of the Commission and the Engineer in all or any other respects, apply to the construction and reconstruction of sewers, both along the route occupied by the Railroad and elsewhere, except as herein otherwise *expressly* provided.

SECTION No. 283. Not more than one hundred (100) feet of trench in sewers off the line of the Railroad shall be opened at any one time in advance of the sewer already completed, unless by permission of the Engineer and then only for such distance as he shall specify.

SECTION No. 284. The excavation of trenches shall be fully completed a sufficient distance in advance of the laying of the sewer, and the exposed end of the sewer shall in all cases be fully protected.

SECTION No. 286. Where the ground does not afford a sufficiently solid foundation, the trench shall be excavated to

such increased depth as the Engineer may deem necessary, and this extra depth and all other irregularities in the bottom of the trench shall be filled up to the required level and form with such material and in such manner as the Engineer shall direct. If so directed by the Commission, piles shall be driven and a timber or reinforced concrete foundation shall be constructed, as elsewhere provided in these specifications, to support the sewer.

SECTION No. 287. When the trench is properly prepared, and before laying any sewer, the Contractor shall notify the Engineer, who will thereupon cause the grades for the sewer to be tested, and if correct the sewer shall then be laid in the presence of the Inspector, and no construction work shall be done in his absence.

SECTION No. 288. The trenches shall be kept entirely free from water while the foundation and the masonry are being constructed or the sewer laid. In no case shall water be allowed to flow over the invert or foundation or through the sewer until the mortar is thoroughly set.

SECTION No. 289. At all times, gutters shall be kept open for surface drainage, and the streets and sidewalks shall be kept clear and free for the passage of carts, wagons, carriages and street railroad cars or pedestrians, and as otherwise provided in these specifications.

SECTION No. 290. Where any cross-walk or roadway is cut by the trench, it shall be temporarily replaced by a timber bridge with side railings, according to the direction and approval of the Engineer. The work shall at all times be conducted so as to cause as little inconvenience as practicable to the public.

SECTION No. 291. All curb, gutter, flagging, paving and macadam stones, necessary to be removed, which in the judgment of the Engineer are suitable to be used again, shall be stored in such places as the Engineer shall direct, or shall be removed as provided in these specifications; in all cases a

passageway on the sidewalks and in the roadway shall be preserved free from obstructions.

SECTION No. 292. The Contractor shall provide for the flow of all sewers, drains and water-courses interrupted during the progress of the work, shall restore and make good all connections, and shall immediately cart away all offensive matter, in such manner and with such precautions as the Engineer may direct. All temporary house connections shall be made by closed iron pipes, with suitable provision for preventing leakage at joints. Wooden troughs for such connections will not be permitted.

SECTION No. 293. In the construction of brick masonry none but the best quality of common brick burned hard entirely through, regular and uniform in shape and size and of compact texture, shall be used. They shall be culled as they are brought on the ground, and bats and bricks of improper quality shall be removed from the work. A limited number of bats may be used in manholes and closures, and in the outer ring of the sewers where more than two (2) rings of bricks are required.

SECTION No. 294. The bricks shall be properly wet immediately before laying. Every brick shall be laid in a full joint of mortar, made as described in these specifications, on its bed, end and side, at one operation. In no case shall mortar be slushed or grouted in afterward. The bricks shall be neatly and truly laid, every second course to line, and the joints shall be carefully struck on the inside.

SECTION No. 295. All brick work, as it progresses, shall be racked back in courses, and in no case will it be allowed to be toothed, unless by special permission from the Engineer.

SECTION No. 296. All inverts, or bottom curves, shall be formed from profiles accurately made according to the dimensions of the sewer, and correctly set according to the grades furnished. The masonry shall be allowed to set for twenty-four (24) hours before the arch is turned. Vitrified brick or granite paving blocks shall be used for the inner ring of the

invert when required by the Commission, and whenever so used they shall be thoroughly jointed, so as to be water-tight along the inner surface of the sewer. The last course of the invert masonry below the springing line shall be laid as headers.

SECTION No. 297. The arches or upper curves shall be formed on strong centers of correct form, according to the sizes and shapes required, and keyed with stretchers in full joints of mortar. The extrados of the arch shall be plastered with mortar one (1) inch thick, mixed in the proportion of one (1) part of cement to two (2) parts of sand. The centers shall not be removed or withdrawn in less than thirty-six (36) hours, or until the work is thoroughly set, and until the filling in of the arch is properly put into place to a depth which is at least one (1) foot above the crown of the arch. The centers in all cases shall be struck and not drawn, so as not to crack or injure the work. Should any crack or settlement appear in the arch after the centers are removed, so much of the work as the Engineer may require shall be taken down immediately and replaced.

SECTION No. 298. Vitrified or cast-iron sewer pipes or spurs, equal in every respect to those described elsewhere in these specifications, and of a size required by the Commission, but not less than six (6) inches interior diameter with hubs moulded for house connections, and of sufficient length to project at least four (4) inches beyond the exterior of the sewer, shall be built into the walls of brick sewers and at such an angle as may be indicated on the drawings or as the Engineer may direct.

SECTION No. 299. Spurs shall be built in wherever similar house connections exist in the present sewer which is to be reconstructed, but in no case shall the distance be more than twenty (20) feet between spurs. In the case of the construction of new sewers where no sewers existed previously, except sewers crossing intersecting streets, they shall be built opposite each house, and where there are no houses, they shall be not more than fifteen (15) feet apart on each side of the sewer or at such frequent intervals as local conditions may require. They shall be set so that their inner ends shall be

flush with the inner face of the sewer, at such height in the walls as the Engineer may direct, and each pipe shall be sealed on the outside with an approved earthen-ware cover set in mortar.

SECTION No. 300. Where the sewers to be built will be at a depth greater than thirteen (13) feet below the established grade of the street (or below the surface of the street where final grades have not been established), cast-iron spurs or bends of the design shown on the drawings, not less than six (6) inches in diameter and of the weight of extra heavy soil pipe, shall be used unless otherwise ordered by the Engineer. Where house drains are to be connected to these spurs, extra heavy soil pipe and fittings shall be used for the riser between the spur and the house drain. Where spurs are provided for future connections, risers of extra heavy soil pipe shall be placed in each spur and shall be brought to a point thirteen (13) feet below the established grade of the street, the end of which shall be sealed with an approved cover laid in cement mortar. The joints of this pipe shall be packed, leaded and caulked in accordance with these specifications for laying water-mains.

SECTION No. 301. Wherever the sewer passes under another structure, extra heavy soil pipe shall be laid from the spur to the outside of such structure, brought up to a point thirteen (13) feet below the established grade of the street, caulked and sealed as provided above. All pipes passing under such structures shall be laid in concrete.

SECTION No. 302. If, during the construction of the sewers, it is deemed advisable to interchange concrete and brick, the Contractor may, with the approval of the Commission, build such sewers of either kind and quality herein specified.

SECTION No. 303. Concrete sewers shall be reinforced with steel bars, if so indicated on the drawings or directed by the Commission.

SECTION No. 304. Proper profiles for the concrete inverts shall be set up at the required distances, and the concrete

for the bottom and invert of the sewer shall be deposited in place and rammed and worked down to the required shape. The concrete for the bottom and invert, if so directed, shall be placed in alternate lengths extending between every other pair of profiles, so that opportunity may be given to properly work the concrete into place.

SECTION No. 305. The concrete of the invert shall be protected during the progress of the work with planking, or by such other suitable methods as the Engineer shall direct and for so long a time as he may require.

SECTION No. 306. Suitable forms or moulds, of the size and design to be approved by the Engineer, shall be provided by the Contractor to support the concrete of the side walls and roof while the concrete is being rammed into the permanent work.

SECTION No. 307. If any irregular or defective work is discovered upon removing the forms or moulds, such work shall be cut out and the space, also any void spaces, filled with a rich concrete or mortar mixed in such proportions and of such materials as are provided elsewhere in these specifications.

SECTION No. 308. No joints between different sections of the walls of a sewer shall, in any case, be a straight line, but shall always be stepped or toothed, so as to give a broken joint in the manner to be approved by the Engineer.

SECTION No. 309. In so far as they will be applicable to sewers constructed of concrete, the provisions and requirements for spurs, branches, etc., in brick sewers shall be understood to govern in such construction.

SECTION No. 310. Tile pipe sewers shall be built of vitrified, salt glazed stone-ware pipe, with extra deep and wide sockets and corrugated spigot ends. The pipe shall be of the best quality, thoroughly and perfectly burnt, without warps, cracks or imperfections, well and smoothly glazed over the entire inner and outer surfaces and perfect in shape. The

pipe shall be subject to all tests ordered in conformity with any requirements of the Bureau of Sewers of the Borough of Brooklyn, at any time previous to its being used.

SECTION No. 311. The sizes of the pipes shall be designated by their interior diameters. Each pipe shall be a true cylinder, of even thickness throughout, and shall conform to the following scheduled dimensions:

DOUBLE STRENGTH TILE PIPE; EXTRA DEEP AND WIDE SOCKETS

Diameter.	Thickness of shell.	Depth of socket.	Length of plain, straight pipe.	Weight of pipe per ft.	Annular space.
6″	5/8″	2½″	2′	16 lbs.	5/8″
8″	¾″	2¾″	3′	25 "	5/8″
10″	7/8″	2¾″	3′	37 "	5/8″
12″	1″	3″	3′	45 "	5/8″
15″	1¼″	3″	3′	75 "	5/8″
18″	1½″	3¼″	3′	118 "	5/8″
20″	1 2/3″	3½″	3′	148 "	5/8″
22″	1 5/6″	3¾″	3′	157 "	5/8″
24″	2″	4″	3′	190 "	5/8″

SECTION No. 312. All "special" vitrified pipe shall conform to the dimensions given for plain, straight pipe.

SECTION No. 313. Pipes having spurs not less than six (6) inches in diameter with hubs moulded thereon for house connections shall be furnished and laid at such points as indicated on the drawings or as directed by the Commission, and when not immediately used, they shall be sealed on the outside with approved vitrified earthen-ware covers set in mortar.

SECTION No. 314. The provisions for risers on brick sewers shall also apply to pipe sewers.

SECTION No. 315. All pipes shall be laid in concrete cradles of the required form and dimensions. The minimum thickness of concrete under the outside of the shell, or barrel,

shall be six (6) inches. The first layer of concrete shall be for the full width of the cradle, and shall be deposited continuously to the height of the outside bottom of the shell of the pipe; before the concrete has set the pipe shall be firmly bedded therein true to line and grade and the remainder of the concrete immediately deposited and carefully tamped in such a manner as to avoid disturbing the sewer. The ends of the pipes shall abut against each other in such manner that there shall be no shoulder or unevenness of any kind along the bottom half of the sewer on the inside. Unless otherwise ordered, not less than fifteen (15) feet of pipe shall be laid at any one time, in any one length of trench, and it shall be exposed for at least twenty-four (24) hours for inspection.

Section No. 316. Before inserting the spigot end of the pipe into the hub or socket, the lower half of each socket shall be plastered on the inside with a layer of cement mortar mixed in the proportion of one (1) part of cement to one and one-half (1½) parts of sand and of a sufficient thickness to bring the inverts of the abutting pipes flush and even with the established flow line. After pipes are fitted, the space between the inside of the upper half of each socket and the outside of the entering pipe shall be filled with cement mortar, mixed as above specified, and the outside of the joint shall be thoroughly sealed with the same kind of mortar and the joints carefully wiped to a smooth bevel outside, and all mortar that may be left on the inside of the pipe shall be thoroughly removed and the inside of the pipe left clean and smooth throughout.

The ends of pipes, which enter masonry, shall be neatly cut to fit the face of the masonry. When directed, such cutting shall be done before the pipes are built in.

Section No. 317. Sewers of iron pipe, of the quality and laid in the manner described elsewhere in these specifications for the laying of water mains, shall be laid wherever indicated on the drawings or at such places as the Commission shall direct.

Section No. 318. Wherever such pipes are laid through vaults, they shall, when required by the Commission, be provided

with special castings for manholes, which shall be fitted with a cover bolted on so as to make an air-tight joint, according to the drawings.

SECTION No. 319. Whenever, in the opinion of the Commission, it becomes necessary to provide ventilation for sewers under other structures, iron pipe shall be laid from the sewer to the surface of the street and fitted with proper gratings according to the drawings.

SECTION No. 320. All existing sewers, culverts, drains and house connections intercepted by the proposed sewers, culverts or receiving basins shall be connected with the new work by proper curves and grades and in such manner as the Commission shall direct; and all drains, basins or culverts rendered unnecessary or becoming disused by the work herein contemplated shall be filled in and made solid with good, wholesome earth in the manner directed. Provision shall also be made for the connection of future sewers or basins by constructing brick spurs or inserting vitrified pipe at the points indicated on the drawings and at other points as the Commission may direct. These connections shall be closed with bulkheads not less than eight (8) inches in thickness and of the quality specified for brick masonry.

SECTION No. 321. All fresh work shall be carefully protected from injury in every way. No wheeling or walking will be allowed on it and any portion injured shall be relaid by the Contractor; no walking or working over the pipes after they are laid, except as may be necessary in tamping the earth and backfilling, will be allowed until there is at least two and one-half (2½) feet of earth over them.

SECTION No. 322. The interior of pipe sewers shall be carefully freed from all dirt, cement and superfluous material of every description as the work progresses, for which purpose a disc, mould or plate, attached to a rod sufficiently long to pass two (2) joints from the end of the pipe last laid, shall be continuously worked through.

SECTION No. 323. The exposed ends of pipe sewers shall,

in all cases, be protected with a board or other stopper carefully fitted to the pipe, to prevent earth or other substances from washing in, and in no case shall brick or stone be used for that purpose.

SECTION No. 324. The masonry of manholes shall be carried up so that the top of the iron head when set shall be at the level of the established grade of the street at that point or to such height as the Commission may direct, and from templates correctly made and set at top and bottom, between which not less than eight (8) lines shall be drawn. Where manholes are not built to the established grade of the street, they shall be covered, when necessary, by selected bluestone slabs eight (8) inches in thickness, to support the manhole heads. All joints shall be neatly struck and pointed on the inside. Each manhole shall be plastered thoroughly on the outside with cement mortar one (1) inch in thickness, mixed in the proportion of one (1) part of cement to two (2) parts of sand.

SECTION No. 325. The foundations for manholes shall be of concrete or masonry of the kind indicated on the drawings and shall not be less than twelve (12) inches below the invert elevation of the sewer, except as otherwise indicated on the drawings. When any foundation additional to that indicated on the drawings is required, it shall be built as directed by the Commission.

SECTION No. 326. Sewer pipes shall be built in and trimmed, when necessary, so as to be flush with the inner face of the manhole, and an arch, laid in cement mortar, shall be turned over the pipe.

SECTION No. 327. The invert shall be built of vitrified brick, granite paving blocks or concrete masonry, as indicated on the drawings.

SECTION No. 328. A reasonable number of bats not smaller than half bricks may be used in the construction of manholes or receiving basins, provided all interstices are completely filled with mortar.

SECTION No. 329. Standard steps of good quality of galvanized wrought iron, of the size, length and shape required for steps, shall be built into the interior sides of all manholes at a distance apart of not more than fifteen (15) inches vertically and they shall be so arranged that the lowest step shall be not more than two (2) feet above the bench at the bottom of the manholes nor more than two (2) feet above the invert of the sewer where there is no bench. Each manhole head shall be cast with a wrought-iron step on the inside, when directed by the Commission.

SECTION No. 330. Hammer-dressed bluestone of the form and thickness required shall be furnished and laid as indicated on the drawings or as otherwise directed by the Commission.

SECTION No. 331. A cast-iron manhole head and cover of the quality specified for cast iron, and except in special cases, of the pattern adopted by the President of the Borough in which the work is located, and in dimensions, weight and all other respects satisfactory to the Commission shall be fitted on a bed of mortar to each of the above described manholes. Manhole heads and covers which do not conform to these specifications shall be removed at once from the work.

SECTION No. 332. Covers to be used on manholes in the street shall be perforated. Those used on sidewalk manholes shall be tight-fitting, without perforations.

SECTION No. 333. Each manhole head and cover shall have its weight distinctly marked upon it with oil paint. The following shall be allowed as the minimum and maximum weights:

Street manhole head, 475 to 500 pounds;
Street manhole cover, 135 to 150 pounds;
Sidewalk manhole head, 300 to 310 pounds;
Sidewalk manhole cover, 100 to 110 pounds.

SECTION No. 334. When the pavement of the street is asphalt or wooden block, the manhole shall be fitted with a noiseless head and cover, to be approved by the Commission, where new heads and covers are necessary.

SECTION No. 335. All manholes in vaults or other structures shall be provided with sealed manhole heads and covers according to the design indicated on the drawings.

SECTION No. 336. Where a sewer crosses under the Railroad, emergency manholes shall be provided when directed by the Commission and according to the drawings.

SECTION No. 337. Manholes shall in all cases be fully and completely built and fitted with their covers as the work progresses, and the sewers shall not be laid beyond or in advance of any uncompleted manhole.

SECTION No. 338. Receiving basins shall be built as located on the drawings or as the Commission shall direct and in accordance with the drawings. Each portion of the basin shall be built to the size and of the materials designated on the drawings and shall be thoroughly plastered, both inside and outside, with cement mortar in the proportion of one (1) part of cement to two (2) parts of sand.

SECTION No. 339. The foundations for receiving basins shall be of concrete or masonry of the kind indicated on the drawings and shall extend not less than twelve (12) inches below the finished floor of the basin, except as otherwise indicated on the drawings. When additional foundation is required, it shall be built as directed by the Commission.

SECTION No. 340. The flooring shall be of hammer-dressed North River bluestone flagging, not less than three (3) inches thick, in not more than two (2) pieces, and shall be well set in a full bed of mortar and rammed into place. The floor may be finished with cement mortar mixed in the proportion of one (1) part of cement to one (1) part of sand if so directed by the Commission. The mortar shall be spread, while fresh, upon the concrete base and before the latter shall have reached its first set; it shall be in such quantity that after thorough manipulation it shall be one (1) inch in thickness.

SECTION No. 341. Where head stone and gutter stone are required they shall be of sound, durable granite of the dimen-

sions indicated on the drawings, hammer dressed to an even surface and cut to the satisfaction of the Engineer. Cast-iron basin heads and gutter pieces of the design indicated on the drawings shall be set instead of the above when required by the Commission.

SECTION No. 342. A cast-iron cover of a pattern approved by the Commission weighing not less than eighty (80) pounds nor more than ninety-five (95) pounds shall be fitted to the opening in the head stone.

SECTION No. 343. A grate bar made according to the drawings shall be fastened solidly into the head stone in the manner indicated.

SECTION No. 344. A cast-iron trap of the form and dimensions indicated on the drawings, free from inperfections, and properly coated with coal-tar pitch varnish shall be furnished and built into place as directed by the Commission.

SECTION No. 345. The joints shall be tightly fitted with an oakum gasket or with cement mortar if so directed.

SECTION No. 346. Galvanized iron steps of the same design as required for manholes shall be built into the walls.

SECTION No. 347. The culvert pipe for connections with sewers shall be twelve (12) inch vitrified pipe unless otherwise indicated on the drawings, and of the kind and quality previously described, and shall be laid, in all cases, in a concrete cradle of the form and dimensions required for pipe sewers, in accordance with the directions of the Engineer. In case it becomes necessary to connect any basin already built with the work to be constructed, so much of such culverts as in the opinion of the Engineer may be necessary shall be taken up and rebuilt or relaid with vitrified pipe or brick as the case may be, in the manner described above and reconnected in a straight line from the basin to the sewer.

SECTION No. 348. Automatic flush tanks of a type approved by the Commission shall be built where indicated on the drawings or where directed by the Commission.

SECTION No. 349. Whenever, in the opinion of the Commission, it is necessary to waterproof a sewer, chamber or receiving basin, or its appurtenances, it shall be done as indicated on the drawings or as directed by the Commission and in the manner described elsewhere in these specifications.

SECTION No. 350. All masonry shall be laid in Portland cement mortar of the quality described in Subdivision 9. It shall be mixed in the proportion of one (1) part of cement to two (2) parts of sand, except as otherwise specifically provided.

SECTION No. 351. All concrete for sewers shall be made in the proportion of one (1) part of cement to two (2) parts of sand and four (4) parts of stone of the quality described in Subdivision 11.

SECTION No. 352. On the completion of each section of one hundred (100) feet of sewer, the sidewalks and roadway shall be restored as provided under Subdivision 22.

SECTION No. 353. The Commissioner of Public Works shall have the right to connect any sewer or sewers with the sewers herein described or to grant permits to any person or persons to make connections therewith at any time before they are finally completed, and the Contractor shall not interfere with or place obstructions in the way of such person or persons as may be employed in building such new sewer or sewers or in making such connections. This is not to be construed, however, as permitting the introduction of storm water or sewage into any sewer being constructed before its final completion.

SECTION No. 354. During the progress of the work, and until the entire completion and final acceptance thereof, the sewers, drains, basins, culverts and connections shall be kept thoroughly cleaned throughout, and left clean, and the drainage of any old sewer that may be taken up or intercepted shall be provided for and taken care of by the Contractor.

SUBDIVISION 19

Requirements for Pipes

Section No. 363. Whenever it is necessary to relay any water main, all new material required for the same shall be of the quality and laid in the manner specified below, and subject to the various clauses of these specifications applicable thereto.

Section No. 364. The pipes shall be circular cylinders, with the inner and outer surfaces concentric, and of the full interior diameter required.

Section No. 365. The hub or socket and the spigot end shall be shaped in exact conformity with the standards of the Department of Water Supply, to be furnished by the Commission, and will be tested by circular gauges.

Section No. 366. The seat or shoulder of the socket and the end of the spigot shall be straight and even, and at right angles to the axis of the pipe, so as to make a smooth, tight joint. Special care will be required in making the sockets and spigots to conform to the drawings and all pipes will be rigorously inspected at these points. No pipe will be received whose eccentricity at either the spigot or socket end exceeds one-eighth (⅛) of an inch.

Section No. 367. The pipes shall be designated by dimensions of the interior diameter.

Section No. 368. Bands, lugs, buttons, or ribs of such forms and dimensions as the Commission may direct, shall, if required, be cast on the pipes.

Section No. 369. The straight pipe shall be twelve (12) feet long, exclusive of hub; other pipe as may be directed.

Section No. 370. All straight pipes shall be straight in the direction of the axis of the cylinder.

SECTION No. 371. The thickness of pipe, branches and special castings shall be in strict accordance with the standard of the Department of Water Supply, Gas and Electricity.

SECTION No. 372. The weights for straight pipe shall be as follows, in pounds per length:

For Low-pressure Pipes:

60-inch pipes,		special weight.
48-inch pipes,	9,886	pounds each.
42-inch pipes,		special weight.
36-inch pipes,	5,920	pounds each.
30-inch pipes,	4,460	pounds each.
24-inch pipes,	2,965	pounds each.
20-inch pipes,	1,979	pounds each.
16-inch pipes,	1,458	pounds each.
12-inch pipes,	1,018	pounds each.
8-inch pipes,	542	pounds each.
6-inch pipes,	416	pounds each.
4-inch pipes,	286	pounds each.

SECTION No. 373. The thickness of the metal of the pipes and special castings will be tested by calipers after the castings have been freed from sand and cleaned.

SECTION No. 374. For low-pressure pipes the inside diameter of the bells and the outside diameter of the spigot ends of the pipes shall not vary from the standard dimensions of the pipe by more than the following:

For pipes 16″ or less in diam. 0.06 of an inch.

For pipes 20″ and 24″ in diam. 0.08 of an inch.

For pipes 30″, 36″ and 42″ in diam. 0.10 of an inch; and

For pipes 48″ in diam. 0.12 of an inch.

The inside diameter of the bells and the outside diameter of the spigot ends of special castings for low-pressure mains shall not vary from the standard dimensions by more than the following:

For castings 16″ or less in diam. 0.08 of an inch.

For castings 20″ or 24″ in diam. 0.10 of an inch.

For castings 30″, 36″ and 42″ in diam. 0.13 of an inch.

For castings 48″ in diam. 0.16 of an inch.

SECTION No. 375. Any straight pipe the weight of which is deficient by more than the following stated percentages of the standard weight, will be rejected:

For pipe 16″ or less in diameter, 5%

For pipe over 16″ in diameter, 4%

Any special casting the weight of which is deficient by more than the following stated percentages of the standard weight, will be rejected:

For special castings 12″ or less in diameter 10%

For special castings over 12″ in diameter 8%

SECTION No. 376. All straight pipes shall be cast vertically, and all pipes twelve (12) inches or more in diameter shall be cast with the hub end down.

SECTION No. 377. All the castings shall be made in such moulding-sand or loam as will leave the surface clean and smooth.

SECTION No. 378. All the castings shall have cast on the outer side in raised letters of not less than two (2) inches in length and one-eighth (⅛) of an inch in relief, in such manner as the Engineer may designate, the year in which they are cast, the running number of the castings of the same size and form, the letters D. W. S., and the initials or name of the Contractor, and of the foundry where cast, and in case any pipe shall be condemned, the letters D. W. S. shall be erased by the Contractor.

SECTION No. 379. The metal of which the castings are to be cast (which shall be remelted in a cupola or air-furnace) shall be pig-iron, made without any admixture of cinder-iron or other inferior metal, and shall be of such character as to make a pipe strong, tough and of an even grain, entirely free from uncombined carbon when seen under the microscope, and such as will bear, satisfactorily, drilling and cutting, and shall have a tensile strength of at least sixteen thousand (16,000) pounds to the square inch.

SECTION No. 380. The castings shall be free from scoria, sand holes, air bubbles, and other defects and imperfections.

SECTION No. 381. The castings shall be perfectly cleaned and no lumps shall be left on the inner surface of the barrels or sockets, or on the outer surface of the spigot end. The castings shall be subject to hammer inspection. Iron-wire brushes shall be used, as well as softer brushes, to remove the loose dust. No acid or other liquid shall be used in cleaning the castings.

SECTION No. 382. Every pipe, branch and special casting shall be carefully coated inside and out with coal-tar pitch and oil. Every casting shall likewise be entirely free from rust when the coating is applied. If the casting cannot be dipped immediately after being cleaned, the surface shall be oiled with linseed oil, to preserve it until it is ready to be dipped. No casting shall be dipped after rust has set in.

SECTION No. 383. The coal-tar pitch shall be made from coal-tar distilled until the naphtha is entirely removed and the material mixed with linseed oil so as to make a smooth, tough and tenacious coating. Pitch which becomes hard and brittle when cold will not answer for this use.

SECTION No. 384. Pitch of the proper quality having been obtained, it shall be carefully heated in a suitable vessel to a temperature of three hundred (300) degrees Fahrenheit, and shall be maintained at not less than this temperature during the time of dipping. The material will thicken and deteriorate after a number of pipes have been dipped; fresh pitch shall, therefore, be frequently added, and occasionally the vessel shall be entirely emptied of its old contents and refilled with fresh pitch.

SECTION No. 385. Every casting shall attain a temperature of three hundred (300) degrees Fahrenheit, before being removed from the vessel of hot pitch. It shall then be slowly removed and laid on skids to drip.

SECTION No. 386. No casting shall be dipped until the Inspector has examined it as to cleaning and rust, and subjected it thoroughly to the hammer test. It may then be dipped, after which it will be passed to the hydraulic press to meet the required water test. The proper coating shall be tough and tenacious when cold on the pipes, and not brittle or with any tendency to scale off.

SECTION No. 387. The castings shall be capable of sustaining a pressure, in the hydraulic press, of two hundred and fifty (250) pounds per square inch, and any casting which shows any defect by leaking, sweating or otherwise, will be rejected. This test shall be made at the foundry.

SECTION No. 388. The castings shall be weighed, and the weight distinctly marked on the castings in white paint. The Contractor shall provide at the foundry where the pipes and castings are to be manufactured proper sealed scales and weights for weighing the castings.

SECTION No. 389. On low-pressure mains, unless otherwise ordered, each pipe twenty-four inches and larger in diameter shall be placed in the trench on two blocks and four wedges of sound hemlock lumber, the wedges to rest on the blocks and the pipe on the wedges. Where the bottom of the trench is rock, or if ordered by the Engineer, the 12-inch, 16-inch and 20-inch pipe shall also be placed on blocks and wedges.

The blocks for the 48-inch and 36-inch pipe shall be forty-eight inches long, twelve inches wide and six inches thick, with wedges eighteen inches long, six inches wide, four inches thick on one end and one-half inch thick on the other; the blocks for 30-inch and 24-inch pipe shall be thirty inches long, twelve inches wide and four inches thick, with wedges fifteen inches long, five inches wide, three inches thick on one end and one-half inch thick on the other. The blocks for the 20-inch pipe shall be twenty inches long, eight inches wide and four inches thick; the wedges six inches long, four inches wide and three inches thick on one end and one-half inch on the other. The blocks for the 16-inch and 12-inch pipe shall be sixteen inches long, six inches wide and four inches thick; the wedges six inches long, four inches

wide and three inches thick on one end and one-half inch on the other.

SECTION No. 391. The spigot end of the pipe shall be inserted into the hub to the full depth of the bell, and the space around the pipe shall be equalized so as to give as nearly as possible an equal space for the packing. The space between the pipe and hub shall be packed with clean, sound jute packing yarn, free from tar, far enough to leave the proper space for lead. The remaining space shall then be filled by running it full of lead to a depth of four (4) inches, with a bead outside of the face of the hub large enough to allow for caulking, so that when the joint is properly caulked the lead will be flush with the hub of the pipe. After the joint shall have been run with lead, it shall be caulked by means of proper tools, so as to make a water-tight joint.

SECTION No. 392. The lead to be used shall be of the best quality of pure, soft lead, and in every respect suitable for the purpose.

SECTION No. 393. In case it becomes necessary to cut any connection with any other main, house or hydrant, or in any way to interfere with the continuous and normal flow of water, due notice shall be sent at least forty-eight (48) hours in advance to the Engineer, the Commissioner of Water Supply and the consumers, and the Contractor shall, if so ordered, make a temporary by-pass or other arrangement to preserve the flow of water while breaking connections.

SECTION No. 394. All connections cut, interfered with or injured shall be restored under the directions of the Engineer, without delay and in accordance with the rules and regulations of the Department of Water Supply governing such matters, to a suitable condition as good as existed before commencing work.

SECTION No. 395. Stop cocks, boxes, branches, curved pipe, and other specials according to the standards of the Department of Water Supply shall be set where necessary.

SECTION No. 396. For all pipes, other than water mains, the standard weights and all other requirements shall be in accordance with the standard specifications and requirements of the several owners of such structures.

SUBDIVISION 20

Railroad Ducts

Section No. 397. The ducts to contain cables for transmitting electricity for the operation of the Railroad shall be of the one-way form with circular holes.

Section No. 398. The dimensions and form of each piece shall conform to the following requirements:

The length shall be eighteen (18) inches, except that a sufficient number of short pieces of various lengths shall be furnished to lay on curves and to piece out at manholes, so as to bring the ends of all ducts into a vertical plane.

The minimum inside diameter of holes shall be such as to pass a mandrel three and one-half (3½) inches in diameter.

The outside width shall be not less than five (5) inches nor more than five and one-fourth (5¼) inches measured at right angles to the flat of each side.

The thickness of the walls measured at the thinnest part of the body of the duct shall be not less than five-eighths (⅝) of an inch.

The ducts shall be made square on outer lines. Ducts shall have the outside corners cut off to leave a flat surface of not less than two and three-fourths (2¾) inches, the ends to be cut smooth and at right angles to the axis of the duct and beveled on the inside for one-half (½) of an inch.

Section No. 399. Ducts shall be combed on each face with at least five (5) longitudinal combings, each combing to have a width of one-fourth (¼) of an inch and a depth of not less than one-sixteenth (1/16) nor more than one-eighth (⅛) of an inch.

Section No. 400. All ducts shall be manufactured of the best clay, mixed thoroughly and in proper proportions, burnt hard through their entire thickness until well vitrified but in no case so burnt as to be fused or scoriated. The clay used shall be plastic and smooth, perfectly free from limestone, lime pebbles, pyrites and chalk, and sufficiently fireproof to acquire proper density before vitrification takes place. The clay shall be well pulverized and made perfectly homogeneous,

and the surface of each piece both inside and outside shall be thoroughly glazed in the most approved manner with good salt glaze. The ducts shall be sound and without soft spots, stones, gravel, cracks, breaks or blisters, and the interior surface shall be free from warts, tits, nodules, chips, breaks, rough spots or cracks that in the opinion of the Engineer may prove injurious. Each duct shall be practically straight and under no circumstances will any piece be accepted which shall have a bow, curve or kink sufficient to prevent the passage of a mandrel three and one-half (3½) inches in diameter and twenty-four (24) inches long. No piece will be accepted if it shall have a bow, bend or kink in more than one direction. Throughout its entire length the bore shall be straight, smooth and circular. The center of the bore shall be exactly in the center of the ducts.

SECTION No. 401. All ducts shall be subject to inspection at the place of manufacture and on the work and at any other time and place required by the Engineer. All rejected ducts shall be promptly removed by the Contractor.

SECTION No. 402. The ducts shall be laid in beds of cement mortar, about one-fourth (¼) of an inch in thickness, with broken joints both horizontally and vertically, true to line and grade, and so placed that there shall be no shoulders or offsets in the bore. All interstices shall be filled with mortar. In laying ducts care shall be taken to close abutting joints so that the ends of all consecutive ducts shall be practically in contact on all sides.

SECTION No. 404. Two (2) strips of thick, unbleached muslin six (6) inches wide and coated with neat cement mortar shall be used to wrap each joint, the ends of the wrap to lap four (4) inches. The muslin shall be not less than 56x60 count, weight not less than four (4) ounces to the yard and width thirty-six (36) inches. Where ducts are laid on curves, the wraps shall be doubled if required, to protect the openings between the ends of the ducts on the outer line of the duct

and to exclude all mortar from duct openings. Metal wraps will not be permitted.

SECTION No. 405. Ducts shall be laid with a link mandrel of a length and diameter to be prescribed, which shall be drawn through each duct as it is laid, so as to remove all projections of mortar that may be in the ducts; the mandrel shall also be equipped with a suitable swab to remove all loose material in the ducts; the mandrel shall be left in each duct until the succeeding duct is laid.

The ducts shall be laid within a concrete envelope four (4) inches thick on the top and bottom and three (3) inches thick on the sides, well tamped into place.

SECTION No. 406. After the duct bank has been completed and the trench backfilled, the manholes built and heads set, the ducts shall be rodded by pushing a wooden mandrel through the bore. This mandrel shall be of approved design, three and one-fourth (3¼) inches in diameter, eight (8) inches long and screwed to the end of the rod. If obstructions are found in rodding the ducts which cannot be removed by cleaners so as to give a clear and smooth opening sufficient to pass the above mandrel without damaging the duct, the duct shall be removed and relaid. All ducts during construction and after being rodded shall be plugged with suitable plugs to be furnished by the Contractor. If wooden plugs are used they shall be immersed in water for at least eight (8) hours before being put in place.

SECTION No. 408. Generally the Railroad duct line will be constructed as indicated on the detailed plans, but to escape subsurface structures it may be placed in another location as ordered by the Commission. Railroad duct manholes shall be built as indicated on the drawings or as directed by the Commission. These manholes shall be generally at intervals of about four hundred (400) feet. They may vary in form to adapt the work to local conditions.

The drain pipes for the duct manholes shall be vitrified pipe of the best quality, thoroughly and perfectly burnt, without imperfections, well and smoothly glazed inside and outside and perfect in shape.

SUBDIVISION 22
Surfaces Restored

Section No. 420. As soon as the structure in any excavation or trench made within a street (including the roadways in Eastern Parkway) shall be completed and the trench permanently backfilled, a temporary pavement shall be laid and maintained for at least four (4) months in a condition satisfactory to the Engineer; and whenever after such time the earth shall, in the opinion of the Engineer, have become sufficiently settled, the Contractor shall proceed to restore the surface to a condition similar to, and equally as good as, that existing previous to the commencement of construction. In cases where a temporary backfilling is placed pending further work to be done in the same excavation, a satisfactory temporary pavement for proper maintenance of traffic shall be laid if deemed necessary by the Engineer.

Section No. 421. All the requirements as to street and park surface restored shall apply to the trenches for sewers, pipes, Railroad ducts or other subsurface structures along or off the line of the Railroad.

Section No. 422. Nothing contained in these specifications shall be understood or construed as prohibiting the Contractor from making any arrangement with the President of the Borough or the Commissioner of Parks or such other officer of the City as may be in charge of the roadway pavement, sidewalk or other surface covering (including the roadway and park surfaces in Eastern Parkway) to lay a better or other form of roadway pavement, sidewalk or other surface covering in place of the roadway pavement, sidewalk or other surface covering taken up; in which case the Contractor shall file with the Commission a copy of his contract with such municipal officer duly acknowledged in writing by both parties.

In case the municipal officer in charge of the roadway pavement, sidewalk or other surface covering (including the roadway and park surfaces in Eastern Parkway) desires to lay a roadway pavement, sidewalk or other surface covering different from the one removed and shall notify the Commission in writing that he has failed to make satisfactory arrangements

for such work with the Contractor or in case the Commission shall for any other reason deem it advisable so to do, then the Commission, in its discretion, may direct the Contractor to finish and dress off the filling over his work to such grade as the Commission may select and further direct him to remove from the area to be restored all material of whatever nature not required to be relaid and to permit another contractor to lay such roadway pavement, sidewalk or other surface covering; in which case the liability of the Contractor shall cease, as far as that part of his work is concerned, whenever the instructions of the Commission have been complied with, exactly the same as if the Contractor had fully completed the restoration as hereinbefore provided.

When required by the Commission, the Contractor shall furnish and set contiguous to ventilating grating work and station vault light work new bluestone or eight (8) inch granite curb dressed to fit the structure.

When required by the Commission, the Contractor shall set such new curbs, or restore the old curbs contiguous to such grating and vault light work when new ones are not ordered, at a new line to be established by the President of the Borough or the Commissioner of Parks or other proper officer of the City.

SECTION No. 425. All street and park surface either along or off the line of the Railroad, that may have become damaged, directly or indirectly, as a result of the Contractor's operations, shall be restored by the Contractor to a condition similar to and equally as good as that existing previous to the commencement of construction.

Where any grass plots or trees exist along any street occupied by the Contractor, proper precautions must be taken to protect them from injury. For every tree removed, injured or destroyed, the Contractor shall set out a new, thrifty tree of the same kind as the tree removed, injured or destroyed, and not less than fifteen (15) feet in height and not less than three and one-half (3½) inches in diameter measured two (2) feet above the surface of the ground, and in such position as the Commissioner of Parks shall indicate. All grass plots,

shrubbery and other plants removed or affected by the construction of the Railroad, shall be restored as soon as possible to as good a condition as existed before the commencement of the work. In replanting trees and the replanting of grass plots and shrubbery and other plants the Contractor must be governed by the reasonable requirements of the Commissioner of Parks or by other authorities specially charged with the care of these trees, grass plots, shrubbery or other plants, and the nature and depth of the soil to be placed therein must be as approved by such authorities and by the Commission.

In any park or parkway the Contractor must take proper precautions to protect from injury all trees, roads, cross-paths, grass plots, shrubbery and other plants and other park features, and when the same are removed, injured or destroyed by the construction of the Railroad, they (except trees) shall be restored as soon as possible to as good a condition as existed before the commencement of the work. The nature and the depth of the soil to be placed and all other work in connection with such restoration must be governed by the reasonable requirements of the Commissioner of Parks or of other authorities responsible for the care of such parks or parkways. For every tree removed, injured or destroyed, the Contractor shall set a new tree, as provided in the preceding paragraph of this section.

Nothing contained in the foregoing provisions of this Subdivision *22* shall be construed as applying to the trees in Eastern Parkway, the matter of the maintenance, protection, preservation, removal and replacing of said trees being governed by the provisions of Section No. 425-a.

SECTION No. 425-a. The Contractor shall maintain, protect and preserve in place undisturbed and in as good a condition in all respects as existed before construction was begun all the trees in Eastern Parkway which are four (4) feet or more outside the net outside lines of the Railroad structure measured horizontally from such net outside lines to the nearest point of the trunk of the tree at a height two (2) feet above the surface of the ground at the tree, together with the soil within a radius of six (6) feet of the outside of the trunk of said trees and for a

depth within said radius of eight (8) feet from the surface of the ground at the tree.

The Contractor may remove any trees in Eastern Parkway which are within the net outside lines of the Railroad structure or which are less than four (4) feet outside such net outside lines measured horizontally from such net outside lines to the nearest point of the trunk of the tree at a height two (2) feet above the surface of the ground at the tree.

Where the Contractor is permitted to remove any tree in Eastern Parkway and does remove the same, he shall, if required by the Commission, replace the tree so removed with a new thrifty elm tree six (6) inches in diameter measured two (2) feet above the surface of the ground, such replacing to be satisfactory to the Commission and in accordance with the reasonable requirements of the Commissioner of Parks.

SUBDIVISION 23

Gratings

Section No. 426. **Steel gratings shall be provided and placed over fan and other ventilating chambers at places** shown on the drawings or at other places if required by the Commission. They shall be constructed as shown on the drawings.

Reinforced Concrete Elevated Railroad

Section No. 427. Besides the concrete usually required in subway and elevated railroad construction work as specified in Subdivision 11, a portion of the Railroad will be constructed as a reinforced concrete open cut and elevated railroad, extending from about Station 109+65 to about Station 114+65, as shown on the drawings. Such portion of the Railroad to be built as a reinforced concrete open cut and elevated railroad is referred to in these specifications as the "reinforced concrete elevated Railroad." The reinforced concrete for such reinforced concrete elevated Railroad shall be constructed in accordance with the requirements of Subdivision 11 (except the requirements of Section No. 137 or as otherwise qualified in this subdivision), and also in accordance with the requirements of this subdivision.

Section No. 428. The lumber for wooden forms and centers shall be spruce or Norway pine or other approved wood, sound and free from knots, shakes and rot. The lumber for forms shall be tongued and grooved, dressed on the side next to the concrete surfaces which will be exposed in the finished work, and also dressed in any other manner which may be necessary to secure water-tight and smooth fitting forms.

Section No. 429. Metal forms, if used, shall be made of metal sufficiently thick to retain their shape without the use of wood. No forms made of wood and covered with iron will be permitted.

Section No. 430. Forms shall be constructed by experienced and capable workmen and shall be of first-class workmanship throughout. For exposed surfaces of concrete the boards shall be carefully matched. The forms shall be constructed so as to secure beveled or chamfered edges for beams and columns where ordered, and when required the edges or corners of the forms shall be rounded at interior angles formed between intersecting concrete surfaces. The forms shall be constructed so that the lagging can be removed without disturbing the support for the concrete, in order that the concrete surface may be subjected to a finishing process when

the concrete has reached the proper age for treatment. All forms shall be lubricated with a thick and heavy filler oil of a quality known as "sludge" or its equal. Just before being used forms shall be carefully cleaned of all cement, dirt and debris in order to insure a perfectly smooth surface on the concrete which is to remain exposed.

SECTION No. 431. Every precaution shall be taken in placing or assembling the forms to do so in such a manner that when removed, after the concrete has been placed, the faces of the concrete that are to remain exposed shall present a smooth and even surface.

SECTION No. 432. Forms shall be removed as soon after the concrete has been placed as may be done with safety to the work, but no forms shall be removed without previous notification to the Engineer. Such notification shall not relieve the Contractor of responsibility for the construction and for the removal of such forms and for the proper execution of the work. Immediately on the removal of the forms the faces of the concrete that will remain exposed shall be carefully examined and any irregularities of the surface corrected; projections shall be removed and voids filled with mortar. All projecting wires, bolts or other devices that are used for holding forms and that pass through the concrete shall be cut off at least one (1) inch beneath the finished surface and the ends covered with mortar. Care shall be taken to form perfectly all edges, arrises and mouldings. If after the removal of the forms it is found that any of these lines are imperfect, the cement film shall be cut away to insure a proper bond and such lines shall be restored. In order to secure a uniform surface color and texture, the mortar to be used for filling voids, to cover the ends of projecting wires, bolts or other devices and to restore edges, arrises and mouldings shall be of the same materials and of the same proportions as that contiguous to such restored work.

SECTION No. 433. Concrete to which waterproofing is to be applied shall be made smooth at the time of laying and shall be carefully protected from injury until thoroughly set.

SECTION No. 434. It is intended to obtain concrete impervious to water; the concrete shall be mixed and deposited with this end in view, and if required, it shall be carefully troweled as may be directed in order to add to its imperviousness. Surfaces which require special provision for drainage shall be troweled.

SECTION No. 435. Arch centers shall be constructed so as to remain as nearly as possible constant in level and form from the time they are ready for the concrete until the time of their removal from under the arches; they shall also be constructed so that they may be removed with ease and without shock or jar to the concrete masonry. The main members of centers shall be bolted together at the joints. Centers shall not be removed from under the arches in less than twenty-eight (28) days after the concrete of the arch is entirely in place.

SECTION No. 436. All surfaces of the concrete masonry for the reinforced concrete elevated Railroad which are to remain exposed (except the inside faces of the walls adjacent to the tracks, below the balustrades) shall be tooled with pneumatic hammers to uniform surfaces, the surfaces where irregular to be dressed back to true planes. Edges or arrises, borders, etc., shall be rubbed to a smooth surface.

Immediately following the removal of the forms (or lagging only if directed), followed by the removal of the projections and the filling of the voids, etc., as herein provided, the inside faces of the walls adjacent to the tracks, below the balustrades, shall be rubbed down in such a manner as may be directed and so as to insure a generally smooth, uniform, and finished natural, concrete surface, in accordance with Section No. 155.

SECTION No. 437. Where surfaces of the concrete are to remain exposed, care shall be taken to insure the flushing of the cement against the forms. This shall be done by careful spading and puddling while the concrete is being placed, for which special tools shall be provided as required.

SECTION No. 439. In order to remove the cement film and to obtain the desired tooled surfaces, the pneumatic hammer or hand tools ordinarily used for dressing stone surfaces shall be used when required.

PART SECOND—STATION FINISH WORK

SUBDIVISION 1

General

SECTION No. 120. The general provisions and requirements for workmanship and material given in Part First of these specifications are to be deemed to apply to Part Second of the specifications to the extent to which they are applicable.

The Contractor shall furnish such samples as may be required by the Engineer of materials and models of all ornamental work and lettering.

SECTION No. 121. The Contractor, in order to prevent the access of unauthorized persons to the Railroad structure and to protect stations from vandalism, shall board up all station stairway entrances as soon as the stairways are constructed and shall keep a watchman at each station at all times until the final acceptance of the work. The Contractor shall also keep the stations and station approaches free from ice and snow until the final acceptance of the work.

SUBDIVISION 2

Tile

Section No. 122. All tile shall be of first quality and equal to the sample on file in the office of the Commission. Tile on walls in toilet rooms shall in general be white glazed tile.

All tile shall be brought to the work in large quantities, carefully sorted as to size and shade. No broken or imperfect tile shall be used, and the tile work shall be perfectly true, plumb and straight; tile shall be furnished to lay in courses made up of the sizes indicated on the drawings and shall be jointed in colors as directed by the Commission. The height of the tiled wall surfaces, as indicated on the drawings, has been figured for a certain number of courses with an allowance for joints, and the Contractor will be required to adhere to these figures. All corners and angles shall be rounded and shall have curved tile to conform to the radii indicated on the drawings. Mitre pieces shall be used at the intersection of all angles and corners. Some tiles shall be cut to special widths and lengths, and special tiles shall be furnished where required. Combination (straight and curved) tile shall be generally used on all corners and angles, and angle bead tile of any radius will not be used unless specifically called for on the drawings.

Section No. 123. All tile work shall be set in Portland cement mortar.

Section No. 124. Where the scratch coat for tile is applied to metal lath, the first coat shall consist of a mixture of one (1) volume of cement, two and one-half (2½) volumes of sand, a volume of hydrated lime equal to ten per centum (10%) of the volume of cement and sand, and a proper quantity of long goat hair. The second coat shall consist of a mixture of one (1) volume of cement and three (3) volumes of sand, put on perfectly straight and true, and of thickness necessary to conform to the finished lines established by the Commission.

Where the scratch coat for tile is applied to concrete or other masonry it shall be the same as specified for the second coat on metal lath. The surface of the concrete shall be well hacked or roughened in order to obtain a good bond.

SECTION No. 125. Before final acceptance of the tile work, the Contractor shall remove all condemned tiles and replace them with approved tiles and, if required by the Engineer, shall, at any time during the progress of the work and prior to the final acceptance of same, submit a statement from the manufacturer certifying to the quantity and quality of tile furnished for each station.

SECTION No. 126. Samples of all tiles which the Contractor proposes to furnish shall be approved by the Engineer before proceeding with the work, but the approval of samples shall not be considered as modifying the requirements of these specifications, nor as relieving the Contractor of his responsibility under his guarantee.

SECTION No. 127. The Contractor shall guarantee all tile work not to craze, crack or fall off for three (3) years from the date of the completion of the Works.

SUBDIVISION 3

Plastering and Metal Lath

Section No. 129. All surfaces which are to be plastered, other than masonry surfaces, shall first be covered with metal lath.

The first coat on metal lath shall be as hereinbefore specified for first coat on metal lath for tile. The plaster coat on masonry surfaces and the second coat on metal lath shall, unless otherwise specified, be mixed in the proportion of four (4) barrels of cement (three and one half (3½) cubic feet per barrel), one and one-half (1½) cubic yards of sand and one-half (½) package [fifty (50) pounds] hydrated lime. The surface of the plaster shall unless otherwise specified be given a smooth troweled finish. All concrete or other masonry which is to be plastered shall be given one (1) coat as specified for the second coat on metal lath. The surfaces shall be thoroughly cleaned and wet before the plaster is applied. The surface of the concrete shall be well hacked or roughened in order to obtain a good bond.

Metal lath shall be galvanized wire lath No. 18 gauge, U. S. standard, one-half (½) inch mesh. It shall be secured to the wood furring with galvanized wire staples and so stretched that there shall be no bulges or irregularities.

Where required the metal lath shall be secured to metal furring with galvanized lacing wire, No. 14 gauge, U. S. standard. The metal furring shall consist of steel angles.

The Contractor shall guarantee all plastering not to crack or fall off within three (3) years from the date of completion of the Works.

SUBDIVISION 4

Asphalt and Cement Floors, Bases and Coves

Section No. 131. The floors of mezzanines, except in toilet rooms and under stove recesses, will in general consist of a rock asphalt floor laid on an underflooring of wood. Where the floors of mezzanines are supported on concrete slabs the floors shall in general have a cement finish. At the intersection of asphalt and of cement floors with the sidewalls a sanitary cove of two (2) inch radius shall be formed. Coves shall be of the same material as the floor finish.

Asphalt floors shall in general be laid on an underflooring of yellow pine, as specified in Section No. 157 of this Part. This pine floor shall be covered with one (1) ply of untreated felt or unsurfaced building paper without binder. Where the asphalt floor is laid on concrete the felt or paper shall be omitted.

Section No. 132. The surface mixture shall consist of the following proportions, by weight: eleven and one-half (11½) parts asphalt, ten and one-half (10½) parts sand, thirty (30) parts grit, forty-four (44) parts limestone dust and four (4) parts Portland cement.

Asphalt shall conform to the requirements of Subdivision 14 of Part First, except that the penetration shall be between 30 and 50 at 77 degrees Fahr.

Sand shall be clean, sharp, and free from dirt, mica and vegetable matter. It shall contain both coarse and fine particles and shall be graded according to the percentages herein specified. Sand which does not fulfill the above requirements in its natural condition shall be screened, washed, or mixed with other sand to produce a result in accordance with said requirements. Of the ten and one-half (10½) parts of sand

100% shall pass through a 10-mesh sieve,
40% shall pass through a 40-mesh sieve,
10% shall pass through an 80-mesh sieve.

All grit shall pass through a 4-mesh sieve, thirty per centum (30%) through an 8-mesh sieve and one hundred per centum (100%) shall be retained on a 16-mesh sieve.

All limestone dust shall be of such fineness that it shall leave a residue of not more than twenty per centum (20%) on a 100-mesh sieve, and not more than ninety per centum (90%) on a 200-mesh sieve.

Portland cement shall conform to the requirements of Subdivision 8 of Part First.

All proportions herein mentioned shall be by weight.

SECTION No. 133. The sand, grit, limestone dust and asphalt shall be heated to approximately 325 degrees Fahr., the asphalt being heated separately. The maximum temperature of the sand, grit and limestone dust as delivered at the mixing kettle shall not exceed 375 degrees Fahr. and the maximum temperature of the asphalt shall not exceed 350 degrees Fahr. The Portland cement, heated to not over 325 degrees Fahr., shall be thoroughly mixed with the heated sand, grit and limestone dust. The asphalt shall then be mixed with the sand, grit and limestone dust and Portland cement until a homogeneous mixture is produced, in which all particles are thoroughly coated with asphalt. The mastic may be mixed in an approved mixing machine.

The surface mixture shall be prepared on or close to the work and in amounts not exceeding that which can be laid in one working day. The maximum temperature of any batch of surface mixture immediately after being mixed shall not exceed 325 degrees Fahr. and the minimum temperature of the surface mixture when delivered on the pine floor shall be not less than 275 degrees Fahr.

If the surface mixture contains materials which will become separated by subsidence while the asphalt is in a melted condition, it shall be thoroughly agitated before being drawn and while in the supply kettles. Approved methods of agitation which will not injure the surface mixture shall be used.

The Contractor shall provide a sufficient number of accurate, efficient thermometers for determining temperatures at all stages of the work.

After the mixture has been spread and compressed to a uniform thickness of one (1) inch it shall be rubbed to a smooth surface with a wooden float. Expansion joints shall be provided where necessary.

SECTION No. 134. The floors of mezzanines where indicated on the drawings shall consist of a reinforced concrete slab finished with another layer of concrete and a cement finish. The cement finish for floors, bases and coves shall be in the proportions, by volume, of one (1) part cement to two (2) parts sand. The under side of the concrete slab shall be rubbed to a smooth and even finish.

In general the floors of enclosures between stations shall be of plain or reinforced concrete as indicated on the drawings and shall have a cement finish.

SECTION No. 135. The top of the plain or reinforced concrete slab shall be left three (3) inches below and parallel to the finished floor elevation, and after this concrete slab has set, a two (2) inch layer of concrete shall be spread thereon to an even thickness and rammed so that its top surface shall be one (1) inch below and parallel to the finished floor elevation. Before this layer of concrete has set, a one (1) inch layer of cement finish shall be spread over its surface and well floated to grade to fill all voids and hollows. A dry mixture of one (1) part of an approved concrete hardener and one (1) part of Portland cement (by weight) mixed to an even color, shall then be sprinkled over the surface and floated thoroughly and troweled to a smooth, uniform, hard finished surface.

Cement floors shall be laid out in blocks about three (3) feet square. These blocks shall be formed by cutting through the two (2) inch concrete layer, before it has begun to set, with a tool which will make a one-fourth (¼) inch joint. The cement finish shall be marked with a suitable tool directly over the joint above described.

SECTION No. 136. A cement wainscot or base, of the height indicated on the drawings, shall be formed of the same materials as used for the cement finish. The cement wainscot or base shall project beyond and conform to the line of the finished wall.

SUBDIVISION 5

Concrete Work

Section No. 139. Concrete copings shall be reinforced with steel rods placed as directed by the Engineer should he consider reinforcement necessary, and finished on all exposed surfaces with a finish coat of one (1) inch minimum thickness. The face of the copings shall be washed with a cement grout before the concrete is thoroughly set (where practicable, immediately after the removal of the forms) and rubbed down to a hard, even finish. The cement grout shall be colored with lampblack as directed.

Section No. 140. The finish for copings shall be as hereinbefore specified for cement floors, and shall be colored with lampblack where required.

The core concrete and finish coat of copings shall be filled into the forms at the same time and in such a manner that they will set as one mass.

Section No. 141. Steel beams, girders and columns where required by the Engineer, shall be wrapped with special wire forms, of a type and weight approved by the Engineer, and encased in concrete.

Section No. 142. Concrete foundations shall be provided for columns as specified in Part First and after the columns are secured in place the concrete shall be carried up around the columns, enclosing the base as indicated on the drawings. The surface of the concrete around stairway columns above the surface of the street shall be given a troweled finish.

Section No. 143. Concrete street landings at the foot of stairways shall be reinforced with steel rods, and concrete foundation walls shall be provided for the support of the landings. The portions of the street landings above the surface of the street shall have a cement finish one (1) inch thick, mixed in the proportion of one (1) volume of cement and two (2) volumes of sand, colored with lampblack. The cement finish shall be placed in the forms at the same time as the concrete so as to set as one mass.

Where necessary, the foundations in poor ground shall be increased in size to obtain a proper distribution of the load.

Section No. 144. Manholes of concrete or brick masonry shall be provided, as hereinafter specified, for enclosing the main traps and water supply valves.

SECTION No. 145. The track floors over mezzanines shall consist of reinforced concrete, waterproofing and protective concrete. The upper surface of the protective concrete over the waterproofing shall be troweled smooth and carefully graded to provide proper drainage. The under side of the concrete track floors shall be rubbed to a smooth and even finish. Reinforcing metal shall consist of steel rods. Wood sleepers, bolted to the girders, shall be provided where indicated on the drawings in the under side of the track floors for securing the walls of mezzanines. Galvanized wrought iron pipe ferrules with galvanized iron flanges and nuts shall be provided for drainage.

SECTION No. 146. The portion of the train platforms over the mezzanines, where indicated in the drawings, shall consist of reinforced concrete, waterproofing, protective concrete and wood flooring. The protective concrete over the waterproofing shall have wood sleepers imbedded therein to provide nailing for the platform floor as hereinafter specified. Ferrules for smoke flues shall be set in the concrete platforms. Sleeves for expansion bolts to support the wood facias may be imbedded in the exposed edge of the concrete platforms. The under side of the concrete train platforms shall be rubbed to a smooth and even finish. Reinforcing metal shall consist of steel rods. (See Section No. 162 of this Part.)

SECTION No. 147. Stove recesses formed of concrete reinforced with expanded metal or steel rods shall be provided where indicated on the drawings, and particular care shall be taken with the forms for this work so as to carry out the design indicated. Where indicated on the drawings the sides of the stove recesses shall be extended over the wood framing of the adjacent walls by the use of metal lath and plaster, as hereinbefore specified, and the surface of the plaster shall be finished the same as the surface of the concrete stove recesses. The surface of the concrete shall be washed with a cement grout and rubbed down to a smooth, hard, even finish. The concrete and grout for stove recesses shall be colored with lampblack. The expanded metal shall be of No. 25 gauge, U. S. standard, three (3) pounds per square yard, without paint or other coating. The Contractor may, with the approval of the Engineer, substitute other reinforcement in place of the expanded metal. One (1) cast-iron cover and one (1) cast-iron register shall be provided for each stove recess. Covers and registers shall have a bronze plated finish.

SUBDIVISION 6

Woodwork

Section No. 151. Spruce shall be a northern, selected grade, sound, seasoned, free from wanes, loose, large or decayed knots, rots, shakes or any other imperfection impairing its durability, strength or appearance for the use specified. It may contain a number of small, tight knots varying in size from a lead pencil to a silver quarter. Bright sap will be permitted but no stain sap will be accepted.

Yellow pine shall be first growth, long leaf Southern yellow pine, straight, square edged, close grained, and free from wanes, loose, large or decayed knots, splits, shakes, rots or any other defect which may impair its strength or durability for the use specified. In no case will any stick be accepted with less than three (3) heart corners or with more than one (1) inch of sap on the fourth corner, or with more than two and one-half (2½) inches of sap, measured across the face anywhere in the length of the piece.

White pine shall be soft, close-grained and free from shakes, rot or any other defects which may impair its strength, durability or appearance for the use specified. A small percentage of bright sap will be permitted on all surfaces, and stained sap and a few knots not exceeding one-half (½) of an inch in diameter will be permitted on surfaces which will not be exposed in the finished work, but except as specified above all exposed surfaces of the finished work shall show clear.

Oak shall be a selected grade of plain red or white oak, straight grained. All surfaces exposed to view shall be free from knots, shakes, sap, worm holes, rot, checks and other defects; in other words, exposed surfaces to show clear.

All wood unless otherwise specified shall be spruce. Sills shall in general be three (3) inches by six (6) inches; plates shall in general be two (2) inches by four (4) inches; studding shall in general be two (2) inches by four (4) inches; joists shall be three (3) inches by ten (10) inches; rafters for enclosures between stations shall be two (2) inches by six (6) inches, dressed three (3) sides and sawed to pattern; canopy rafters shall be three (3) inches by six (6) inches, dressed three (3) sides and sawed to pattern; framing for canopy valleys shall be

three (3) inches by ten (10) inches, and bridging shall be two (2) inches by four (4) inches; wood furring shall be one (1) inch by two (2) inches, laid horizontally and spaced not more than twenty (20) inches on centers. Wood furring for metal lath shall be not more than sixteen (16) inches on centers. Variations may be made from the above sizes in special cases, as or dered. All the above dimensions are for undressed lumber. In general, dimensions of parts other than those mentioned above shall apply to dressed work.

The exposed surfaces of all wood, and covered surfaces where required, shall be dressed. Grounds shall be provided where required. Stop beads shall be of the sizes indicated on the drawings, and (except for casement windows) shall be secured with brass screws and washers, spaced not more than eighteen (18) inches on centers.

All woodwork shall be thoroughly secured with spikes, nails or bolts, unless otherwise specified, and the spikes, nails and bolts shall be of such size and weight as may be required to secure the woodwork firmly in place. Each board shall be nailed to each bearing, and all joints shall be made over the centers of bearings.

All doors and all window sash shall have mortised and tenoned stiles and rails, pinned and glued, and rabbeted where directed. Window and door frames shall be rabbeted, mortised and tenoned, and pinned where required.

All sash unless otherwise specified shall be glazed with double-thick glass selected from glass graded as "A". It shall be free from any perceptible amount of air bubbles, blisters, sulphur stain, burnt specks, burns, cords and strings, shall show a good gloss and even surface and shall be well flattened. The thickness shall be uniform, and not more than nine (9) lights shall have a total thickness of one (1) inch. Each light shall weigh not less than twenty-four (24) ounces to the square foot.

Plate glass shall be polished, not less than three-sixteenths (3/16) of an inch in thickness and shall be free from open or large bubbles.

All glass unless otherwise specified shall be secured with wooden strips and shall be bedded in an approved mixture of white lead and putty.

SECTION No. 152. Studs shall be spaced not more than sixteen (16) inches on centers, shall be doubled at all corners and openings and shall have horizontal bridging at half their height.

Joists shall be doubled and tripled where indicated. All platform joists shall be yellow pine. They shall be set level, and shall be sized to the steel so as to bring the finished platform to the required elevation. All joists having a span of from eight (8) feet to sixteen (16) feet shall have one (1) row of cross-bridging; spans of over sixteen (16) feet shall have two (2) rows of cross-bridging. Bridging shall be accurately cut and fitted and shall be nailed at each end. The lower ends of bridging shall not be nailed until after the floor is laid.

Sills and plates shall be bolted to the concrete with expansion bolts or to the steel with one-half (½) inch or five-eighths (⅝) inch bolts as directed, provided with washers and spaced not more than thirty (30) inches on centers, or nailed to wood sleepers embedded in the concrete.

Rafters shall be framed upon plates and purlins, and shall be well spiked at all bearings and intersections.

SECTION No. 153. Stairway canopies shall be furnished with two (2) inch by three (3) inch plates dressed three (3) sides, to provide a fastening for the roof boarding. These plates shall be bolted to the canopy steel as indicated. Roof boarding for canopies over train platforms, passageways, stairways and roofs of mezzanines extending beyond the main structure, shall be yellow pine, showing one (1) heart face, clear from all defects. It shall be three and one-half (3½) inches wide by seven-eighths (⅞) of an inch thick, dressed one (1) side, with "V" joints and tongued and grooved. Roof boarding for enclosures between stations shall be yellow pine, showing one (1) heart face, clear from all defects. It shall be seven-eighths (⅞) of an inch thick, dressed one (1) side, tongued and grooved.

SECTION No. 154. The exterior walls of mezzanines and enclosed stairways shall, unless otherwise indicated on the drawings, be built up of two (2) inch by four (4) inch studs with plates and sills, framed for openings and to accommodate steel hangers, flues and pipes, conduits and other electric work and where covered with copper shall be sheathed on the outside with

spruce boards seven-eighths (7/8) of an inch thick, dressed one (1) side, tongued and grooved, laid diagonally, carried down to the sills and blocked off with planed and trued wood to form a solid backing for rails, stiles and panel work. This blocking shall be laid on top of the roofing fabric specified in Section No. 156 of this Part, and the metal panels shall bear directly on the roofing fabric next to the sheathing. The space between studs where indicated on the drawings shall be filled with hollow terra cotta blocks laid in cement mortar.

The inside of exterior walls of mezzanines shall, unless otherwise indicated on the drawings, be furred as hereinbefore specified, and then sheathed with two and one-half (2½) inch by thirteen-sixteenths (13/16) inch oak, with "V" joints, tongued and grooved, and applied vertically. Bases, sills, aprons, stools, stop beads and mouldings of oak shall be formed as indicated. At least ninety per centum (90%) of the sheathing shall be in single lengths. Before placing oak sheathing on masonry-filled walls or walls finished on one side with tile the back of the sheathing shall be given two (2) coats of an approved paint.

Inside trim shall be oak, hollow backed. Stops shall be put on with stop bead screws. All trim shall be mitred, and door trim shall stop on top of base block.

Partition walls on mezzanines shall, unless otherwise indicated on the drawings, be built up of two (2) inch by four (4) inch studs, framed for openings and to accommodate steel hangers, flues and pipes, conduits and other electric work and (except the walls of toilet rooms, closets and booths other than ticket booths) shall be finished on both sides with oak sheathing, bases and trim as specified for inside of exterior walls of mezzanines. Partition walls shall be supported on and secured to the wood underflooring or to the concrete floor. The space between studs where indicated on the drawings shall be filled with hollow terra cotta blocks laid in cement mortar.

Section No. 155. The exterior walls of enclosures between stations shall be built up of studs bolted to the steel framing and with bridging, sills, plates, outside sheathing and copper covering as hereinbefore specified for the exterior walls of mezzanines. The partition walls of enclosures between stations shall be built of studs, bridging, sills and plates as hereinbefore specified for

partition walls in mezzanines. The inside wall finish shall be as hereinafter specified.

Rafters and cross-ties shall be of yellow pine, two (2) inches by six (6) inches, not more than twenty (20) inches on centers; ridge pieces shall be two (2) inches by eight (8) inches, and plates three (3) inches by six (6) inches. Standing gutters shall be built up over the eaves.

The interior walls and inside of exterior walls of enclosures between stations shall be furred or sheathed and finished with galvanized iron, plaster, slate or other materials as herein elsewhere specified and as indicated on the drawings. Framing shall be arranged to accommodate flues and pipes, conduits and other electric work.

SECTION No. 156. Immediately after the under-boarding is laid an approved tar paper shall be laid as directed upon the under-boarding of all roofs which are to be covered with tin. An approved red rope roofing fabric shall be laid on all under-boarding which is to be covered with other sheet metal and elsewhere where required. The red rope roofing fabric shall be lapped and nailed and shall not be put in place until the sheet metal or other covering is about to be laid.

SECTION No. 157. The wood underflooring of mezzanines shall consist of sills and planks. Planks shall be two (2) inch by six (6) inch yellow pine, tongued and grooved, dressed one (1) side, laid across the sills, breaking joints, and nailed at each sill or bearing. Pieces shall be cut in between the sills to form panels on the under side of flooring. The upper flooring shall consist of an asphalt composition as specified in Subdivision 4 of this Part Second. Copings and facia pieces of yellow pine shall be provided in single lengths at stairwells where concrete is not used. Wood flooring for passageways at stations shall be as hereinafter specified for train platforms and shall be supported on wood sills.

SECTION No. 158. The parting strips and pulley stiles of window frames shall be made of clear yellow pine. Window sills which are to be covered with copper shall be made of spruce. All other parts of window frames shall, unless otherwise speci-

fied, be made of white pine. Box frames with pockets for weights shall be made for double hung sash. The pockets for weights shall be easily accessible and the covers shall be secured with screws.

The interior trim, stools and aprons of windows in exterior walls of mezzanines shall, in general, be built of oak, except in toilet rooms and porters' closets.

All double hung sash shall be made of white pine, and shall have checked meeting rails. Sash shall be hung with approved sash cord of best quality and evenly balanced with weights of cast iron, and shall be provided with two and one-fourth (2¼) inch extra strong, ball-bearing pulleys having brass wheels and rectangular brass faces. Hinged sash shall be hung to swing as indicated.

Sash and frames for partition walls of mezzanines in waiting rooms shall be made of oak. Sash and frames for casement windows shall be made of white pine.

All sash, unless otherwise specified, shall be one and three-fourths (1¾) inches thick, and shall be divided into lights as indicated on the drawings. All sash in toilet rooms and elsewhere where indicated on the drawings shall be glazed with Florentine glass. Plate glass shall be used for all glazed door panels and for sash in enclosures beween stations where indicated on the drawings.

SECTION No. 159. Frames for doors at stations shall be made of one and three-fourths (1¾) inch oak, rabbeted for the doors and well nailed to the studs. All moulding and trim shall be as indicated on the drawings.

Frames for doors to enclosures between stations shall be made of yellow pine, one and three-fourths (1¾) inches thick, rabbeted for the doors and well secured to the studding. Moulding and trim shall be as indicated on the drawings.

Doors for enclosures between stations shall be made of white pine, one and three-fourths (1¾) inches thick, paneled as directed. Panels shall consist of not more than three (3) pieces, slip-tongued and glued. Batten doors with oak or pine facing shall be provided where required in interior walls of mezzanines.

SECTION No. 160. Doors at stations unless otherwise speci-

fied, shall be built up of soft pine cores, properly framed and glued together, paneled and glazed as indicated, and veneered on both sides with oak. Doors shall be one and three-fourths (1¾) inches thick with six (6) inch stiles, and panels shall be three (3) ply.

Doors for toilet stalls shall be built of oak, framed and glued together. Doors shall be one and one-fourth (1¼) inches thick and paneled as indicated.

All window and door frames, sash and wind screens, unless of oak, shall be painted on all sides, before being brought upon the work, with a priming coat of "E" paint as specified in Section No. 288 of this Part, reduced with one (1) quart of benzol per gallon of paint. Parting strips and pulley stiles shall be given two (2) coats of raw linseed oil only. Other painting shall be as hereinafter specified.

SECTION No. 161. Vent doors shall be provided in the walls of mezzanines, where indicated on the drawings. The doors shall be made of yellow pine or oak as may be ordered by the Commission. The doors shall be one and three-fourths (1¾) inches thick, paneled as indicated on the drawings.

SECTION No. 162. Wood flooring for train platforms shall be two (2) inch by six (6) inch yellow pine, dressed four (4) sides, laid transversely, with one-eighth (⅛) inch open joints, double nailed to each bearing and neatly sawed to line at both nosings. At least sixty per centum (60%) of the flooring shall be in single lengths, but no piece laid shall be less than five (5) feet long. Joists shall be three (3) inch by ten (10) inch spruce, dressed three (3) sides, spaced twenty (20) inches on centers, doubled where indicated and fastened to the steel beams with approved clips. A one and one-eighth (1⅛) inch yellow pine facia shall be provided on the outside of the floor joists and shall be furred out from the edge of the joists. Where platform construction is of concrete, as specified in Section No. 146, sleepers shall be provided in the concrete as indicated for nailing flooring. The sleepers shall be coated with an approved preservative before being laid, and the joints in this portion of the flooring shall be filled with an approved elastic cement. Holes two (2) inches in diameter shall be provided in floors of island platforms under free standing lamp standards, and in floors of side platforms

under the end post of Type "K" railings nearest the wind screens.

The floor joists shall be doubled around all stairwells, and a two and seven-eighths (2⅞) inch by seven and three-fourths (7¾) inch yellow pine plank shall be framed around stairwells to form a coping where concrete is not used.

SECTION No. 163. Platform edge construction for concrete platforms shall consist of a two (2) inch yellow pine facia bolted to the edge of the concrete slabs with expansion bolts. The surface of the facia in contact with the concrete shall be coated with white lead just before being put into place, in order to effect a water-tight joint, and the flooring shall be secured to the facia.

SECTION No. 164. Wind screens with drop sash on train platforms shall be built of white pine, and shall be provided with removable panels and with pockets for drop sash. Panels shall be slip-tongued to avoid opening and parting and no panel shall consist of more than three (3) pieces. Access to the pockets shall be provided by removable baseboards, secured in place by screws. Movable sills shall be provided over the sash pockets and shall be secured with brass screws and washers. The wind screens shall be secured to the canopy steel at the top and to the platform flooring at the bottom, and to the steel uprights supporting the canopy.

Panels for name tablets shall be formed where indicated on the drawings, and fixed sash shall be provided above these panels. Sash shall be made of white pine, one and three-fourths (1¾) inches thick.

SECTION No. 165. The risers, treads and flooring for landings for stairways, unless otherwise indicated on the drawings, shall be built of yellow pine. Wood treads shall be two (2) inches thick, with rounded nosings, and shall be secured to angles with round headed bolts, four (4) to each tread. Wood risers shall be one and one-half (1½) inches thick. Wood treads and risers shall be dressed two (2) sides and furnished in single lengths. Wood flooring for landings shall be two (2) inches by six (6) inches, tongued and grooved, the joints made with white lead, and shall be secured to the angles with round headed bolts with washers, two (2) bolts to each bearing. All

wood risers and treads in stairways shall be set in white lead. Wooden ladders at ends of train platforms shall consist of stringers and treads of yellow pine and the ladders shall be secured to the platforms and to the service walks as indicated on the drawings.

All stairways and stairway landings shall unless otherwise indicated on the drawings be provided on each side with a seasoned white oak hand-rail of approved cross-section for their entire length. Hand-rails shall be straight grained and free from knots, checks, warp or any other imperfections that will impair their strength or durability. They shall be supported on and secured to cast-iron brackets spaced not more than five (5) feet six (6) inches on centers. Additional brackets shall be provided at all bends and returns where required. Special bends and returns shall be provided and the hand-rails shall return to sockets on the railings at the top and bottom of stairs. The hand-rails shall be secured to the sockets with long screws passing through the socket and into the end of the hand-rail. All bends and returns shall be neatly curved and finished, shall be secured at joints with rail bolts and shall be doweled.

SECTION No. 168. Frames for ticket booths shall be built of two (2) inch by three (3) inch studs, with plates and sills of the same size. Floors shall be supported on three (3) inch by four (4) inch sleepers eighteen (18) inches on centers, and sleepers and sills shall be laid flat on the wood underflooring or concrete. Framing shall be arranged to accommodate conduits and other electric work.

The exterior and interior of the ticket booths, including ticket shelves, drawers, closets and doors, shall, unless otherwise specified, be made of oak. The exterior of the ticket booths shall consist of one and one-eighth (1⅛) inch panel frames, with seven-eighths (⅞) inch panel stiles and rails, and one-half (½) inch panels set in from the back and nailed on one side. Bases shall be seven-eighths (⅞) inch, and cornices shall be built up as indicated on the drawings and provided with hinged vent panels. Doors shall be one and three-fourths (1¾) inches thick, veneered on soft pine cores, and panels shall be three (3) ply. The interior of ticket booths shall be furred, sheathed vertically with five-eighths (⅝) inch by three (3)

inch oak, tongued and grooved, with "V" joints, and pieces of quarter-round oak shall be set in all angles.

Ticket shelves shall be of oak, two (2) inches thick, supported on bronzed iron brackets. A coin shelf of plate or other approved glass, with or without change pockets, as determined by the Commission, shall be furnished for each ticket window, and shall be let into the oak ticket shelves so as to finish flush with the tops of the shelves. Special cement or a sheet of felt as directed shall be placed under each coin shelf. Cash drawers and change pockets of oak shall be divided inside as directed, and each drawer shall be fitted with one (1) pair of metal rollers and one (1) stop. Closets with shelves and doors shall be provided. A foot rail of oak supported on galvanized iron brackets shall be provided below each ticket window.

Flooring for ticket booths shall consist of seven-eighths (⅞) inch by two and one-half (2½) inch clear maple flooring, hollow-backed, tongued and grooved, laid with close joints in courses and blind nailed to every bearing. Flooring shall be of a minimum length of four and one-half (4½) feet. No short pieces will be allowed. Flooring shall be hand smoothed and cleaned, after which it shall be covered with building paper and protected until the completion of the station. The space between the flooring of the mezzanine and the flooring of the ticket booth shall be closely packed with an approved asbestos fibre. The flooring shall not be laid until ordered by the Engineer.

All ticket windows shall have grilles of bronze tubing or bars. The main pieces of grilles shall be five-sixteenths (5/16) of an inch by one-half (½) inch with one-fourth (¼) inch square pieces for filling. Grilles shall be secured with oval-head bronze screws. Sash and sash frames shall be of No. 18 gauge rust-proof iron, as described in Section No. 234-A of this Part. They shall be finished in an approved color in the manner specified for hollow metal work. All sash frames and panels shall be glazed with plate glass. The sash frames shall have hinged folding panels arranged to swing inward and the lower panels shall be stationary. A simple fastening shall be provided for each panel. On the booth side of the stationary panel a brass sliding door with knob, fastener and roller guide shall be provided. The door shall slide on a top track of brass and against knee pieces secured to the

glass shelf below. A plate glass sign with copper letters shall be provided for each ticket window. All glass in ticket booths shall be set in place without the use of putty, and rubber tape or other approved material shall be used as a cushion for the glass. Copper letters shall be formed of cold rolled copper and shall be similar to the samples on file in the office of the Commission. Coat and hat hooks shall be secured to the walls of the ticket booths.

No part of the ticket booths shall be nailed to the mezzanine structure, but iron knees with bronze finish shall be provided where necessary for securing the booths in place. Conduit and outlet boxes shall be built into the ticket booths as indicated on the drawings.

The ticket booths will generally be scribed to the ceilings of the mezzanines. The ceilings are of different heights and where the ticket booths are not scribed to the ceilings a wood ceiling and roof shall be provided for the booths as indicated on the drawings.

SECTION No. 169. Panel-board boxes in mezzanines shall have doors and trim of oak, and doors shall be glazed with plate glass. Trim shall be secured to the boxes with special brass machine screws and nuts. Panel-board boxes in wind screens shall be set into the framing of the wind screens and shall have doors of white pine backed with sheet steel.

SECTION No. 170. All seats shall be built of oak. (See Section No. 203 of this Part.)

SUBDIVISION 7

Ornamental Iron and Steel Work

Section No. 184. All bars, shapes and plates shall, unless otherwise specified, be made of open-hearth steel. All wrought iron shall be double rolled, fibrous and uniform in character. It shall be thoroughly welded in rolling and shall be free from surface defects. All iron castings shall be made of tough gray pig iron, shall be not less than one-fourth (¼) of an inch thick and shall have cast lugs, as may be required, for connections. All joints shall be cut and filed to a close fit; all bolt and screw holes shall be drilled (not cored); all joints shall be made with red lead putty and where exposed shall be filled flush with an approved cement. All sizes and shapes shall be as indicated on the drawings. Mitre joints in cast-iron work will not be permitted, and all joints shall be made in horizontal or vertical planes. All square steel tubing shall be cold drawn seamless tubing. The thickness of the walls of one (1) inch square tubing shall be not less than No. 11 gauge and of two and one-half (2½) inch square tubing not less than three-sixteenths (3/16) of an inch.

Castings shall be sharp, sound, true to pattern, free from cracks, flaws and excessive shrinkage, and shall have smooth, clean surfaces. They shall be neatly chiseled and wire-brushed before leaving the foundry. Castings shall accurately conform to the cross-section indicated on the drawings.

Section No. 185. Machine bolts and screws shall have U. S. standard threads, and threads shall be coated with graphite or other approved material to prevent corrosion. Bolts and screws of brass or bronze shall be used where required by the Commission.

Expansion bolts shall be of an approved type. Holes for expansion bolts shall be drilled to the exact size for the bolt or sleeve, and no packing shall be used.

Gate ropes shall be made of No. 9 drab bell cord. Provision shall be made for easy access to all electric conduit, wiring, outlets and gate ropes by providing removable panels or handholes with cover plates.

Holes shall be provided in the steel framing where necessary for conduit and pipes.

Post caps of special pattern shall be furnished where required in order to make a proper connection to the structure. Outriggers of plates or bars shall be provided where necessary to secure the tops of the posts. Steel braces shall be provided where necessary to give additional support to the posts.

Bronze top rails shall be made of extruded metal not less than one-eighth (⅛) of an inch thick, or of cast bronze not less than three-sixteenths (3/16) of an inch thick.

All castings shall be sharp and smooth, free from blow holes or other defects, and true to pattern.

Gauge numbers used herein and on the drawings refer to U. S. standard.

Conduit and outlets shall be provided for and secured to all illuminated signs and lamp standards.

Railing posts in mezzanines shall be supported on the concrete floors or wood underflooring. The posts shall be secured to wood blocks set on top of the underflooring.

SECTION No. 187. Outer stringers for stairways and stairway landings from the street to mezzanines shall be built of steel channels, spliced at landings, bolted to cast-iron canopy posts and to concrete landings at the foot of stairways, supported on and riveted to transverse channels and column brackets under intermediate landings or supported on and riveted to steel hangers or brackets, and riveted to steel floor beams at the top of stairways. In wide stairways an intermediate built-up or channel stringer may be required. Steel angles for supporting risers, treads and landings shall be riveted to the stringers, and cross ties of angles or other sections shall be provided as indicated. The risers, treads and landings shall in general be made of wood. Steel channels under intermediate stairway landings shall be riveted to the column brackets. Stairways and stairway landings from the mezzanines to the train platforms shall be as specified for stairways and stairway landings from the street to mezzanines, but shall be riveted to the steel floor beams at the foot of stairways. Steel framing for stairwell openings shall be provided where indicated on the drawings.

SECTION No. 188. Steel columns for stairways and stairway landings shall consist of built-up sections of plates and angles riveted together and shall be secured to the concrete foundations

with steel anchor bolts, nuts and washers as indicated. As the heights of stairway landings above the street surface will vary, the columns will be of varying lengths for the different stairways.

Steel hangers and brackets for supporting stairways shall consist of built-up sections of plates and angles or other shapes, as may be required, and shall be riveted to the railroad structure.

SECTION No. 189. The ornamental canopy posts at the foot of stairways shall be of cast iron, not less than three-eighths (⅜)' of an inch thick, and shall be securely bolted to the concrete street landings with expansion bolts and provided with lugs for bolting as indicated on the drawings.

Intermediate posts for supporting stairway canopies shall be of two and one-half (2½) inch square steel tubing, and shall be supported on cast-iron shoes at the bottom, with cast-iron caps at the top, and secured to shoes and caps with countersunk machine screws.

Cast-iron shoes shall be bolted to the steel stringers and shall extend up into and be fitted to the steel tubing. Cast-iron caps shall be fitted to the steel tubing and the top flange shall conform to the rake of the stairway so as to avoid fillers or wedges and shall be bolted to the steel canopy framing.

SECTION No. 190. The framing for stairway canopies shall be built up of steel sections as indicated on the drawings and shall be riveted together and neatly fitted at all splices and connections.

SECTION No. 191. Frames for signs over street landings shall be built up of steel sections and shall generally be secured to the canopy framing and cast-iron posts. Enameled signs, lettered as directed, shall be provided for one side of the sign frames.

SECTION No. 192. Railings on stairways and stairway landings, Type "A", from the street to the mezzanines shall consist of three-fourths (¾) inch square steel bars riveted to a steel angle at the bottom and to a steel bar at the top. A

cast-iron top rail shall be bolted to the top bar with countersunk machine screws. The bottom angle shall be riveted to the top flange of the steel channel stringer with one-half (½) inch rivets, and the railings shall be bolted to the canopy posts. Posts shall be of two and one-half (2½) inch square steel tubing and may be of variable heights to conform to local conditions. Cast-iron brackets and sockets shall be provided for supporting the wood hand-rail, and plates for the support of the brackets and sockets shall be riveted to the bars of the railings.

SECTION No. 194. Railings, Type "C", with posts supported on the sides of existing floor framing shall consist of vertical steel bars with top bar, top rail and bottom angle, all as hereinbefore specified for railings, Type "A". Posts shall be of two and one-half (2½) inch square steel tubing with cast-iron caps and shoes and may be of variable heights to conform to local conditions. Shoes shall be bolted to the webs of the existing floor beams. Railings shall be secured to the posts with bolts and ferrules, and steel braces shall be provided to give additional support to the posts.

SECTION No. 195. Train platform railings, Type "K", shall consist of a cast-iron base, bottom rail and top rail and three-fourths (¾) inch square steel bars. The bars shall be fastened to the cast-iron bottom rail with machine screws tapped into the bars, the ends of screws headed over, and shall be riveted to a steel channel at the top. The cast-iron top rail shall be secured to the top channel with countersunk machine screws and the cast-iron base shall be secured to the bottom rail in a similar manner. Cast-iron posts and lamp standards for railings, and frames and supporting posts for name tablets shall be provided. The lamp standards shall be made of two and one-half (2½) inch square steel tubing fitted over the upper part of the cast-iron posts and secured to the posts with countersunk machine screws. Cast-iron hoods for lamps, and small cast-iron frames for enameled signs shall be bolted to the steel tubing. Hoods shall be arranged to support lamp bases and reflectors.

The cast-iron base and posts shall be secured to the train

platform flooring and the posts supporting lamp standards and sign frames shall be anchored to the steel platform framing.

SECTION No. 196. Railings, Types "D" and "E", shall consist of panels of three-fourths (¾) inch square steel bars bolted to cast-iron top and bottom rails with machine screws tapped into the bars and ends headed over. The upper portion of the top rail shall be secured with countersunk machine screws and the cast-iron base of Type "E" railings shall be secured to the bottom rail in a similar manner. The panels shall be bolted to intermediate posts of cast iron, and cast-iron posts shall be provided where indicated on the drawings. The posts shall be bolted to the steel floor framing.

SECTION No. 197. High railings, Type "G", shall consist of panels of one-half (½) inch square steel bars, riveted to a one and one-half (1½) inch by five-eighths (⅝) inch bar at the top and to a one and three-fourths (1¾) inch by one and one-eighth (1⅛) inch steel channel at the bottom, and with intermediate horizontal bars of one (1) inch by one-half (½) inch steel. Panels shall be supported on posts of two and one-half (2½) inch square steel tubing. Posts shall be provided with cast-iron caps at the top and cast-iron footings at the bottom and shall be bolted to the floor and roof.

SECTION No. 198. Additional high posts in connection with railings shall consist of two and one-half (2½) inch square steel tubing, and shall be provided with cast-iron caps and bases. Other high posts with cast-iron caps and special cast-iron bases will be required for the support of the roof over mezzanines extending beyond the main structure.

SECTION No. 199. Railings in mezzanines, Type "F", shall consist of cast-iron posts and steel panels. The panels shall consist of one-half (½) inch square steel bars riveted to a one-half (½) inch by one and one-half (1½) inch steel bar at the top and to a five-eighths (⅝) inch by one and one-half (1½) inch steel bar at the bottom. Top and bottom bars shall be bolted to the cast-iron posts. The bronze top rail shall be secured to the steel top bar with countersunk machine screws. Cast-iron posts shall be secured to the wood blocking and

underflooring with lag screws through holes in the bottom flanges of the posts.

Bevel railings, Type "L", on stairways shall be as hereinbefore specified for Type "F" railings, except the top rail, which shall be of cast iron, and the posts, which shall be of two and one-half (2½) inch square steel tubing with cast shoes and caps. Posts may be of variable heights to conform to local conditions.

SECTION No. 200. Grille railings, Type "B," shall consist of one-half (½) inch square steel bars riveted to a one-half (½) inch by one and one-half (1½) inch top bar and to a five-eighths (⅝) inch by one and one-half (1½) inch bottom bar, and with intermediate bars of the same size as top bars. Top, intermediate and bottom bars shall be bolted to steel posts. Posts shall be of two and one-half (2½) inch square steel tubing and shall be furnished with cast-iron caps, shoes and flanges as indicated. Cast-iron shoes and flanges shall be bolted to the steel channel stringers or to the flooring and the cast-iron caps shall be bolted to the roof.

SECTION No. 201. Pipe railings shall be made of galvanized wrought-iron pipe, and shall have special fittings and bases of galvanized cast iron; bases shall be secured to the stairways, stairway landings, mezzanine floors, platforms, ladders and ladder platforms with bolts or lag screws.

SECTION No. 202. Free standing lamp standards on island train platforms shall consist of two and one-half (2½) inch square steel tubing supported on posts of cast iron and the tubing shall be fitted over the top of the posts and secured with countersunk machine screws. Cast-iron hoods shall be secured to the lamp standards. Hoods shall be arranged to support lamp bases and reflectors. Lamp standards shall be anchored to the steel or wood floor framing or to concrete platforms as indicated on the drawings.

SECTION No. 203. Enameled sign plates and reflectors shall be made of the best charcoal iron, No. 18 gauge, pickled and freed from rust, and shall be drilled before being enameled.

Enamel shall be fused to the iron, and not less than two (2) coats of enamel shall be used for each color. Colors shall be as directed.

Frames for enameled signs on mezzanines shall be built up of cast-iron and steel sections, and shall be either built into the railing panels or supported on high posts over the railing as indicated on the drawings. Enameled sign plates shall be provided for both sides of the sign frames.

Frames for suspended signs shall consist of frames built up of steel plates and angles and cast iron. The frames shall be suspended by square steel tubing attached to the structure. Enameled sign plates shall be provided for both sides of sign frames.

Sign frames on train platform railings shall be built up of cast iron and steel plates and angles. The frames shall be bolted to the top rail of the platform railing. The cast-iron railing posts shall be extended to the top of the sign frames to provide additional support. Enameled sign plates shall be provided for one side of sign frames.

Sign frames for name tablets on island train platforms shall consist of cast iron and steel plates and angles and shall be secured to posts of two and one-half (2½) inch square steel tubing having cast-iron caps and bases. The posts shall be anchored as hereinbefore specified for free-standing lamp standards and shall be securely braced. Enameled sign plates shall be provided for both sides of the sign frame. Oak seats shall be constructed between the steel posts. Provision shall be made for supporting the seats and the seats shall be neatly fitted to the steel supports. Where indicated on the drawings, panels of No. 14 gauge steel shall be provided between the steel posts in place of the oak seats. The panels shall be subdivided by one and one-fourth (1¼) inch by one-fourth (¼) inch bars and shall be riveted to an angle frame. The frame shall be secured to the posts with countersunk machine screws and shall also be secured to the flooring by intermediate cast-iron footings.

Section No. 204. All sliding gates shall be run on ball-bearing sheaves and shall be provided with approved guides, stops, tracks, ropes, hangers, fittings and ball-bearing pulleys. Sliding gates shall consist of panels of square steel bars, with top, inter-

mediate and bottom bars of steel, secured to a built-up frame of steel angles and perforated steel plates. At each gate opening in the railings two (2) vertical posts of cast iron or steel shall be provided and shall be secured to the floor and ceiling and joined at the top with a built-up frame of steel angles and perforated steel plates. An enameled "EXIT" sign plate shall be secured to one side of this frame. The cast-iron or steel posts shall have cast-iron footings, floor boxes where gate ropes are run below the surface of the floor, supports for track and pulleys, and provision for the gate ropes and weights, and shall be provided with hand-holes. Where necessary, additional high posts of two and one-half (2½) inch square steel tubing shall be provided to support the tracks. Gates shall be so arranged that they may be operated from one or more points as required and where possible the ropes shall be concealed from view by running them in one and one-fourth (1¼) inch galvanized wrought-iron pipes below the surface of the floor or in one (1) inch square steel tubing suspended from the ceiling. In general the gate ropes will be run in tubing suspended from the ceiling and only in special cases, when directed by the Commission, will the ropes be run in pipes below the surface of the floor. Gates shall be properly balanced with lead weights and shall operate smoothly. Pulleys will be required at each change in direction of the gate ropes suspended from the ceilings and at intermediate points and all pulleys shall be ball-bearing and shall be housed.

Floor boxes shall be made of cast iron and shall be fitted with removable cover plates, ball-bearing pulleys, and connections for gate posts and pipes. Where floor boxes occur in ticket booths a connection shall be made to receive the vertical pipe.

Section No. 205. Folding gates shall be of the pantograph type and where required shall be provided with guides at the top and bottom of the end bars, or hinged, and provided with an approved locking device. The diagonal members shall consist of flat bars, channels or other approved sections, forming openings the maximum dimension of which shall not exceed twelve (12) inches when the gates are locked in place across the gate openings. Intermediate vertical bars, with guides at top and bottom, shall be provided where necessary. The top guides shall consist of pulley and track, with the track secured to the gate posts. The

bottom guides shall consist of angles set flush with the floor in such manner as to form the sides of a recess. Folding gates shall, unless otherwise indicated, be made of a height six (6) inches less than the clear height of the opening from the floor to the under side of the cross frames between gate posts, or to the roof where cross frames are not installed. Folding gates at ticket booths shall be secured to a built-up steel post. Other folding gates shall be provided with posts of two and one-half (2½) inch square steel tubing on each side of the gate openings, with cast-iron caps and footings and a cross frame of the same material as the posts.

Gate controls shall consist of high posts of square steel tubing on each side of ticket chopper, and a cross frame of the same material as the posts. The posts shall have special cast-iron footings, floor-boxes where gate ropes are run below the surface of the floor, and shall be provided with ball-bearing pulleys and hand-holes for the gate ropes. Single controls shall consist of two (2) posts and one (1) cross frame.

Chains of one-fourth (¼) inch galvanized wrought iron or steel shall be provided at all gate controls or other openings where indicated on the drawings. Eye-bolts shall be provided in the posts or walls on each side of openings, and one end of the chain shall be securely fastened to the eye-bolt on one side of the opening. The free end of the chain shall be provided with a snap hook.

SECTION No. 208. Enameled sign plates, inscribed as directed, shall be secured to the steel panel plates by one-fourth (¼) inch brass screws with ends riveted over nuts. Lead or soft copper washers shall be provided under screw heads and nuts.

SECTION No. 211. Non-slip treads shall be used on the treads and landings of all stairways and shall also be used on the floor of mezzanines where indicated on the drawings. They shall have a metal base and an approved non-slipping surface; they shall be durable, readily cleaned and maintained and shall be arranged so that they may be renewed in sections without renewing the entire tread. Where laid on wood they shall be set in white lead. The non-slip treads shall be secured to the treads and landings with brass screws. Where they are laid on a cement finish,

they shall be secured to wood blocks and the blocks shall be imbedded in the concrete and furnished with iron anchors. Samples of the non-slip treads which are approved for the work can be seen at the office of the Commission. The Contractor shall call at the office of the Commission and inspect these samples of approved non-slip treads.

Saddles of cast iron shall be provided for door openings where indicated on the drawings. They shall be made in one piece and secured to wood blocks. The wood blocks shall be furnished with iron anchors and imbedded in the cement floor or shall be blocked up from the wood underflooring and secured with brass screws.

SECTION No. 212. Wire mesh partitions in enclosures between stations shall be provided where indicated on the drawings. The wire shall be No. 10 gauge, one (1) inch mesh, secured to a steel frame. The frames shall be secured to the partition and roof framing.

SUBDIVISION 8

Sheet Metal Work

Section No. 228. All roofs shall, unless otherwise specified, be covered with approved "IC" tinned charcoal iron plates of the best quality, twenty (20) inches by twenty-eight (28) inches, weighing at least two hundred and twenty-four (224) pounds per box of one hundred and twelve (112) sheets, or other sizes as may be required. The coating shall weigh at least thirty-five (35) pounds per box of one hundred and twelve (112) sheets, twenty (20) inches by twenty-eight (28) inches, and the weights for other sizes shall be in the same relative proportion. Gauge numbers used herein and on the drawings refer to U. S. standard. Standing seams shall be formed and all seams shall be double locked and soldered. All roofing tin shall be secured with tin clips two (2) inches wide, spaced not over eight (8) inches on centers. Clips shall be locked into the standing seams and nailed to the roof boarding with tinned nails. Flashing shall be provided wherever necessary and roofing tin shall be secured to the flashing.

Section No. 229. The outside of exterior walls of mezzanines, walls enclosing stairways below the roof of the mezzanines at stations and the outside of exterior walls of enclosures between stations, excepting sash and doors, shall be covered with sixteen-ounce cold rolled copper in design as indicated. All panels shall be made of "fine crimped" copper, a sample of which shall be approved by the Commission before being used on the work. Joints shall be carefully soldered and shall be locked where required by the Commission. All copper sheathing shall be nailed with copper nails.

Where indicated on the drawings, the walls of mezzanines and of enclosures between stations shall be covered with crimped galvanized iron, No. 24 gauge, nailed to the studs, furring or sheathing with tinned nails and washers.

Section No. 230. All ornamental work shall be carried out as indicated, bracketing off for same and strapping to the roof or other support where necessary. Gutters for stairway canopies shall be of No. 24 gauge galvanized iron. Gutters for mezzanines

at stations shall be of sixteen-ounce cold rolled copper.

SECTION No. 231. Along the canopies over side platforms standing gutters of No. 24 gauge galvanized iron shall be built up immediately over the eaves. These gutters shall be stayed with straps and brackets spaced not over twenty-eight (28) inches on centers. Hung gutters shall be made of galvanized iron as specified for standing gutters, with roll edge and moulded and shall be well graded and securely hung or braced as indicated. Where the gutters join the roofing tin the joints shall be locked and soldered.

SECTION No. 232. All leaders, except where otherwise specified, shall be three (3) inches in diameter, and shall be made of No. 24 gauge corrugated galvanized iron of an approved quality.

Leaders next to copper sheathing shall be made of sixteen-ounce cold rolled copper and shall be secured with copper straps.

Where leaders pass through platforms they shall be carried in three and one-half (3½) inch galvanized wrought-iron pipes extending from six (6) feet above the platform to one (1) foot below the platform and securely fastened to the canopy posts. The pipes shall be set in cast-iron collars fitted to the posts at the platform level, and where these pipes pass through the roof over the mezzanines this joint shall be made water-tight.

All leaders shall be supported by straps and shall unless otherwise specified be carried to the street alongside of the existing columns. At the outlet end three and one-half (3½) inch galvanized wrought-iron pipe leaders with elbows at the lower end shall be used for a distance of six (6) feet above the street surface.

Leaders of cast-iron pipe shall be provided where indicated on the drawings.

Water on stairway roofs shall be carried to the street through special galvanized wrought-iron leaders set inside of each cast-iron canopy post at the foot of stairways and connecting to a galvanized iron pipe laid under the street landing and arranged to discharge at the curb. Galvanized wire strainers, No. 12 gauge, shall be provided for all leaders ex-

cept copper leaders, which shall have No. 12 gauge copper wire strainers.

SECTION No. 233. All water and drain pipes which are exposed to the weather shall be encased in No. 20 gauge galvanized iron to protect the insulation described in Section No. 254 of this Part, except where the pipes are alongside of the copper sheathing, when they shall be encased in sixteen-ounce copper. Casings shall be secured in place with approved clips or straps, and shall be easily removed and replaced.

SECTION No. 234. A smoke flue of No. 24 gauge galvanized iron, with an approved hood or cowl at the outlet, shall be provided from each mezzanine. Where the flue passes through the wood ceilings, partitions, walls or roofs, an outer casing pipe of the same material as the flue and flanged at each end shall be provided. Approved shields shall be provided around the flue to protect the space between the flue and the casing pipe. Where the smoke flue passes through the concrete train platform it shall be encased in a wrought-iron pipe ferrule, threaded for and provided with a pipe flange. The joint between ferrule and concrete shall be made water-tight. The smoke flue above the train platform shall be protected with a casing made of steel plates and angles. The casing shall be five (5) feet high and shall be bolted to the canopy posts. The flue shall be wrapped with an approved asbestos covering.

The interior of booths on mezzanines other than ticket booths shall be sheathed with stamped sheet steel, No. 29 gauge, similar and equal to sample on file in the office of the Commission. The steel shall be nailed to the wood furring, lapped at joints and neatly fitted as to pattern and at all corners and angles. A sample of the stamped sheet steel shall be approved by the Engineer before such steel is used on the work.

Galvanized iron roof ventilators for enclosures between stations shall be of an approved type and shall be made of No. 22 gauge galvanized iron and secured to the roof.

All sheet metal, except copper, which is inaccessible for painting after erection, shall be given one (1) coat of paint, as hereinafter specified, before it is set in place in the work.

SECTION No. 234-A. Rust-resisting iron shall be used in hollow metal construction and shall be of commercially pure iron having high rust-resisting qualities. It shall contain a total of not more than sixteen-hundredths per centum (0.16%) of carbon, manganese, phosphorus, silicon, sulphur and copper, taken together. Test specimens shall bend cold flat on themselves without fracture on the outside of the bent portion.

All iron shall be true to gauge, free from defects visible to the eye, such as seams or cracks at the sheared edges, slivers or depressions in the surface, rust, scale and pit marks of any character. As much of the iron as may be deemed necessary shall be cleaned by sand blast or other approved method, in order to determine the condition of the surface. Any defects disclosed by such cleaning will be cause for rejection. All accepted iron shall be marked close to the edge with the Inspector's private mark, and no marking shall be done except by the Inspector. Gauge numbers used herein and on the drawings refer to U. S. standard.

Stall partitions in toilet rooms of stations shall consist of panels of No. 12 gauge iron, with top and bottom rails of No. 16 gauge iron. The top and bottom rails shall be of circular cross-section and the panels shall be welded to them and to the posts described below. Posts for toilet stall partitions and for supporting toilet stall doors where metal panels are used shall be built of No. 16 gauge hollow metal with cast-iron or wrought-iron caps and footings. The footings shall be set into the floors of the toilet rooms. Posts adjacent to walls or pipe chamber partitions shall be secured to the walls by cast-iron brackets and by wall flanges, as shown on the drawings. Posts supporting toilet stall doors shall be connected by top rails. Top rails connecting posts of toilet stall partitions shall consist of extra heavy wrought-iron pipe one and one-fourth (1¼) inches in diameter, secured to the posts by standard pipe fittings. Partitions and posts shall be provided with extra reinforcement where hardware is to be attached. Partitions, posts, top rails and all fittings shall be finished in white and in the manner hereinafter specified for surfaces of hollow metal work.

All interior surfaces of hollow metal work which are not accessible after erection shall be given two (2) coats of metallic

paint before assembling. All exterior surfaces of such metal work shall be given seven (7) coats as follows: filler coat, body coat, three (3) coats of enamel and two (2) coats of varnish. Each coat shall be thoroughly dried and baked before the following coat is applied. Samples of all materials used for filler, paint, oil and varnish shall be approved by the Engineer before being used.

Hardware

Section No. 236. All hardware, unless otherwise specified, shall be of solid bronze metal, without lacquer, and of weight, quality and design equal to samples on file in the office of the Commission.

Section No. 237. All butts shall be made of heavy wrought metal, four and one-half (4½) inches by four and one-half (4½) inches, unless otherwise specified, self-lubricating, loose pinned, and shall have bushings running the full length of knuckles.

In general the heads of all screws shall be designed so as to require a special wrench.

Locks for doors shall have all inside works of brass except the three (3) tumblers, which shall be of steel. The locks shall center on lock stiles unless otherwise directed by the Commission and shall operate under approved key systems as hereinafter specified.

Doors to ticket booths shall have cylinder locks with the cylinder set in the ornamental escutcheon. Panel board doors and all drawers shall, unless otherwise specified, have heavy pin tumbler cabinet locks, and shall operate under approved key systems as hereinafter specified.

Two (2) keys shall be furnished for each lock, except the locks on the doors to ticket booths, which shall be furnished with three (3) keys each. Each key shall have stamped thereon the number of the key, as hereinafter noted. (See Section No. 242 of this Part.)

Section No. 238. The key systems shall correspond with the key systems on said Brooklyn-Manhattan Rapid Transit Railroad, and the locks shall be designed to accomplish this uniformity.

Special precautions shall be taken to control the distribution of the keys during construction. All locks when installed shall be arranged by the Contractor to operate under one tumbler or other approved method, so as to permit the use of the locks during the construction of the work under this contract. When directed by the Engineer and before completion of all of the work, the locks shall be adjusted by the manufacturer for the final key system. Three (3) keys shall

be furnished for each station for use with the temporary arrangement of locks in addition to the number required for the final key system. Upon the completion of the work a complete set of keys, as herein specified, shall be furnished to the Engineer.

SECTION No. 239. All knobs shall be of screwless pattern, with sleeve adjustment.

Door checks shall be fastened to the doors with plates, bolts running through the doors and nuts headed on, or in other approved manner.

All doors shall be furnished with either combined door stops and hooks or rubber covered chains, as directed.

SECTION No. 240. Spring hinges for doors to toilet stalls shall be of the pivot type (single axis), attached to the lower corners of the doors by means of vertical and horizontal arms. The weight of the doors shall be carried by ball bearings located at the end of the pintle and the tops of the doors shall be guided by pivots and sockets. The sides of the hinges shall be fitted with removable plates to permit adjustment of the springs. A throw latch of bronze with wood bumper shall be provided for each pair of Type "G" doors. A combination door stop and coat hook of bronze shall be provided for each stall and the stop shall be secured to the panels or wall and provided with a wood bumper. Door stops, latches and exposed parts of hinges and pivots shall have the same kind of finish as hereinbefore specified for exterior surfaces of hollow metal work.

Sash adjusters for one or more sash, as required, shall be provided where called for on the drawings or ordered by the Engineer. Casement sash adjusters for gangs of two (2) to six (6) sash shall have the gear wheel and shaft hangers of cast iron, the worm of hard brass, the shafting of steel and the remainder of the material of malleable iron. All material shall be sherardized throughout except the worm. Each sash shall have one (1) universal arm and rod and the whole apparatus shall be operated by means of a detachable key. Sash adjusters shall be bolted through the sash and the shaft hangers shall be bolted through or screwed into the walls.

SECTION No. 241. Doors, windows and ticket booths shall be provided with hardware as listed in the following schedule, in addition to the hardware herein elsewhere specified:

Doors to Enclosures between Stations

One (1) heavy mortise lock complete, plain knob and rosette both sides.
One and one-half (1½) pairs loose pin butts.
One (1) rubber covered chain or one (1) door stop, as may be designated.

Doors to Toilet Rooms and Waiting Rooms

One (1) heavy mortise dead lock complete.
One and one-half (1½) pairs loose pin butts.
One (1) push plate. (Toilet rooms only).
One (1) door pull. (Toilet rooms only).
Two (2) push bars. (Waiting rooms only).
One (1) door check.
Two (2) kick plates.
One (1) rubber covered chain or one (1) door stop, as may be designated.

Doors to Closets

One (1) heavy mortise lock complete, ornamental knob and escutcheon outside, plain knob and rosette inside.
One and one-half (1½) pairs loose pin butts.
One (1) rubber covered chain or one (1) door stop, as may be designated.

Doors to Toilet Stalls

One (1) pair spring hinges, pivots and sockets.
One (1) throw latch.

Batten Doors and Doors to Panelboard Boxes

One (1) heavy pin tumbler cabinet lock.
One and one-half (1½) pairs fast joint butts, three (3) inches by three (3) inches.

Vent Doors

One (1) pair of fast joint butts, three (3) inches by three (3) inches.
One (1) transom catch.
Two (2) friction adjusters.

Double Hung Sash

One (1) sash fastener.
One (1) pair of flush sash lifts.

Sash; Hinged Top or Bottom

One (1) pair fast joint butts, three (3) inches by three (3) inches.
One (1) transom catch.
One (1) friction adjuster.

Casement Sash

One and one-half (1½) pairs fast joint butts, three (3) inches by three (3) inches.
Sash adjuster to operate two, three, four, five or six sash in gangs.
(Separate casement adjuster and casement fastener for sash in ticket booth enclosures.)

Drop Sash

Two (2) flush lifts (special).

Ticket Booths, Type B

One (1) heavy mortise cylinder lock complete, ornamental knob and escutcheon outside, plain knob and escutcheon inside for each door.
One and one-half (1½) pairs loose pin butts for each door.
One (1) rubber covered chain or one (1) door stop for each door, as may be designated.
One (1) drawer pull for each drawer.
One-half (½) dozen coat and hat hooks.
One (1) heavy pin tumbler cabinet lock for each drawer.
Two (2) pairs fast joint butts, three (3) inches by two and

one-half (2½) inches, one (1) spring cupboard turn and two (2) book case bolts for each pair of closet doors.

One (1) pair fast joint butts, one and one-half (1½) inches by one and one-half (1½) inches, and one (1) cupboard catch for each hinged ventilator.

SECTION No. 242.

Key No. 1

Doors to upper part of enclosure between stations more than one (1) story in height.

Keys alike, but different from Nos. 2, 3 and 4.

Key No. 2

Doors to enclosures between stations other than upper part of enclosures between stations more than one (1) story in height.

Keys alike, but different from Nos. 1 and 3.

Key No. 3

Doors to waiting rooms, toilet rooms and closets, other than transformer closets.

Keys alike, but different from Nos. 1 and 2.

Key No. 4

Doors to transformer closets on mezzanines.

Keys alike, but different from Nos. 1, 2 and 3.

Key No. 5

Doors to ticket booths and all drawers in ticket booths.

Keys alike, but different from Nos. 6 and 7.

Key No. 6

Doors to panel-boards.

Keys alike, but different from Nos. 5 and 6.

Key No. 7

Batten doors.

Keys alike, but different from Nos. 5 and 6.

Plumbing and Drainage

Section No. 244. All cast-iron pipes and fittings shall be uncoated, sound, cylindrical, free from cracks, sand holes and other defects, of uniform thickness and of the grade known in commerce as "extra heavy". Pipe, including hub, shall weigh not less than the following average weights per lineal foot:

Two	(2)	inches	diameter,	five and one-half	(5½)	pounds
Three	(3)	"	"	, nine and one-half	(9½)	"
Four	(4)	"	"	, thirteen	(13)	"
Five	(5)	"	"	, seventeen	(17)	"
Six	(6)	"	"	, twenty	(20)	"

The size and weight of pipe and also the maker's name shall be cast on each length of pipe.

All joints in cast-iron sockets, pipe and fittings shall be made with picked oakum and molten lead, and shall be thoroughly caulked to insure gas-tight joints. Twelve (12) ounces of fine, soft pig lead shall be used at each joint for each inch in the diameter of the pipe.

All changes in directions shall be made with bends of large radius, and all branches shall be "Y" branches or curved tees.

Section No. 245. All wrought-iron pipes shall be galvanized, lap welded, equal in quality to "Standard" and shall be tested by the manufacturer.

Wrought-iron pipe fittings for supply, drain and vent pipes shall be malleable iron steam and water fittings, and shall be galvanized.

All joints except in cast-iron and lead pipe shall be screw joints made up with red lead, and the burr formed in cutting shall be carefully reamed out.

Pipe installed in a vertical position shall be firmly held in place by strong pipe rests on supports well fastened to the walls. Where hung from the ceilings or walls, pipes shall be held in place by approved iron hangers. Pipes carried above the floor shall be supported at suitable intervals. Special care shall be taken to thoroughly insulate all pipes and fittings from the steel work of the structure as directed by the Commission.

SECTION No. 246. All brass pipe shall be thoroughly annealed, seamless, drawn brass tubing of standard iron pipe gauge and of the standard weights specified by the Department of Buildings.

All joints shall be screw joints made up with red lead. Soldering nipples shall be heavy cast brass or brass pipe, iron pipe size.

SECTION No. 247. No lead pipes shall be used except where specially permitted by the Commission. All lead pipe used, except for water supply, shall be of the best quality, known as "D", and of weight as specified by the Department of Buildings.

Lead pipe used for water supply shall be of the best quality known as "AA".

All connections between lead pipes and between lead and brass pipes shall be made by means of "wiped" solder-joints.

All solder shall be soft and free from impurities.

All lead for caulking purposes shall be soft, pure pig lead, free from any admixture of antimony, zinc, or other metal. No scrap lead shall be used.

SECTION No. 248. All stop valves, except the valves at the street mains, shall be standard gate valves with bronze valves and valve seats. All check valves shall be of the swinging type with bronze valves and valve seats.

All valves shall be of an approved make and the valves on the street main shall be of a type to conform to the requirements of the Department of Water Supply, Gas and Electricity.

SECTION No. 249. The entire work shall be arranged and executed in strict conformance with the specifications and the drawings showing the plumbing work and the location of the plumbing fixtures, and in accordance with the conditions of each station, as actually constructed. Unless special permission is obtained from the Commission to deviate from the lines as laid out in the drawings, these lines shall be followed. Where plumbing work is installed connection shall be made with sewers and water pipes where such sewers and water pipes exist.

All soil, waste, vent and supply pipes, except where otherwise indicated, shall be run in specially arranged pipe chambers between an outer partition and the side walls of the toilet rooms. The soil pipes shall be connected with the main drain in such a manner that they may be wholly enclosed within the pipe chambers. All pipes and valves installed in the above pipe chambers shall be arranged so as to be easily accessible for maintenance and repairs.

A three (3) inch fresh air pipe shall be connected to the main drain above the street surface and the top of the fresh air pipe shall be furnished with a special return fitting as indicated on the drawings. A three (3) inch vent pipe shall be connected to the upper end of the soil pipe in the stations and shall be extended up and through the upper portion of the mezzanine, and the end of the pipe shall be fitted with a perforated cap or as otherwise indicated on the drawings. All waste pipes from fixtures shall connect to the three (3) inch vent through a two (2) inch horizontal vent pipe run at proper elevation as indicated on the drawings.

Section No. 250. All main soil pipes shall be of cast iron six (6) inches in diameter except where otherwise indicated. All pipe extensions for ventilating shall be three (3) inch wrought-iron pipe. All main waste pipes shall be of cast iron or wrought iron two (2) inches or three (3) inches in diameter, as may be required. All additional vent pipes shall be of wrought iron two (2) inches in diameter. All soil and waste pipes shall have a fall of at least one-fourth (¼) of an inch per foot. All vent pipes shall have a sufficient fall to insure proper drainage. All offsets in soil and vent pipes shall be made at an angle of not more than forty-five (45) degrees to the center line of the pipes.

The main drain (the pipe connecting the surface soil pipe in toilet rooms and catch basins with the sewer) shall be six (6) inches in diameter, except where otherwise specified, and shall have a fall of not less than one-fourth (¼) of an inch per foot. It shall be of galvanized wrought iron with an approved insulated joint. Cleanouts, fitted with screw plugs, shall be provided where necessary on the main drains, soil and waste pipes.

Section No. 251. The main drains shall be trapped by

running traps before connecting with the sewers. The traps shall be placed below the surface of the street and enclosed in manholes as indicated on the drawings. The manholes shall be built of concrete or brick masonry and shall be provided with steel or cast-iron frames and covers set flush with the pavement. Where the drains and water supply pipes are not connected to sewers and water mains the water supply pipe and the outlet side of the main trap shall be extended beyond the manholes; the outlet side of the main trap shall be provided with a metal plug set in cement and the water supply pipe shall be provided with a brass screw plug.

Each fixture connected to the soil or waste pipe system shall be provided, as near as possible to its outlet, with a suitable trap, of a type to be approved by the Engineer. The diameter of trap shall be the same as the waste pipe to which it is attached.

All traps shall be provided with brass trap screws placed on the inlet side or below the water level, so as to permit the trap to be cleaned.

Trap vent pipes shall be not less than two (2) inches in diameter for water closet traps; for all other traps the vents shall be of the same diameter as the trap. Branch vents shall be set at such a height above the floor that the vent cannot act as an overflow pipe.

Overflow pipes from fixtures shall be connected on the inlet side of traps.

All fixtures shall be arranged in an open manner unless otherwise directed by the Engineer.

Section No. 252. All supply pipes shall be of wrought iron of the quality hereinbefore specified. Supply pipes shall not have any depressions or sags and shall be set to such grade that they may be easily and completely emptied. No check valves shall be used unless specially called for. The supply pipe to each fixture shall be fitted with a valve so that each fixture may be independent.

Main supply pipes shall be two (2) inches in diameter. Branches for lavatories in toilet rooms shall be not less than three-fourths (¾) of an inch in diameter. Flushing pipes shall be one and one-half (1½) inches in diameter, taken direct from receiving cylinders.

SECTION No. 253. Receiving cylinders and check valves shall be provided on supply mains where indicated. The cylinders shall be heavy galvanized iron pipe, twelve (12) inches in diameter by thirty-six (36) inches long, reinforced at all pipe connections and attachments. They shall be connected with the street main, and provided with check and gate valves. A drain cock shall be provided in the bottom of the cylinders and an air cock in the top. From each receiving cylinder a line of one and one-half (1½) inch galvanized pipe shall be run to supply all water closet bowls, urinals and slop sinks.

SECTION No. 254. In general, a one (1) inch connection shall be provided between the street main and manhole. From the manhole a one and one-half (1½) inch galvanized wrought-iron pipe with an approved insulated joint shall be carried to a point within the mezzanines or enclosures between statons, as indicated on the drawings, to connect with the water meter, and thence to the receiving cylinder. Lavatories in toilet rooms shall be supplied through a separate three-fourths (¾) inch wrought-iron pipe taken from the two (2) inch supply main. An additional meter shall be provided on the supply to lavatories, if required by the Department of Water Supply, Gas and Electricity. All supply mains to fixtures shall be so constructed that there shall be no pounding of valves. Enclosures between stations shall be supplied through separate connections to the street main.

A valve and necessary box and cover enclosing same shall be provided at the connection of the supply main with the street main in such manner that the valve may be accessible from the street surface. Swinging joints shall be provided where required. The supply main shall be carried through the trap manhole and shall be provided with a roundway stop and waste valve within the manhole as indicated.

If, for any reason, the Department of Water Supply, Gas and Electricity will not permit a one (1) inch connection to the street mains, then such connections as they will permit, and of at least equal capacity to the connections indicated on the drawings, shall be made.

All water and drain pipes, cylinders and meters shall be thor-

oughly wrapped with an approved hair felt insulation. Where this insulation is exposed to the weather it shall be encased in metal as provided in Section No. 233 of this Part.

SECTION No. 255. A water meter with flange connections shall be furnished and set on each supply main, including the supply to lavatories, where required by the Department of Water Supply, Gas and Electricity, of size to conform to the requirements of that Department and of type to be approved by the Commission. All meters shall be properly tested and sealed before delivery.

SECTION No. 256. The entire plumbing and drainage system within each station and enclosure between stations shall be tested by the Contractor, in the presence of the Engineer, under a water, smoke or chemical test as directed. All pipes shall be uncovered in every part until they have successfully passed the test. The Contractor shall securely close all openings as directed, the use of wooden plugs for this purpose being prohibited.

Before the main drain is covered, the outlet end and other openings shall be closed, and the pipe subjected to pressure due to a head of water at least six (6) feet greater than the maximum normal head on the pipe.

After the completion of all the piping in the toilet rooms and before any fixtures are connected, all openings of waste, soil and vent pipes and the outlet end of the main drain shall be securely closed, and the whole system of piping filled with water. The water shall remain at the same level before the test will be satisfactory.

All supply pipes shall be tested with City water pressure.

The entire plumbing work shall be tested after completion by turning the water into all pipes, fixtures and traps, in order to detect imperfect joints; and finally the Contractor shall make a smoke or chemical test of the whole completed system if directed by the Engineer. All service pipes shall be given two (2) coats of paint as hereinafter specified, when directed by the Commission.

Ferrules for mezzanine roof drainage including ferrules draining to gutters shall be made of three (3) inch galvanized wrought-iron pipe with galvanized cast-iron screw flanges.

SUBDIVISION 11

Plumbing Fixtures

Section No. 258. All plumbing fixtures, fittings and hardware in toilet rooms shall be of a type approved by the Commission and shall be so designed that they will as far as possible be vandal-proof. All metal fittings of plumbing fixtures exposed in the toilet rooms shall be covered with an approved durable acid-proof white finish. All toilet room fixtures shall be provided with shut-off valves on the supply and flush connections.

All vitreous ware shall be non-absorbent throughout, homogeneous and free from fine cracks, dents and crazes. The right is reserved to test one piece of each pattern, make or design, selected at random from each lot and broken in the presence of the Engineer, for absorption by immersion in red alkaline ink or other approved method. If the piece passes the test satisfactorily, the lot represented by the piece tested will be accepted. If the piece tested does not pass the test satisfactorily, the whole lot may be rejected.

All fixtures shall be ground to set true against the walls. Warped fixtures will not be accepted. Each fixture shall be of sufficient strength to support, when in place, a load of two hundred and fifty (250) pounds concentrated on any part of the fixture, without any signs of failure. All fixtures of their respective kinds shall be interchangeable, of the same mould and pattern, with supply and outlet openings, bolt holes, etc., in the same relative position. The weight of fixtures shall vary not more than five per centum (5%) from the weight specified.

Section No. 259. All water closet bowls shall be made of the best vitreous ware and shall be of the siphon jet type. The bowls shall have extended front lips, flushing roll rims, integral seats with openings not less than eight (8) inches by twelve and three-fourths (12¾) inches, and shall be supported on cast-iron wall chairs imbedded in and anchored to the floors or on special steel framing, as may be required by the Engineer, and the soil lines shall not be depended upon for supports. The weight of each bowl, without fittings, shall be fifty (50) pounds. The connections between the bowls and the soil lines shall be by means of cast brass flanges brazed to a copper pipe and connected

to the roughing as indicated on the drawings. The heads of the bolts securing the bowls and cast brass flanges shall be provided with porcelain covers. Each bowl shall be fitted with a one and one-half (1½) inch rough brass flush valve with integral stop, the flush valve being set behind the pipe chamber partition, fitted with a porcelain push button marked "Push," and a brass sleeve, finished where exposed on surface of wall, and secured with lock nut and set screw. The bowls shall be secured to the cast-iron chairs or steel framing by one-half (½) inch brass bolts, with heads finished where exposed, and each bolt shall be fitted with two (2) lock nuts and washers.

SECTION No. 260. All lavatories for toilet rooms at stations shall be made of the best vitreous ware, with integral backs, integral shields for supply nozzles and integral waste strainers, and shall not exceed twenty (20) inches in width. The weight of each lavatory, without fittings, shall be one hundred (100) pounds. Lavatories shall be supported on cast-iron hangers, secured to same by brass bolts, and each lavatory shall be fitted with one rough brass slow closing supply valve with a porcelain push button marked "Push," and with a rough brass supply connection from valve to nozzle, a one-half (½) inch rough brass loose key shut-off valve, and a one and one-half (1½) inch rough brass trap. Valves, traps and waste pipes for traps shall be enclosed with a vitreous shield bolted to hangers with brass bolts.

SECTION No. 261. All lavatories for enclosures between stations shall be made of the best vitreous ware with integral backs and hangers, shall have brass pop-up wastes, rough brass self-closing faucets with coupling for one-half (½) inch iron pipe, a one-half (½) inch rough brass shut-off valve and a one and one-half (1½) inch rough brass trap. The width, method of support, and weight of these lavatories shall be the same as specified for lavatories in toilet rooms at stations.

SECTION No. 262. All urinals shall be made of the best vitreous ware, with integral flushing rims and integral outlet strainers, and shall not exceed twenty-four (24) inches in width including the rim. The weight of each urinal, without fittings, shall be two hundred and twenty (220) pounds. Urinals shall

be supported on approved wall hangers, and each urinal shall be fitted with a one and one-fourth (1¼) inch rough brass push button flush valve with integral stop. The flush valve shall be set behind the pipe chamber partition, shall be fitted with a porcelain push button marked "Push," and a brass sleeve, finished where exposed on surface of wall, and secured with lock nut and set screw.

SECTION No. 263. All slop sinks shall be made of the best vitreous ware, with integral flushing rim and ledge to wall, shall not exceed twenty-two (22) inches in width, shall have rough brass waste strainers and shall be supported on galvanized adjustable trap standards, finished in white enamel and fitted with brass cleanout screws. Each slop sink shall weigh, exclusive of all fittings, one hundred and eighty (180) pounds. Each slop sink shall be fitted with a one and one-half (1½) inch rough brass push button flush valve connected to the flushing rim, fitted with a porcelain push button marked "Flush" and a one and one-half (1½) inch rough brass shut-off valve. Each supply nozzle shall be connected to a one (1) inch rough brass push button supply valve, fitted with a porcelain button marked "Supply," and a one (1) inch rough brass globe valve.

SECTION No. 264. Where the slop sinks are set in the toilet rooms, the valves and connections shall be placed in a recess provided in the wall and enclosed by a porcelain enameled iron shield, bolted to beveled cast-iron frames built into the wall.

SECTION No. 265. Where the slop sinks are set in closets the valves and connections shall be exposed and supported on wall brackets.

SECTION No. 266. All floor drains shall have cast-iron trap bodies with brass tops nine (9) inches square fitted with perforated hinged covers. Where necessary, special shallow floor drains shall be furnished.

SUBDIVISION 12

Structural Glass, Slate and Fittings in Toilets

Section No. 268. All wainscoting, pipe chamber partitions and shelves, and floor slabs in toilet rooms of stations shall be of structural glass with all exposed surfaces in toilet rooms ground and polished, and shall be of three-fourths (¾) inch average thickness, except the urinal floor slabs, which shall be of one (1) inch average thickness.

No slab of structural glass which measures more than one-sixteenth (1/16) of an inch less than the average thickness herein specified will be accepted.

All wainscoting, partitions and shelves in toilet rooms of enclosures between stations shall be of clear, genuine Bangor slate and shall be one (1) inch thick.

Samples of the structural glass and slate which the Contractor proposes to use in the work shall be submitted to the Engineer for approval.

All wainscoting and pipe chamber partitions shall extend from the sanitary cove up to a height of six (6) feet six (6) inches above the finished floor, except where, owing to the low ceiling in the toilet rooms, it is found necessary to extend them to the ceiling. Pipe chamber partitions shall be secured at top and bottom to steel angles by round head machine screws. Wainscoting shall be secured to the walls by round head screws. It shall be set out from the walls with wood furring so as to give a projection of one-fourth (¼) of an inch beyond the adjoining finish and shall have the upper edge rounded. The space between the wainscoting and the walls shall be filled with an approved material. All corners and angles shall be curved to a two and one-half (2½) inch radius. Pipe chamber shelves shall be supported on steel angles and secured with round head machine screws. Urinal floor slabs shall be set level, one-half (½) inch above the floor, with a full bed, and the upper surface shall be countersunk one-fourth (¼) of an inch deep with a three (3) inch border around the slab. The back of the slab shall be joined to the vertical partition or wainscoting with a cove of one and one-half (1½) inches radius above the top of the slab. The outer edges of the floor slab shall be cut to form a cove from the floor to the top of the slab. Special precautions shall be taken to protect the above materials, and sheet

lead, lead washers or other approved material shall be used to separate them from the steel or iron.

SECTION No. 269. Steel angles shall be securely fastened to the walls and shall be braced where necessary. Special framing of steel angles and plates shall be provided where required by the Commission for the support of the water closet bowls, urinals and lavatories. The lower angles supporting partitions shall be anchored to the floor or masonry foundation. The angles shall be painted with a shop coat, and after erection with a first field coat as hereinafter provided for railings.

Iron castings shall be as hereinbefore specified and shall be thoroughly cleaned and painted as hereinafter provided.

All round head screws shall be of brass, with three-fourths (¾) inch washers. All screw heads and washers shall have an approved finish as hereinbefore specified for metal fittings of plumbing fixtures exposed in toilet rooms.

Register frames and louvres shall be set in the pipe chamber partitions or in the walls of toilet rooms where indicated on the drawings. A white enameled perforated plate shall be secured to the face of the frame in the toilet room, and the frames shall be secured to the partitions or walls.

Where urinals or water closets are set against pipe chamber partitions, removable white enameled cast-iron plates with frames shall be set in the partitions to provide access to the flushometers.

SUBDIVISION 13

Electric Work

Section No. 274. All electric conduit shall be of the best grade standard weight wrought-iron or steel piping, protected inside by a coat of zinc, enamel, or other approved preservative and outside by a coat of zinc. All conduit shall be delivered to the work in bundles of full length pipes, each length marked with the trade mark of the manufacturer. All conduit shall bend cold ninety (90) degrees about a radius equal to ten (10) diameters without signs of flaw or fracture in either pipe or enamel. Flexible conduit shall be provided where specially called for on the drawings. Samples of conduit and boxes shall be submitted for approval before proceeding with the electric work.

Section No. 275. All conduit shall be carefully cleaned before and after erection, all ends shall be reamed free from burrs, and inside surfaces shall be free from all imperfections liable to injure the cable. All conduit shall be snaked with steel band wire, and any conduit which cannot be snaked shall be removed and replaced. All joints shall be made with standard couplings, well treated with red lead, and screwed up to make a water-tight joint.

Conduit built into the structure shall be properly protected and supported, to prevent their becoming injured by the building operations, and shall be placed far enough back to clear the station finish.

Conduit shall be protected at all times from the entrance of water or other foreign matter by being well plugged over night or when the work is temporarily suspended, and furnished with iron caps if to be left dead ended. Special care shall be taken with conduit which are to be buried in masonry, to prevent their becoming choked with cement.

Section No. 276. Bends and offsets may be made in the field if proper tools are used, but in no case shall deformed, split or crushed conduit be used. Not more than two (2) right angle bends shall be made between any two (2) outlet boxes without special approval of the Engineer.

All elbows, fittings or other materials installed in the work shall be protected inside by a coat of zinc, enamel or other approved preservative and outside by a coat of zinc. All joints and

connections shall be well treated with red lead and made water-tight. Boxes installed in the work shall be protected inside and outside by a coat of zinc, enamel or other approved preservative. Boxes shall be set square with adjacent ceiling, floor, wall or beam line, and shall have all conduit enter squarely.

SECTION No. 277. All outlet boxes and combination outlet boxes and ceiling rings, pull boxes and extension floor boxes shall be made of cast iron with openings threaded for the conduit ends, and conduit shall be screwed into these openings and made up with red lead to effect a water-tight joint. The interior faces of combination outlet boxes and ceiling rings shall be finished with approved white enamel and as indicated on the drawings. All conduit ends inside of boxes shall be fitted with bushings. Covers shall be of cast iron and water-tight, and secured to boxes with brass screws, and no other boxes or covers shall be used except under special permission of the Commission.

Outlet boxes and combination outlet boxes and ceiling rings shall be placed at all light locations, as indicated on the drawings. Boxes shall be firmly and permanently secured in place, and if held with screws passing through the back, shall be made water-tight by means of a lead washer under the screw head. No box shall be drilled for more conduit than actually enter it.

Special cast-iron boxes thirteen (13) inches by twenty (20) inches by four (4) inches with hinged covers and special screw locks shall be provided in the exterior walls of mezzanines as indicated on the drawings. A hole shall be provided in each box for a porcelain ferrule which will be furnished to the Contractor and installed by him.

Pull boxes shall be provided where indicated on the drawings, or where, in the opinion of the Commission, they are necessary. In general a pull box shall be provided for every one hundred (100) feet of continuous conduit. These boxes shall be of ample size to receive without crowding all conduit entering them. All boxes shall be accessible when wall or ceiling finish is in place, and where covers are exposed on finished walls or ceilings they shall be secured to the boxes with button head brass machine screws and painted as hereinafter provided.

SECTION No. 279. Panel-board boxes shall be built up of steel plates and angles riveted together. They shall be drilled for the necessary conduit and shall be built into or mounted on the walls of the stations, wind screens or ticket booths as indicated on the drawings. Brass machine screws and special nuts shall be provided for securing trim to boxes. All conduit entering these boxes shall be secured with lock nuts and bushings.

SECTION No. 280. No permanent wiring, switches, transformers, light fixtures or lamps will be required under these specifications, but such temporary wires, fixtures and lamps as may be necessary for the proper conduct of the work under these specifications will be required as hereinbefore specified.

SUBDIVISION 14

Painting

Section No. 285. All iron, steel, woodwork and plastered surfaces installed under this Part Second shall be painted or varnished as hereinafter specified. The Contractor shall repaint in accordance with the requirements of Section No. 291 of this Part any portion of the railroad structure where the paint has been damaged.

Section No. 286. Paint, varnish and filler shall be subject to inspection at the place of manufacture and to such tests as may be ordered by the Engineer. The Engineer shall have access, at all times, to all places to inspect the methods of manufacture, and shall have liberty to inspect the daily laboratory records and analyses of all such paints, varnishes or fillers as are subject to his inspection. Tests will be made against standard samples. Such analyses as are required will be made by the Engineer.

The Contractor shall furnish all facilities required for the proper inspection of the paint, varnish and filler and their manufacture. All containers and metal cans will be sealed by the Inspector at the time of inspection.

Section No. 287. Before purchasing any paint or varnish, the Contractor shall obtain the Commission's approval of the subcontractor who is to furnish such paint or varnish.

A subcontractor for paint, in order to be acceptable to the Commission, shall have manufactured good grades of paint for at least five (5) years; and a subcontractor for varnish, in order to be acceptable to the Commission, shall have manufactured good grades of varnish for at least five (5) years. A subcontractor shall have an adequate factory located within one hundred (100) miles of the City.

Due to the cost of inspection, the Contractor will be required to purchase paint, varnish and filler in as large quantities as practicable. In no case will the manufacture of less than five (5) barrels of one kind of paint be inspected at one time.

Section No. 288. Each kind of paint, varnish or filler will be referred to hereinafter by the letter indicating its quality

or formula. All proportions are by weight, except as otherwise noted.

The paint, varnish and filler formulæ are as follows:

"A." Light Paste Wood Filler:

Refined linseed oil	11%
Drier "O"	1%
Varnish "D"	8%
Turpentine	13%
Silica	44%
Magnesium silicate	23%

The paste wood filler when thinned with turpentine to a brushing consistency shall dry hard on glass in twenty (20) hours. It shall not rub up by friction under the finger and when immersed in water shall remain intact for at least four (4) hours. It shall dry full, translucent and without luster, so that it will not color or cloud the work, and it shall be hard enough after twelve (12) hours to withstand sandpapering without clogging the paper.

"B." Dark Paste Wood Filler:

"A," with the addition of sufficient burnt umber and lampblack ground in raw linseed oil to match the color of the standard sample.

"C." Varnish:

Kauri gum	100 pounds
Refined linseed oil	25 gallons
Turpentine, not over	30 gallons

Sufficient lead and manganese salts to dry the varnish according to specifications.

The varnish when poured on glass and held in a vertical position shall dry dust-free in not less than six (6) hours nor more than eight (8) hours, and shall dry hard in not less than forty (40) hours nor more than forty-eight (48) hours at 70 degrees F. The varnish shall equal the standard sample in clearness, color, specific gravity, body, flowing qualities, cov-

ering properties, gloss, finish, durability, and in all other respects.

"D." Rubbing Varnish for use in "A" and "B":

Kauri gum	100 pounds
Refined linseed oil	8 gallons
Turpentine substitute, not over	10 gallons
Turpentine	20 gallons

Sufficient lead and manganese salts to dry the varnish according to specifications under "A" and "B."

This varnish shall equal the standard sample in clearness, color, specific gravity, body, flowing qualities, covering properties, gloss, finish, durability, and in all other respects.

All varnish shall be properly filtered through an approved filter.

After it is manufactured, the varnish shall be stored in clean metal containers for at least three (3) months. These containers shall be so made that they can be sealed by the Inspector. At the end of the period of storage, the varnish "C," except the portion which is to be used in "K," shall be emptied into metal cans of five (5) gallons capacity in the presence of the Inspector. These cans shall then be sealed by him and shall be delivered on the work with the seal of the Inspector thereon.

After a similar period of storage, varnish "D" shall be ground with silica and linseed oil in the proportions specified under "A" and "B," and placed in metal cans of not over five (5) gallons capacity, in the presence of the Inspector. These cans shall then be sealed by him and shall be delivered to the work with the seal of the Inspector thereon.

"E." Outside White Paint:

	Pigment	Vehicle	Paint
Magnesium silicate	10.0%		5.5%
Basic sulphate white lead	50.0%		27.6%
Zinc oxide	40.0%		22.1%
Ultramarine blue in linseed oil	Trace		Trace
Refined linseed oil		82.0%	36.7%
Turpentine		6.0%	2.7%
Prepared Tung Oil "N"		6.0%	2.7%
Drier "O"		6.0%	2.7%
	100.0%	100.0%	100.0%

Standard weight, 14 pounds 4 ounces per gallon.

"F." Shop Coat for Iron and Steel:

Red lead	500 pounds
Raw linseed oil	11 gallons
Boiled linseed oil	5½ gallons

Standard weight, 26 pounds 12 ounces per gallon.

The shop coat of paint shall be mixed, as needed, in such quantities as can be used before it thickens in the container. Any paint which settles and thickens before use shall be rejected and a new paint mixed.

"G." Under Coating for Metal Surfaces:

	Pigment	Vehicle	Paint
Blue lead	50.0%		21.5%
Red lead	30.0%		12.9%
Lampblack	10.0%		4.3%
Magnesium silicate	10.0%		4.3%
Linseed oil		79.0%	45.0%
Turpentine		7.0%	4.0%
Prepared Tung Oil "N"		7.0%	4.0%
Drier "O"		7.0%	4.0%
	100.0%	100.0%	100.0%

Standard weight, 11 pounds 12 ounces per gallon.

"H." First Coat for Tin Roofs:

	Pigment	Vehicle	Paint
Lampblack	3.0%		1.3%
Red lead	15.0%		6.6%
Spanish oxide	82.0%		36.2%
Linseed oil		80.0%	44.7%
Turpentine		4.0%	2.2%
Prepared Tung Oil "N"		8.0%	4.5%
Drier "O"		8.0%	4.5%
	100.0%	100.0%	100.0%

Standard weight, 12 pounds 0 ounces per gallon.

"I." Finishing Coat for Tin Roofs:

	Pigment	Vehicle	Paint
Persian Gulf oxide	100.0%		43.2%
Linseed oil		86.8%	49.4%
Prepared Tung Oil "N"		6.6%	3.7%
Drier "O"		6.6%	3.7%
	100.0%	100.0%	100.0%

Standard weight, 11 pounds 8 ounces per gallon.

"K." Enamel Paint for Stair Stringers, Railings, etc.:

	Pigment	Vehicle	Paint
Lampblack	40.0%		8.2%
Chrome yellow, medium, c. p.	60.0%		12.7%
Linseed oil		38.0%	30.1%
Drier "O"		3.9%	3.1%
Turpentine		6.5%	5.1%
Varnish "C"		51.6%	40.8%
	100.0%	100.0%	100.0%

Standard weight, 8 pounds 13 ounces per gallon.

"L." Second and Third Coats for Wood Underflooring, etc.:

	Pigment	Vehicle	Paint
Chrome yellow, medium, c. p.	6.3%		2.9%
Chrome green, medium, 25%	7.4%		3.5%
Yellow ochre	15.6%		7.3%
Basic sulphate white lead	46.5%		21.8%
Zinc oxide	23.4%		10.9%
Lampblack	0.8%		0.4%
Linseed oil		88.0%	46.8%
Prepared Tung Oil "N"		6.0%	3.2%
Drier "O"		6.0%	3.2%
	100.0%	100.0%	100.0%

Standard weight, 12 pounds 8 ounces per gallon.

"M." Second and Third Coats for Window and Door Frames, Trim, etc., for Enclosures between Stations:

	Pigment	Vehicle	Paint
Chrome yellow, medium, c. p.	16.5%		6.6%
Chrome green, medium, 25%	20.6%		8.3%
Yellow ochre	41.3%		16.5%
Zinc oxide	20.6%		8.3%
Lampblack	1.0%		0.4%
Linseed oil		87.6%	52.5%
Prepared Tung Oil "N"		6.2%	3.7%
Drier "O"		6.2%	3.7%
	100.0%	100.0%	100.0%

Standard weight, 11 pounds 0 ounces per gallon.

"N." Prepared Tung Oil:

Rosin, treated	15 pounds
Litharge	2 pounds
Tung oil	40 gallons
Turpentine substitute	50 gallons

"O." Drier:

Litharge	10 pounds
Manganese resinate	25 pounds
Raw linseed oil	25 gallons
Turpentine	50 gallons

"P." Finishing Coat for Structural Iron and Steel:

	Pigment	Vehicle	Paint
Chrome yellow, medium, c. p.	21.9%		6.8%
Lampblack	19.2%		6.0%
Spanish oxide	3.6%		1.1%
Zinc oxide	7.8%		2.4%
Yellow ochre	36.5%		11.3%
Magnesium silicate	11.0%		3.4%
Linseed oil		85.2%	58.8%
Prepared Tung Oil "N"		6.0%	4.1%
Drier "O"		8.8%	6.1%
	100.0%	100.0%	100.0%

Standard weight, 9 pounds 13 ounces per gallon.

SECTION No. 289. Linseed oil shall conform to the specification of the American Society for Testing Materials for the purity of raw linseed oil from North American seed, adopted August 25, 1913. It shall be free from foots and moisture, and shall have been heated to 275 degrees F.

Boiled linseed oil shall conform to the proposed specification of the American Society for Testing Materials, 1915. When boiled linseed oil is flowed over a plate of glass and allowed to drain in a nearly vertical position, it shall dry free from tackiness in fifteen (15) hours at 70 degrees F.

Varnish oil shall be refined linseed oil, whose acid number shall not exceed four (4). It shall be free from foots and moisture and shall equal the standard sample.

Tung oil (or China wood oil) shall conform to the proposed specification of the American Society for Testing Materials, 1915.

Turpentine shall be gum turpentine and shall conform to the proposed specification of the American Society for Testing Materials, 1915, for gum turpentine.

Turpentine substitute shall equal the standard sample.

Benzine shall equal the standard sample.

Benzol shall equal the standard sample.

Kauri gum for use in varnish "C" shall be of a "Cross" grade of hard, fossil Kauri gum. It shall be of clean, chiseled gum, free from "sugar." Kauri gum for use in varnish "D"

shall be a No. 2 grade fossil Kauri gum. Both grades shall equal the standard sample.

Orange shellac shall be free from rosin and shall equal the standard sample.

Silica shall be ground from rock crystal and water floated. It shall be ninety-nine per centum (99%) pure silica (SiO_2) and shall be of such fineness that ninety-nine per centum (99%) will pass through a standard 200-mesh sieve. Under the microscope, silica shall be sharp and free from rounded particles. (By standard 200-mesh sieve is meant the 200-mesh sieve described in the specification of the American Society for Testing Materials for Portland cement, adopted August 16, 1909.)

Magnesium silicate shall be a hydrated magnesium silicate of crystalline structure and shall be finely ground.

Basic sulphate white lead shall be a true basic sulphate of lead containing not less than fifteen per centum (15%) combined lead monoxide (PbO), not over five per centum (5%) zinc oxide (ZnO), and not more than seventy-five thousandths per centum (.075%) free sulphur dioxide (SO_2).

Zinc oxide shall be "American Process" and shall contain at least ninety-eight per centum (98%), by weight, oxide of zinc (ZnO), not more than two-tenths per centum (0.2%) sulphur in any form, nor more than seventy-five thousandths per centum (.075%) free sulphur dioxide (SO_2).

Blue lead shall be pure blue lead free from water, soluble sulphates and sulphites. It shall contain not less than forty-five per centum (45%) nor more than fifty-five per centum (55%) lead sulphate ($PbSO_4$); not less than thirty-three per centum (33%) nor more than forty-five per centum (45%) lead oxide (PbO); not over six per centum (6%) lead sulphide (PbS); not over five and one-half per centum (5½%) lead sulphite ($PbSO_3$); not over three per centum (3%) zinc oxide (ZnO); and not over three per centum (3%) carbon and volatile matter.

Red lead shall be of the best quality, free from all adulteration, and shall contain not over one per centum (1%) inert hearth materials (such as silica and alumina) and not more than one-tenth per centum (0.1%) metallic lead; the remainder shall be pure lead monoxide (PbO) and lead tetroxide (Pb_3O_4). It shall contain no organic coloring matter and when shaken up with water

shall show no alkaline reaction. It shall be of such fineness that ninety-nine and one-half per centum (99½%) will pass through a standard 200-mesh sieve. When used for shop coat "F," red lead shall contain not less than eighty per centum (80%) nor more than ninety per centum (90%) lead tetroxide (Pb_3O_4). When used in formula "G," it shall contain not less than eighty-five per centum (85%) nor more than ninety-five per centum (95%) lead tetroxide (Pb_3O_4).

Lampblack shall contain at least ninety-eight per centum (98%) pure carbon. The tinting power of lampblack used in finishing coats shall be the same as the standard sample.

Spanish oxide shall contain at least eighty-five per centum (85%) ferric oxide (Fe_2O_3), the remainder to consist of silicates. The oxide shall contain no soluble sulphates nor free acids, shall give a neutral reaction, and shall contain not over one-tenth per centum (0.1%) sulphur in any form. It shall be of such fineness that ninety-nine per centum (99%) will pass through a standard 200-mesh sieve. It shall be free from grit and shall be the same as the standard sample in color and tinting power.

Persian Gulf oxide shall contain at least sixty-five per centum (65%) ferric oxide (Fe_2O_3), the remainder to consist of silicates. The oxide shall contain no soluble sulphates nor free acids and shall give a neutral reaction. It shall be of such fineness that ninety-nine per centum (99%) will pass through a standard 200-mesh sieve. It shall be free from grit and shall be the same as the standard sample in color.

Chrome yellow, medium, C. P., shall be ninety-eight per centum (98%) pure lead chromate or basic lead chromate. It shall be the same as the standard sample in color and strength.

Chrome green, medium, twenty-five per centum (25%), shall be precipitated (wet process) on pure barytes and china clay. It shall be free from grit, and shall contain no free lime, calcium carbonate, or calcium sulphate, nor more than one per centum (1%) of lime in any form. It shall be the same as the standard sample in shade and tinting power.

Yellow ochre shall be of good quality, water floated, French ochre. It shall contain at least eighteen per centum (18%) ferric oxide (Fe_2O_3), and not more than five per centum (5%) of lime in any form. It shall be free from all foreign coloring matter, grit and adulterants and shall be the same as the standard

sample in color and tinting power. It shall be of such fineness that ninety-nine per centum (99%) will pass through a standard 200-mesh sieve.

Litharge shall be ninety-nine per centum (99%) pure lead monoxide (PbO).

Manganese resinate shall equal the standard sample.

SECTION No. 290. Standard samples of ingredients and of the finished paints, varnishes and fillers are on file in the office of the Commission. Paints, varnishes and fillers and their ingredients shall conform to these samples in all respects. The Contractor shall submit separate samples of all ingredients intended for use in the paints, varnishes or fillers for the approval of the Engineer, and if required shall also submit samples of the finished paints, varnishes and fillers. After the approval of these samples, all paints, varnishes and fillers shall be manufactured from materials identical with such samples.

In those details where no special instructions are given, the paint, varnish and filler and their manufacture and application shall conform to the best accepted practice.

All paints, varnishes and fillers shall be properly prepared, using only the specified materials in the proportion stated, with an allowable variation therefrom of not over two per centum (2%) in the quantity of any material therein. Paints shall vary not more than four (4) ounces per gallon from the standard weight, except that the weight of paint "K" shall be not over one (1) ounce less nor two (2) ounces greater per gallon than the standard weight. The specific gravity of a varnish shall be not less than that of the standard sample.

Paints shall dry dust-free under normal conditions in ten (10) hours and shall dry hard in not less than eighteen (18) hours nor more than thirty-six (36) hours. For paint which is to be applied in cold or damp weather, the proportions shall be modified as deemed necessary by the Engineer.

The proportions of the tinting pigments in formulæ "K," "L," "M" and "P" shall be varied as necessary to match the standard sample in color.

All paint shall be very finely ground in paste form through sharp burr stone mills. The required standard of grinding is generally shown by the standard sample.

SECTION No. 291. All stair stringers, stair columns, hangers, brackets, canopy framing over stairways, stairway landings and passageways, and posts, railings, gates, gate controls, lamp standards, tubing, sign frames and panels, steel ladders and ladder platforms shall be painted as follows:

Shop coat: coat of red lead and linseed oil, "F." (This coat will be omitted on cast iron.)

First field coat, "G."

Second field coat for structural steel and iron, "P."

Second field coat for stair stringers, railings, etc., "K."

The steel columns and roof framing for canopies over train platforms, the steel framing for mezzanine floors and the steel framing around stairwells which form part of the railroad structure shall be given one (1) coat of "K."

The vertical steel framing adjacent to and on the outer side of wind screens, the cast-iron posts and exposed pipes in toilet rooms, and all other exposed iron, steel and sheet metal (except copper) within the mezzanine enclosures and at the sides of stairways, the finish of which is not otherwise herein specifically provided for, shall be painted as follows:

Shop coat: coat of red lead and linseed oil, "F". (This coat will be omitted on cast iron.)

First field coat, "E", reduced with one (1) quart of turpentine per gallon of paint.

Second field coat, "E", reduced with one (1) pint of turpentine per gallon of paint.

Third field coat, "E", unreduced.

Before the application of the shop coat and the first field coat all metal shall be thoroughly cleaned with wire brushes or otherwise, as necessary.

Where the shop coat has become damaged before or after erection, through any cause whatever, it shall be renewed with the same kind of paint as originally used, such renewal to be considered only as a part of the original shop coat.

The roofing tin and gutters (except copper gutters) shall be painted on the underside with one (1) coat of "G" and on the side exposed when in place in the work with a first field coat of "H" and a second field coat of "I". All tin and galvanized iron, before being painted, shall have all the rosin scraped

from soldered joints and shall be thoroughly cleaned with benzine so as to remove all grease and dirt, and in addition thereto all galvanized iron which is to be painted shall be first painted with one (1) coat of "F".

All metal work the finish of which is not herein otherwise provided for shall be thoroughly washed with benzine and then painted with one (1) coat of "F" and two (2) coats of the same kind of paint as used on the structure adjacent to such metal work.

SECTION No. 292. All knots and pitchy places in wood which is to be painted shall be given one (1) coat of orange shellac before painting.

All exposed oak woodwork in stations shall be filled with "A" (except hand-rails, which shall be filled with "B") and then given one (1) coat of "C" reduced with one (1) quart of benzol per gallon of varnish, followed by two (2) coats of "C" unreduced. Each coat except the last shall be sandpapered with No. 00 sandpaper before the succeeding coat is applied. All exposed yellow pine in canopies and roofs shall be given one (1) coat of "C" reduced with three (3) pints of benzol per gallon of varnish, followed by two (2) coats of "C" unreduced. Each coat except the last shall be sandpapered with No. 00 sandpaper before the succeeding coat is applied.

Window frames and sash of exterior walls of mezzanines and wind screens shall be given one (1) coat of "E" reduced with one (1) pint of turpentine per gallon of paint, followed by a finishing coat of "E" unreduced.

Facia boards shall be given one (1) coat of "E" reduced with one (1) quart of benzol per gallon of paint, followed by two (2) coats of "K". The base boards on the track side of wind screens shall be given two (2) coats of "K".

The window and door frames and trim, panel stiles and rails of doors of enclosures between stations shall be given one (1) coat of "E" reduced with one (1) quart of benzol per gallon of paint, followed by one (1) coat of "M" reduced with one (1) pint of turpentine per gallon of paint, followed by a finishing coat of "M" unreduced. The under side of the underflooring of the mezzanines, the under side of wooden treads and the backs of risers

of stairs from street to mezzanine, and the panels of doors to enclosures between stations shall be given one (1) coat of "E" reduced with one (1) quart of benzol per gallon of paint, followed by one (1) coat of "L" reduced with one (1) pint of turpentine per gallon of paint, followed by a finishing coat of "L" unreduced.

All plastered surfaces and the concrete ceilings of mezzanines shall be given two (2) coats of an approved white coating, especially prepared for use on concrete and plastered surfaces and which will not absorb moisture. The surface of the plaster and concrete shall be free from moisture and " bone" dry before the application of the first coat and this coat shall be thoroughly dry before the final coat is applied. The exposed surface of concrete platforms under wind screens shall be painted with an approved paint. Samples of the coating material shall be approved by the Engineer before the coating material is used.

SECTION No. 293. All paint and varnish shall be well brushed out so as to show a smooth, even film of uniform thickness. Round brushes shall be used exclusively in applying paint.

No painting shall be done in wet, damp or freezing weather. All surfaces to which paint, varnish or filler is to be applied shall be clean and dry.

The paint shall not liver nor curdle and shall cover properly and work freely under the brush. The pigment shall remain in suspension in a satisfactory manner.

PART THIRD—TRACK WORK

Materials supplied by the Contractor shall be stored and handled by him in the most careful and approved manner and so as to protect the materials against deterioration and damage. If at any time the methods of storing or handling the materials are not satisfactory to the Engineer and the Engineer shall so notify the Contractor, the Contractor shall immediately upon receipt of such notice make the required changes in the methods of handling and storing the materials.

SUBDIVISION 1

Open Hearth Rail

1-1. In these specifications where open-hearth steel is referred to it shall be understood to mean commercial open-hearth steel having a chemical composition as specified for this material hereinafter.

1-2. The section of all rails shall be that known as the American Railway Association Standard, Type "B," 100 pound, approved 1912, and shall conform accurately to the section and dimensions of this standard. An allowance of one-sixty-fourth (1/64) of an inch under, and one-thirty-second (1/32) of an inch over, will be allowed for variations in the specified height, and a variation of one-sixteenth (1/16) of an inch will be permitted in width of flange, provided the variations in weight specified hereinafter are not exceeded; but no variation will be allowed in the dimensions affecting the fit of splice bars.

1-3. The weight of the rails shall be maintained as nearly as possible to one hundred (100) pounds per yard of rail. A variation of one-half (½) of one (1) per centum from the calculated weight of section as applied to the entire amount of rail called for will be allowed. Rails accepted will be paid for according to actual weight within the above limits.

1-4. The standard length of track rails shall be thirty-three (33) feet at a temperature of sixty (60) degrees Fahrenheit. Short lengths by even feet down to twenty-five (25) feet will be accepted to an amount not exceeding ten (10) per centum of the total order.

1-5. Variations in individual rails of not more than three-eighths (⅜) of an inch from the normal length will be accepted. Both ends of all short lengths of No. 1 rails shall be painted green, and both ends of all No. 2 rails shall be painted white.

1-6. The name of the maker, the weight and type of the rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web of each rail. The num-

ber of the heat, and a number representing the number of the ingot in the order poured from each heat, shall be stamped on the side of the web of each rail so as not to be covered by the splice bars and a letter shall be stamped on the side of the web of each rail to indicate the position in the ingot from which that rail was rolled. The letters "O.H." shall be rolled or stamped upon each rail.

1-7. Circular holes, as indicated on the drawings, shall be provided for splice bars, and for bonds if so ordered. They shall conform accurately to the dimensions shown, and shall be free from burrs. These holes shall be drilled and must be cylindrical and not conical.

1-8. All rails, while on the cooling beds, shall be protected from contact with snow or water. They shall be carefully straightened so that gagging under the cold press shall be reduced to a minimum.

1-9. Any rails coming to the straightening presses showing shorter kinks or greater camber than that indicated by the middle ordinate of four (4) inches in thirty-three (33) feet shall be classed as No. 2 rails and so stamped. The distance between the supports of the rails in the gagging press shall be not less than forty-two (42) inches. All rails after finishing shall be smooth on heads, straight in line and surface, without twists, kinks or waves, and all No. 1 rails shall be entirely free from injurious defects or flaws of any kind. All rail ends shall be sawed square, a variation of more than one-thirty-second (1/32) of an inch not being acceptable, and all burrs shall be removed and ends made smooth.

1-10. The entire process of manufacture shall be in accordance with the best current practice at the time of manufacture.

All ingots shall be kept in a vertical position until the interior has solidified. No bled ingots shall be used. Sufficient top discard shall be made to secure sound rails, and care shall be taken to avoid burning in reheating. The end of the bloom or the rail formed from the top of the ingot shall be sheared until the entire face shows sound metal. All metal sheared from the top

of the ingot, either from the bloom or the rail, shall be considered top discard.

1-11. The number of passes and the speed of the train shall be so regulated for all rails, that on leaving the rolls at the final pass the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot saws for a thirty-three (33) foot rail of seven (7) inches. No artificial means of cooling shall be used, nor shall the rails be held, before sawing, for the purpose of reducing the temperature.

1-12. The chemical composition of each heat of steel from which the rails are rolled, determined as herein prescribed, shall be within the following limits:

Carbon .....0.73 to 0.86 per centum
Phosphorus not to exceed.....0.04 per centum
Manganese .....0.60 to 0.90 per centum
Silicon not to exceed.....0.2 per centum

It is desired that the percentage of carbon in an entire order of rails shall average as high as the mean percentage between the upper and lower limits specified. Steel containing more than a trace of chrome or nickel shall not be accepted.

1-13. When the material used at any mill is such that the average phosphorus content of the ingot metal used is running below 0.03 per centum, the carbon may be increased, with the approval of the Engineer, at the rate of 0.035 per centum for each 0.01 per centum that the phosphorus content of the ingot metal used averages below 0.03 per centum for open-hearth steel.

1-14. In order to ascertain whether the chemical composition is in accordance with the requirements, the makers shall furnish the Inspector with a chemical analysis of the elements carbon, manganese, silicon, phosphorus, sulphur, chromium and nickel for each heat. Drillings from the finished rail from each melt of steel rolled shall be furnished the Inspector for check analysis. Specimens shall be selected by him and drillings made in his presence.

1-15. Tests on rails shall be made to determine:

(*a*) Ductility or toughness as opposed to brittleness.

(*b*) Soundness.

The physical qualities shall be determined by the drop test and the "nick and break" test.

1-16. The drop testing machine used shall be the standard of the American Railway Engineering Association.

(*a*) The tup shall weigh two thousand (2,000) lbs., and have a striking face with a radius of five (5) inches.

(*b*) The anvil block shall weigh twenty thousand (20,000) lbs., and be supported on springs.

(*c*) The supports for the test pieces shall be spaced three (3) feet between centers and shall be a part of, and firmly secured to, the anvil. The bearing surfaces of the supports shall have a radius of five (5) inches.

1-17. Drop tests of rail shall be made on pieces of rail not less than four (4) feet and not more than six (6) feet long. These test pieces shall be cut in the presence of the Inspector from the top end of the top rail of the ingot, hot stamped by the mill with the heat and serial number of the ingot and marked on the base with gauge marks one (1) inch apart for three (3) inches each side of the center of the test piece, for measuring the ductility of the metal.

1-18. The temperature of the test pieces shall be between sixty (60) and one hundred (100) degrees Fahrenheit.

1-19. The test piece shall be placed head upward on the supports, and be subjected to impact of the tup falling free from a height of fifteen (15) feet.

Under this impact the rail under one blow shall show at least four (4) per centum elongation for one (1) inch, or three (3) per centum each for two (2) consecutive inches of the six (6) inch scale.

1-20. A sufficient number of blows shall be given to determine the complete elongation of two of the test pieces.

1-21. The permanent set after one blow under the drop test shall not exceed one and two-tenths (1.2) inches, measured by middle ordinate in a length of three (3) feet.

1-22. The test piece which is not tested to destruction under the drop shall be nicked and broken, to determine whether the interior metal is sound.

1-23. Test pieces shall be selected from the second, middle and last full ingot of each heat, and tested under the drop for elongation or ductility, as hereinbefore specified.

(*a*) If two (2) of these test pieces do not break at the first blow, and if both show the required elongation, all of the rails of the heat shall be accepted, provided that none of the three (3) test pieces when broken show interior defect.

(*b*) If two (2) of the test pieces break at the first blow or do not show the required elongation, or if any of the three (3) test pieces when broken show interior defect, all of the top rails from that heat shall be rejected.

(*c*) Second tests shall then be made from three (3) test pieces selected by the Inspector from the top ends of any second rails of the same heat, preferably of the same ingots. If two (2) of these test pieces do not break at the first blow and if both show the required elongation, all of the remainder of the rails of the heat shall be accepted, provided that none of the three (3) test pieces when broken show interior defect.

(*d*) If two (2) of these test pieces break at the first blow or do not show the required elongation, or if any of the three (3) test pieces when broken show interior defect, all of the second rails of the heat shall be rejected.

(*e*) Third tests shall then be made from three (3) test pieces selected by the Inspector from the top ends of any third rails of the same heat, preferably of the same ingots. If two (2) of these test pieces do not break at the first blow, and if both show the

required elongation, all of the remainder of the rails of the heat shall be accepted, provided that none of the three (3) test pieces when broken show interior defect.

(*f*) If two (2) of these test pieces break at the first blow, or do not show the required elongation, or if any of the three (3) test pieces when broken show interior defect, all of the remainder of the rails from that heat shall be rejected.

1-24. All rails improperly drilled or straightened, or from which burrs have not been properly removed as specified, shall be rejected until such time as these defects have been corrected. Rails, which by reason of surface imperfections, or for causes mentioned in Paragraph 1-9 are not classed as No. 1 rails, shall be considered No. 2 rails, but No. 2 rails shall not be accepted for shipment which have flaws in the head of more than one-quarter (¼) of an inch or in the flange of more than one-half (½) of an inch in depth, and these shall not, in the judgment of the Inspector, be in any individual rail so numerous or of such a character as to render it unfit for recognized No. 2 rail uses. The quantity of No. 2 rails shall not exceed the quantity specified.

1-25. Guard rails shall be of open-hearth steel and identical in all respects to those specified above for track rails, excepting that No. 2 quality rails may be used for guard rails. All guard rails shall have one flange planed or sheared as shown on the drawings.

1-26. All rails must be loaded in the presence of the Inspector in an approved manner which shall guarantee their arrival at destination in the same condition as when loaded. The mill shall furnish the Inspector with a copy of the shipping notice. The Inspector shall have access to all the mill records pertaining to the finished material subject to his inspection, and he shall be permitted to make such copy or note of the same as he may deem expedient.

SUBDIVISION 2

Rolled Manganese Rail

2-1. In these specifications where manganese steel is referred to, it shall be understood to mean the special steel having a chemical composition as specified hereinafter for rolled manganese steel, whether this steel is manufactured by the open-hearth process or in any other manner.

2-2. The section of all rails shall be that known as the American Railway Association Standard, Type "B," 100 pounds, approved 1912, and shall conform accurately to the section and dimensions of this standard. An allowance of one-sixty-fourth (1/64) of an inch under, and one-thirty-second (1/32) of an inch over, will be allowed for variations in the specified height, and a variation of one-sixteenth (1/16) of an inch will be permitted in width of flange, provided the variations in weight specified hereinafter are not exceeded; but no variations will be allowed in the dimensions affecting the fit of splice bars.

2-3. The weight of the rails specified in the order shall be maintained as nearly as possible to one hundred and one (101) pounds per yard of rail. A variation of one-half (½) of one (1) per centum from the calculated weight of section as applied to the entire amount of rail called for will be allowed. Rails accepted will be paid for according to actual weights, within the above limits.

2-4. The standard length of track rails shall be thirty-three (33) feet at a temperature of sixty (60) degrees Fahrenheit. Short lengths by even feet down to twenty-five (25) feet will be accepted to an amount not exceeding ten (10) per centum of the total order. Special lengths shall be furnished as specified.

2-5. Variations in individual rails of not more than three-eighths (⅜) of an inch from the normal length will be accepted. Both ends of all short lengths of rails shall be painted green. The length and location mark of special length rails shall be painted on the side of the web.

2-6. The name of the maker, the weight and type of the rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web. The number of the heat and a number representing the number of the ingot shall be stamped on each rail so as not to be covered by the splice bars and a letter shall be stamped on the side of the web of each rail to indicate the position in the ingot from which that rail was rolled. The letter "M" shall be rolled or stamped upon each manganese rail.

2-7. Circular holes, as indicated on the drawings, shall be provided for splice bars, separators and bonds. They shall conform accurately to the dimensions shown, and shall be free from burrs. These holes must be cylindrical and not conical.

2-8. The distance between the supports of the rails in the gagging press shall be not less than forty-two (42) inches. All rails after finishing shall be smooth on heads, straight in line and surface, without twists, kinks or waves, and shall be entirely free from injurious defects or flaws of any kind. All rail ends shall be sawed square, a variation of more than one-thirty-second (1/32) of an inch not being acceptable, and all burrs shall be removed and ends made smooth.

2-9. The entire process of manufacture shall be in accordance with the best current practice at the time of manufacture.

All ingots shall be kept in a vertical position until the interior has solidified. No bled ingots shall be used. Sufficient top discard shall be made to secure sound rails, and care shall be taken to avoid burning in reheating. The end of the bloom or the rail formed from the top of the ingot shall be sheared until the entire face shows sound metal. All metal sheared from the top of the ingot, either from the bloom or the rail, shall be considered top discard.

2-10. The methods and appliances used in the manufacture of the rails shall be such as to give uniform results both as to chemical composition and physical characteristics.

2-11. All rails shall be quenched in a water bath within a

period of a minute and twenty seconds after leaving the final pass. In case, on any occasion, for any cause whatsoever, this limit of time before quenching is exceeded, such rails shall be especially marked and each rail tested as follows:

A bend test shall be made of both ends of the rail, by taking a two (2) inch section from each end and bending the head down towards the base, cold, under the steam hammer. In case either test piece breaks before the head has passed through an angle of ninety (90) degrees, a further test piece shall be cut from the same end of the rail from which the broken section was cut and retested. If this retest breaks, the rail shall be re-treated and tested as before and no rail shall be accepted until it has satisfactorily passed this test.

2-12. The chemical composition of each heat of manganese steel from which the rails are rolled, determined as herein prescribed, shall be within the following limits:

Carbon	0.95 to 1.35 per centum
Phosphorus	not over .100 per centum
Manganese	10.50 to 15.00 per centum

2-13. In order to ascertain whether the chemical composition is in accordance with the requirements, the makers shall furnish the Inspector with a chemical analysis of the elements carbon, manganese, silicon, phosphorus and sulphur, for each heat.

On request of the Inspector, the manufacturer shall furnish a portion of the test ingot for check analysis.

2-14. Tests on rails shall be made to determine:

(*a*) Ductility or toughness as opposed to brittleness.

(*b*) Soundness.

The physical qualities shall be determined by the drop test.

2-15. The drop testing machine used shall be the standard of the American Railway Engineering Association.

(*a*) The tup shall weight two thousand (2,000) pounds, and have a striking face with a radius of five (5) inches.

(*b*) The anvil block shall weigh twenty thousand (20,000) pounds and be supported on springs.

(*c*) The supports for the test pieces shall be spaced three (3) feet between centres and shall be a part of, and firmly secured to, the anvil. The bearing surfaces of the supports shall have a radius of five (5) inches.

2-16. The drop test shall be made on a piece of rail not less than four (4) feet and not more than six (6) feet long. These drop test pieces shall be selected from the top end of the top rail, from one of the ingots of each heat in each pit. These rails shall be placed head upwards on the supports and the various sections shall be subjected to impact of the tup falling free from a height of twenty (20) feet.

2-17. If any rail breaks when subjected to less than three (3) blows under the drop, two (2) additional tests shall be made on the top rails from the same heat and pit. If either of these retests fails, all of the top rails of this heat in the pit in which they were heated shall be rejected. Two (2) tests shall then be cut from the second rails from the same heat and pit and if both of these tests meet the above requirements, all the remaining rails from that heat in that pit shall be accepted. If either of these rails fails all the second rails from that heat in that pit shall be rejected. Then two (2) tests shall be cut from the third rails and tested, and so on until all the rails from the heat in that pit have been tested.

The report of the drop test shall state the atmospheric temperature at the time the test was made. The temperature of the test pieces when tested shall not be less than sixty (60) degrees Fahrenheit, nor greater than one hundred and twenty (120) degrees Fahrenheit.

2-18. All rails improperly drilled or straightened, or from which burrs have not been properly removed as specified, shall be rejected until such time as these defects have been corrected.

2-19. All rails shall be loaded in the presence of the Inspector.

SUBDIVISION 3

Track Rail Splice Bars

3-1. Splice bars shall be of a design approved by the Commission and in accordance with the drawings. Wherever the words "splice bar" are mentioned in the drawings or specifications, they shall mean the splice bar complete, including any base supporting plate, but not including bolts, nuts, clips or any fastenings.

3-2. The splice bars for rail joints shall be for four (4) bolts and strictly in accordance with the drawings. All bolt holes shall be punched without bulging or distorting the section, and bars shall be cut to proper length and slotted for the spikes; punching and slotting shall be accurately done in one operation and at a temperature of not less than seven hundred and fifty (750) degrees Centigrade.

3-3. The splice bar shall be twenty-six (26) inches long, smoothly rolled, free from cracks and other imperfections and true to template and dimensions, and shall have the name of the maker and the year of manufacture rolled in raised letters on the side of the bar.

3-4. The material shall be steel, manufactured by the open-hearth process. The chemical composition shall be:

Carbon, not less than four-tenths (0.4) per centum.

Phosphorus, not to exceed four hundredths (0.04) per centum.

3-5. All test pieces for determining tensile strength shall be cut from the rolled bar, and shall have a uniform sectional area of not less than one-half (½) square inch.

A rectangular test bar cut from full section shall stand bending cold through ninety (90) degrees around an arc whose radius equals the thickness of the rectangular piece, without sign of fracture on the outside of bent portion.

3-6. The steel must be capable of sustaining an ultimate breaking stress of not less than eighty thousand (80,000) pounds per square inch, with an elastic limit of fifty (50) per centum of the ultimate strength, an elongation percentage measured in two (2) inches, of one million five hundred thousand (1,500,000) divided by tensile strength in pounds per square inch, and a reduction of area at a point of fracture of not less than twenty-five (25) per centum.

SUBDIVISION 4

Tie Plates

4-1. Tie plates shall be manufactured in accordance with the drawings. All plates shall be provided with holes for spikes. Plates must have the type letter rolled on the top side outside of the base of rail.

4-2. Tie plates must be manufactured from rolled steel of uniform quality made by either the open-hearth or Bessemer process, but preferably the open-hearth. The steel used must be capable of sustaining an ultimate stress of fifty-six thousand (56,000) to sixty-five thousand (65,000) pounds per square inch, and must have an elastic limit of not less than one-half (½) the ultimate strength; an elongation of not less than twenty (20) per centum, measured on a length of eight (8) inches, and a reduction in area at point of fracture of not less than forty (40) per centum. A plate of full section must withstand bending cold at right angles to the fibre through an angle of one hundred and eighty (180) degrees, doubled on itself without sign of fracture on outside surface of the bent portion.

4-3. Test pieces fourteen (14) inches in length, with uniform section and end area of not less than one-half (½) a square inch shall be cut from the finished material and tested for tensile strength.

4-4. Tie plates must be free from injurious cracks, seams and other imperfections. They must be accurately rolled to the specified section. The spike holes shall be punched accurately and from the top wherever possible, clean cut, without burrs and the plates must not be cracked or bent out of shape in punching. Subject to the following allowances, the form and dimensions of the plates shall conform to the drawings: The length and width shall vary not more than one-eighth (⅛) of an inch from the dimensions shown. All variations in length shall be left on the inside end of the plate. The distance from the shoulder to the outside end of the plate must be made uniform.

4-5. Tie plates shall be wired together in bundles of uniform number, not to exceed seventy-five (75) pounds in weight, and properly tagged by the Inspector. The various types of tie plates, except special work plates, shall be wired separately.

SUBDIVISION 5

Cut Track Spikes

5-1. Spikes shall have five-eighths (⅝) inch square shank and shall be six (6) inches long over all, and shaped in accordance with the drawings.

5-2. All material for spikes must be open-hearth steel of uniform character. The steel must be capable of sustaining an ultimate stress of fifty-six thousand (56,000) to sixty-five thousand (65,000) pounds per square inch, with an elongation of not less than twenty (20) per centum, measured on a length of eight (8) inches and a reduction of area at point of fracture of not less than forty (40) per centum.

5-3. The chemical analysis of the metal must show it to contain not more than five-hundredths (.05) per centum phosphorus.

5-4. When the head of the spike is bent backward cold it shall show no signs of fracture. When the spike is twisted cold one and one-half (1½) turns it shall show no signs of fracture. A finished spike must stand bending cold through one hundred eighty (180) degrees flat on itself without signs of fracture on the outside bent portion. All tests for tensile strength to be made from full section bars cut from stock material; test pieces to be not less than sixteen (16) inches long. The above series of tests shall be made on each order if required; the analysis of each heat or blow must be furnished to the Inspector as required.

5-5. Spikes must be free from injurious cracks or seams, must be finished in a first-class workmanlike manner and shall conform to the dimensions shown on drawings with the following allowances: The thickness shall not vary more than one-thirty-second (1/32) of an inch from the dimensions shown. The length shall be not less, nor over one-quarter (¼) of an inch more, than the dimensions shown. The thickness of the head shall vary not more than one-sixteenth (1/16) of an inch from the dimensions shown. The angle of the hook shall vary not more than one (1) degree from that shown on

the drawings. The spikes must be neatly formed, free from burrs and rough edges, and have well-shaped heads and sharp points.

5-6. All spikes must be carefully selected and packed in good, serviceable kegs, securely hooped and containing two hundred (200) pounds each. All kegs shall be plainly marked as to material, size and number of spikes contained therein and name of manufacturer. The kegs must be left open until the spikes are approved, after which the kegs shall be headed in the presence of the Inspector and stamped by him.

SUBDIVISION 6

Screw Spikes and Lag Screws

6-1. Screw spikes, lag screws and all other articles called for on the drawings or in the specifications to be made of screw spike material shall be manufactured in accordance with the following specifications. Wherever in these specifications the words "screw spikes" are used they shall be taken to mean any of the above mentioned articles.

6-2. All material for screw spikes must be of open-hearth steel of uniform character. The steel must be capable of sustaining an ultimate stress of fifty-six thousand (56,000) to sixty-five thousand (65,000) pounds per square inch, with an elongation of not less than twenty (20) per centum measured on a length of eight (8) inches and a reduction of area at point of fracture of not less than forty (40) per centum.

6-3. The chemical analysis of the metal must show it to contain not more than five hundredths (.05) per centum phosphorus and not more than five hundredths (.05) per centum sulphur.

6-4. A finished screw spike must stand bending cold through ninety (90) degrees without signs of fracture on the outside bent portion. All tests for tensile strength shall be made from full section bars cut from stock material, test pieces to be not less than sixteen (16) inches long. The above series of tests shall be made on each order if required; analysis of each heat or blow must be furnished to the Inspector as required.

6-5. Screw spikes must have rolled threads and be free from all injurious cracks, seams or rough edges and must be finished smooth and in a first-class, workmanlike manner, and shall conform accurately to the dimensions shown on the drawings. The heads must be symmetrical about the shank axis produced.

6-6. When the screw spikes are shipped they shall be properly oiled to prevent rusting and shall be packed in good,

serviceable kegs or boxes. All kegs or boxes must be plainly marked as to material, type and number of screw spikes contained therein and name of manufacturer; all kegs or boxes must be left open until the screw spikes are approved, after which kegs or boxes shall be headed in the presence of the Inspector and stamped by him.

SUBDIVISION 7

Treated and Untreated Ties and Timbers

7-1. All ties and timbers shall be sawed or hewed with the grain of the wood and square butted, shall have straight and square edges and shall be close grained, and free from bark, loose, large or decayed knots, splits, shakes, rots, or any other defect which may impair their strength or durability for the use specified.

7-2. Sap wood in untreated ties and timber shall be limited by the following:

In no case will any stick be accepted with less than three (3) heart corners or with more than one (1) inch of sap on the fourth corner, or with more than two and one-half (2½) inches of sap measured across the face, anywhere in the length of the piece.

7-3. Sap wood will be permitted in treated ties and timbers, provided the other requirements of the specifications are fulfilled.

7-4. Yellow pine shall be taken to mean first growth, long leaf Southern yellow pine.

7-5. Red oak shall be taken to mean what is locally known as red, black, Spanish, scarlet, pin shingle or laurel oak, suitable for the use specified and meeting the other requirements of these specifications. Any stick having one-twentieth (1/20) or more of its cross section bored by worm holes will be rejected.

7-6. White oak shall be taken to mean sound and living white oak, suitable for the use specified and meeting the other requirements of these specifications.

7-7. Wherever in the drawings or specifications ties or timbers are specified hewed, they shall be well and smoothly hewed with straight and parallel faces out of wind. All hewed ties or timbers shall have a thickness and width of not less

than the dimensions specified. Variations will be permitted of one-half (½) of an inch over in thickness and two (2) inches over in width of face and one-half (½) of an inch under or over the lengths specified.

7-8. Where sawed ties or timbers are specified a variation in width or depth of more than one-quarter (¼) of an inch or in the length of more than one-half (½) of an inch from the dimensions specified will not be accepted.

7-9. Where ties or timbers are specified dressed they shall be dressed on all sides but in no case shall the dimensions of the finished ties or timbers vary from the specified dimensions by more than one-eighth (⅛) of an inch in slatting or by more than one-quarter (¼) of an inch in all other ties or timbers and in all cases the finished timbers shall be uniform in thickness for an entire order. A variation in length of such ties or timbers of more than one-half (½) of an inch will not be accepted.

7-10. Where ties or timbers are specified dressed to exact dimensions, they shall be dressed on all sides and cut to length exactly to the dimensions specified and no variation from such dimensions will be accepted.

7-11. Wherever in the drawings or specifications Class A ties are specified, they shall be taken to mean untreated or treated, as specified, yellow pine sawed cross-ties for use in ballasted track in the subsurface portion of the Railroad or other locations as determined by the Commission. When so specified, Class A ties shall be drilled for screw spikes.

7-12. Wherever in the drawings or specifications Class B ties are specified, they shall be taken to mean red oak cross-ties, untreated or treated as specified, for use in concrete track. All Class B ties shall be dressed to exact dimensions and drilled for anchor bolts and screw spikes as shown on the drawings. The ties shall be sawed with the heart as near the bottom as possible.

7-13. Wherever in the drawings or specifications Class C

ties are specified, they shall be taken to mean yellow pine cross-ties, untreated or treated as specified, for use in concrete track. All Class C ties shall be dressed to exact dimensions and drilled for anchor bolts and screw spikes as shown on the drawings. The ties shall be sawed with the heart as near the bottom as possible.

7-14. Wherever in the drawings or specifications Class D ties, guard timbers, joists or flooring are specified, they shall be taken to mean dressed yellow pine ties or timber for use on elevated structures. All Class D eight (8) inch by eight (8) inch ties shall be dressed to exact width and depth. When called for, Class D ties shall be drilled for screw spikes.

The minimum length of guard timbers shall be twenty-eight (28) feet and the lengths shall vary from this dimension in multiples of one (1) foot six (6) inches. Fifty (50) per centum of the total amount shall be thirty-one (31) feet or over.

The minimum length of slatting shall be eighteen (18) feet and lengths shall vary in multiples of four (4) feet six (6) inches from this dimension. At least fifty (50) per centum of the total amount shall be twenty-two (22) feet six (6) inches or over.

7-15. Wherever in the drawings or specifications Class E ties are specified, they shall be taken to mean yellow pine hewed cross-ties treated or untreated, as specified, for use in ballasted track. When so specified, Class E ties shall be drilled for screw spikes.

7-16. Wherever in the drawings or specifications Class F ties are specified, they shall be taken to mean white oak cross ties, treated or untreated, as specified, for use in special work or any other point required by the Commission. All Class F ties or timbers shall be dressed to exact dimensions specified. When so required, Class F ties shall be drilled for screw spikes.

7-17. Whenever in the drawings or specifications ties are specified drilled for screw spikes or anchor bolts, the drilling shall be accurately done through metal templates. The finished hole shall be circular and of true dimensions in the finished

timber and in treated ties after treatment. All drilling or other working of treated ties shall be done before the ties are creosoted.

7-18. Whenever in the drawings or specifications treated ties or timbers are specified, they shall be manufactured in accordance with these specifications and treated with not less than ten (10) pounds of creosote oil per cubic foot in a manner and as specified hereinafter.

7-19. Whenever possible, all treated ties and timber shall be thoroughly air-seasoned before being treated with the creosote oil. Where it is necessary to treat ties and timbers before they have been thoroughly air-seasoned they shall be seasoned by the action of live steam admitted into the treating cylinder at such a rate as to secure twenty (20) pounds per square inch of steam pressure within thirty (30) to fifty (50) minutes as shown by gauge connected to the cylinder. This pressure shall be maintained for periods of from one (1) to ten (10) hours depending upon the character and condition of the timber; but the pressure shall at no time be allowed to exceed twenty (20) pounds per square inch.

During the process of steaming, air and condensation shall be frequently blown off through a valve located at the lowest point of the cylinder.

7-20. When the steaming process is completed the steam in the cylinder shall be blown off, and a vacuum of not less than that equivalent to twenty-four (24) inches of mercury, at sea level, produced. The vacuum shall be maintained at least one hour, or until no moisture comes from the cylinder.

7-21. The creosote oil shall then be introduced into the cylinder without breaking the vacuum until the cylinder is entirely filled. Adequate pressure shall then be applied and maintained, until the specified absorption is obtained. The cylinder shall be provided with an air-vent to enable it to be kept entirely filled during the time that pressure is on.

7-22. The creosote oil shall be heated to a temperature of

not less than one hundred sixty (160) degrees Fahrenheit, before admission to the cylinder.

7-23. The cylinder shall be provided with sufficient steam coils to maintain a temperature of at least one hundred sixty (160) degrees Fahrenheit therein during the entire time that vacuum is being applied and oil is being introduced and held under pressure.

7-24. After the cylinder is emptied of oil, air pressure shall be again applied to render the penetration more perfect and to make the outside surfaces of the timbers drier and cleaner.

7-25. When the timber is properly air-seasoned so that it is possible to secure the specified absorption of oil without steaming, the steaming may be omitted, in which case the method of treatment for such timbers shall begin with the creation of a vacuum as is herein specified.

7-26. The timbers shall be treated by the full cell process by the most approved method of steaming, vacuum and pressure so as to secure ten (10) pounds of creosote oil per cubic foot of timber remaining in the timber after treatment.

7-27. The creosote shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal gas tar or coke oven tar and shall be free from any tar, including coal gas tar and coke oven tar, oil, or residue obtained from petroleum or any other source; it shall be completely liquid at thirty-eight (38) degrees centigrade and shall be free from suspended matter; the specific gravity of the oil at thirty-eight (38) degrees centigrade shall be at least one and three-hundredths (1.03). When distilled by the common method—that is, using an eight (8) ounce retort, asbestos covered, with standard thermometer, bulb one-half (½) inch above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall give no distillate below two hundred (200) degrees centigrade, not more than five (5) per centum below two hundred and ten (210) degrees centigrade, not more than twenty-five (25) per centum below two hundred

and thirty-five (235) degrees centigrade, and the residue above three hundred and fifty-five (355) degrees centigrade, if it exceeds five (5) per centum in quantity, shall be soft. The oil shall not contain more than three (3) per centum water.

7-28. The oil shall be analyzed in the manner specified by the American Railway Engineering Association, 1911 Edition of the Manual.

SUBDIVISION 8

Bolts, Nuts and Rivets

8-1. Unless otherwise specified, all bolts used to connect the rail and its accessories are hereinafter referred to as "track bolts," and all bolts used to fasten timbers to each other or to supporting structure, are hereinafter referred to as "timber bolts." All bolts shall be made of open-hearth or other approved process steel. If necessary to secure the properties desired, the bolts may be heat treated. Bolts shall conform to the following requirements:

	Track Bolts	Timber Bolts
Elastic limit, not less than.....	50,000	35,000
Elongation in eight (8) inches not less than	20%	25%
Reduction of area not less than...	40%	50%

The elastic limit shall in no case be less than fifty (50) per centum of the ultimate strength.

8-2. Tests shall be made for ductility by bending the bolt cold through one hundred eighty (180) degrees flat on itself without fracture on the outside of the bent portion. This bend test may be made on the unthreaded portion of a finished bolt or on a blank bolt or on a test piece of the same size and same grade of steel. The test piece shall in any case be subjected to the same treatment as the finished bolt.

8-3. Subject to the following allowances, bolts shall conform strictly to the drawings:

The length shall not be more than one-sixteenth (1/16) of an inch less, or one-eighth (⅛) of an inch more, than the dimensions shown. The diameter of the bolt shall not vary more than one-sixty-fourth (1/64) of an inch from the dimensions shown. The size of the head shall not vary more than one-sixteenth (1/16) of an inch from the dimensions shown. The outside dimensions of the nut shall not vary more than one-thirty-second (1/32) of an inch from the dimensions shown.

8-4. The heads and nuts shall be free from checks or burrs of any kind. The threads shall be full and clean with

not less than two (2) nor more than five (5) finger threads, except as shown on the drawings. All bolts shall have rolled or cut threads, as specified.

8-5. Rivets shall be made of steel which may contain a maximum of four hundredths (0.04) per centum basic phosphorus, four hundredths (0.04) per centum acid phosphorus and four hundredths (0.04) per centum sulphur. It shall have an ultimate tensile strength of fifty thousand (50,000) pounds per square inch. It shall bend flat upon itself without fracture and when nicked and bent around a bar of the same diameter as the rivet rod it shall give a gradual break with a fine silky uniform fracture.

8-6. The diameters of the rivets shall be of full size shown on the drawings, and the diameters of the rivet holes shall be not more than one-sixteenth (1/16) of an inch greater than the diameters of the corresponding rivets. The rivets shall be of sufficient length to provide full, neatly made heads when driven. They shall be driven tight, bringing all adjacent parts into contact.

8-7. Rivets, when not countersunk or flattened, shall have standard button heads of uniform size for the same size rivets. The heads shall be full and neatly made and concentric with the holes. When the rivet heads are countersunk they shall be flush with the plate and fill the holes.

8-8. When bolts are shipped each shall be provided with a nut and the nuts shall be applied for at least two (2) threads. The bolts and nuts shall be properly oiled to prevent rusting. The bolts, nuts and rivets shall be packed in serviceable kegs. All kegs must be plainly marked as to type or class of material, size and number of bolts or rivets and name of manufacturer; all kegs must be left open until the material is approved, after which they shall be headed in the presence of the Inspector, and stamped by him.

SUBDIVISION 9

Nut Locks or Lock Washers

9-1. Spiral spring lock washers of a pattern approved by the Commission shall be made of an open-hearth steel having:

Phosphorus, not over five-hundredths (.05) per centum.

Sulphur, not over five hundredths (.05) per centum.

9-2. After the finished nut-lock has been subjected to pressure sufficient to compress it flat for a period of one (1) hour, its reaction shall not be less than two-thirds (2/3) of its height or thickness of section, provided thickness is less than width of section. If the section is square, the reaction must be not less than one-half (½) its thickness. If height or thickness is more than its width, reaction shall be not less than the width of the section. The nut locks or lock washers shall have sufficient spring to resist a pressure of twelve thousand (12,000) pounds.

9-3. With one end of the finished nut-lock secured in a vise, and the opposite end twisted to forty-five degrees, there must be no sign of fracture. When further twisted until broken, the fracture must show a good quality of steel.

9-4. A sufficient number of tests will be made to satisfy the Inspector that the material meets with the specifications in every respect.

9-5. The dimensions and form of the nut-lock shall conform to the drawings. The inside diameter shall be such that a good fit is obtained around the bolt with which the nut-lock is to be used. The nut-lock shall be clean, without burrs or rough edges. The cross-section shall be uniform throughout.

9-6. When the nut-locks are shipped they shall be packed in good serviceable kegs or boxes. All packages must be plainly marked as to material, size and number contained therein, and the name of the manufacturer; all packages must be left open until the nut-locks are approved, after which the packages shall be headed in the presence of the Inspector and stamped by him.

SUBDIVISION 11

ANTI-CREEPERS

11-1. Anti-creepers shall be as shown on the drawings and shall be such that the device may be easily applied under full ballasted track and in the case of guarded rail, with a guard in place and shall be substantial enough to stand driving to place without overstraining. The least possible number of movable parts is desirable. When applied they must be in position rigidly enough to carry the tie with them without slipping. They shall be made with sufficient take-up to permit proper tightening, and when in place must not loosen sufficiently to slip when the rail slacks back.

11-2. Controlling or delicate parts shall be made of material which will not rust. Anti-creepers made of steel shall conform to the following:

Carbon..... .08 to .20 per centum
Phosphorus.....not more than .05 per centum
Sulphur.....not more than .05 per centum
Manganese..... .30 to .60 per centum
Ultimate strength.....40,000 to 50,000 pounds per square inch

Anti-creepers made of malleable iron shall conform to the specifications for malleable iron and shall be of sufficient weight to prevent breakage and distortion in application or in service.

11-3. When the anti-creepers are shipped they shall be packed in good serviceable packages tagged by the Inspector and containing about two hundred and fifty (250) pounds each. All packages shall be plainly marked as to material, type and number contained therein, and the name of the manufacturer.

SUBDIVISION 12

Ballast

12-1. Ballast shall be of sound, hard, broken limestone or sound, hard, broken trap rock from quarries which are approved by the Commission as containing material of the desired quality, in accordance with these specifications.

12-2. Class A ballast must be broken to a form not too large to pass through a one and one-quarter (1¼) inch mesh screen and large enough to be retained on a one-half (½) inch mesh screen and must be free from dirt, screenings and stone dust.

12-3. Class B ballast must be broken to a form not too large to pass through a two and one-eighth (2⅛) inch test ring and not small enough to pass through a one (1) inch test ring, and must be free from dirt, screenings or stone dust.

12-4. For Class A and Class B ballast, the following characteristics will govern:

(a) Maximum uniformity in composition.

(b) Maximum weight in pounds per cubic foot.

(c) Least water absorption in pounds per cubic foot.

(d) Greatest hardness.

(e) Greatest toughness.

(f) Least percentage of wear, not greater than 2.3 per cent.

(g) Crushing strength, not less than 29,000 lbs. per sq. in., tested on a 1-inch cube.

The method of determining these characteristics shall be those given in the report of the Committee on Ballast of the American Railway Engineering and Maintenance of Way Association, Volume II, Part 2, of 1910, and the method of testing for these qualities shall be as given by this Committee and developed by the United States Department of Agriculture.

12-5. The Contractor shall ship only such material as will fulfill the requirements named. The Inspector will visit the quarries and crushing plants from time to time, and the manufacturers must afford him every facility for examining the product and the process of manufacture. No shipments may be made of material that has been condemned by the Inspector.

SUBDIVISION 13

Special Work

13-1. Wherever in the specifications or drawings the words "special work" are used, they shall be taken to mean all of the special work material which the Contractor is required to furnish.

All special work shall be of the best design, workmanship and material and shall conform accurately to the drawings and be built up of the material called for on the drawings and manufactured in accordance with these specifications.

13-2. The gauge of track and width of flangeway shall be measured in a plane five-eighths (5/8) of an inch below the top of the rail and shall be as shown on the drawings. The depth of the flangeway shall be two (2) inches.

13-3. The lead, connecting, stock and guard rails shall be furnished straight, curved, kinked and planed as called for on the drawings and in the specifications. Lengths of rails indicated are computed along the gauge lines and the manufacturer shall make proper allowances before cutting to insure an accurate fit in the location for which they are cut and marked.

13-4. Expansion joints at all splices shall be three-sixteenths (3/16) of an inch wide except at insulated joints where one-half (1/2) of an inch shall be provided.

13-5. Switch points shall be made, as called for, of manganese or open-hearth rail of No. 1 quality. They shall be carefully ground or planed to insure perfect gauge, flangeway, line and surface, and an accurate fit against the head and base of the abutting rails.

13-6. Guarded switch points shall be furnished where called for on the drawings or specified. The set-in guard shall be carefully fitted to the back of the switch point to insure perfect line, surface and true flangeway when the point is open, and an accurate fit against the abutting rail when the point is closed.

13-7. The throw of all switch points shall be three and three-quarters (3¾) inches measured at a point opposite the first switch rod.

13-8. Switch points shall be reinforced on both sides with steel plates rolled to fit the rail and of thickness shown on the drawings. The reinforcing bars shall be secured to the points with three-quarters (¾) of an inch rivets, and where a set in guard rail is used, they shall be secured to the guard and point with one (1) inch rivets and bolts, all as indicated on the drawings. Care must be taken to provide at least one-eighth (⅛) of an inch clearance between the heads of all rivets and bolts and the adjacent rails.

13-9. Housed switches shall be either single or double housed and furnished with appurtenances and as shown on the drawings. Guard bars shall be of cast manganese steel. True flangeway shall be obtained throughout, a variation of more than one-sixteenth (1/16) of an inch not being acceptable. The chairs supporting the guard bar shall be made of malleable iron. The chairs and bars shall accurately fit each other and adjoining parts and clear all movable portions of the switch points and switch mechanism.

13-10. Switch plates for switches shall be seven and one-half (7½) inches wide, unless otherwise specified; not less than one-half (½) of an inch thick at any point and of sufficient length to provide for rail braces, housing chairs and spiking. They shall be manufactured from three-quarters (¾) of an inch plates which shall be milled or forged to provide suitable square shoulders for the rail, rail braces, and a one-quarter (¼) of an inch riser. The riser shall extend over the full width of the plate and shall be of sufficient length for the proper operation of the switch points.

13-11. The special plates called for on the drawings shall be manufactured of one-half (½) inch material of the dimensions shown, and shall be accurately fitted and punched in the shop.

13-12. Bearing plates, not less than three-quarters (¾) of an inch thick, shall be furnished under all built up rigid frogs, securely fastened to the frogs with standard malleable iron clips. These plates shall be long enough to extend at least four (4) inches beyond the center line of the outside bolts in the body of the frog, and of sufficient width to give full bearing for the clips.

Bearing plates shall be furnished under all spring rail frogs, and be securely fastened to the same by three-quarter (¾) inch rivets, and be of the dimensions shown on the drawings.

13-13. All special work plates including switch plates, bearing plates and special plates, shall be manufactured of material conforming to the requirements for standard tie plates.

13-14. Switch rods, switch clips, strap braces, foot guards and anti-creeping straps shall be manufactured of rolled steel and shall be free from burrs, cracks or other imperfections.

13-15. Rail braces, manufactured of malleable iron, shall be furnished with all switches and for all other locations indicated. They shall be accurately fitted to the rail and all adjoining parts.

13-16. Frogs and crossings shall be built up of No. 1 quality open-hearth rail, manganese rail and cast manganese, as specified. All surfaces shall accurately fit abutting parts, shall be true to line and surface and free from burrs, cracks, or other imperfections. The legs shall be so formed that standard splice bars can be used for connection with adjoining rails, frogs or switches.

13-17. All filler blocks and separators shall be manufactured of material specified on the drawings and in the specifications, and shall fit in the head and base of rail and the web of rail for a distance of one-half (½) of an inch above the base and below the head, respectively, and shall maintain the required flangeway. Throat filler blocks shall fit the rails suffi-

ciently well to maintain the required spacing. When the brand of the rail interferes with the fit of the filler, the brand shall be chipped off. Fillers shall be grooved or cut to fit over rivet heads. Heel riser blocks shall be made of high carbon cast steel, or high carbon rolled insert cast in a cast-iron filler, and shall fit the head, base and web of rail.

13-18. Bolts, nuts, nut locks and rivets shall be furnished in accordance with the drawings and specifications for such material. Cotter pins shall, when required, be placed outside of and close up to the nut after it is tightened. Bolts must be long enough to allow the nuts to be brought out from under the head of the rail, with a suitable washer, so that they may be readily tightened with an ordinary wrench.

13-19. All bolts, unless otherwise specified, shall be provided with suitable washers to secure a square bearing under head and nut, and with approved head-locks to keep them from turning. Flat washers shall be not less than one-half (½) of an inch thick, and angle washers not less than one-quarter (¼) of an inch thick at the thin end. Washers shall be not less than three (3) inches long and of ample width to provide a bearing for the head and base of rail.

13-20. Spring frogs shall be used where specified and shall conform to the drawings and the following specifications:

The material and workmanship in the frog proper shall be as specified for rigid frogs.

Springs shall be of the best spring steel material and of the dimensions and capacity and of a uniform quality specified hereinafter. The outside diameter shall be two and nine-sixteenths (2–9/16) inches, a variation of not more than three-thirty-seconds (3/32) of an inch over or under not being acceptable. The free height shall be four and five-eighths (4⅝) inches, a variation of more than one-eighth (⅛) of an inch over not being acceptable; no variation under this dimension will be permitted. The size of bar shall be one-half (½) of an inch round, a variation of more than one-sixty-fourth (1/64) of an inch over or one-thirty-second (1/32) of an inch

under not being acceptable. The number of tapered or complete turns shall be seven and one-eighth (7⅛) or an equivalent of six and five-eighths (6⅝) solid coils. The solid height shall be three and five-sixteenths (3-5/16) inches, a variation of more than one-sixteenth (1/16) of an inch over not being acceptable.

At a height of three and five-eighths (3⅝) inches each spring must carry a load of seventeen hundred and twenty-five (1,725) pounds, a variation of more than eleven (11) per centum over or under not being acceptable.

Material entering into these springs must be a commercial grade of spring steel of analysis as follows:

Carbon	.95 to	1.15 per centum
Manganese	not over	.50 per centum
Phosphorus	not over	.15 per centum
Silicon	not over	.10 per centum
Sulphur	not over	.05 per centum

Bars after being tapered on both ends shall be coiled to uniform pitch and carefully dressed on both ends to get a good flat bearing surface.

After cooling from the coiling heat, spring shall be re-heated for tempering in a separate operation at proper tempering heat and shall be quenched cold in a grade of tempering oil especially suited to this class of work. This re-heating shall produce a fine granular structure of material. The springs shall then be drawn to color in a low temperature gas furnace of a type approved by the Engineer. After this drawback, springs shall be allowed to cool for four hours. No water or other artificial cooling agent shall be used.

All springs shall withstand the following tests: Immediately after cooling they shall be driven down solid five (5) times and twenty-four (24) hours after the first test they shall again be tested in the same manner. After completion of the solid testing ten (10) per centum of each lot or shipment shall then be selected at random. Free height and other measurements shall be taken of each and every one of the springs so selected and tested for the load specifications in an approved testing machine. If any of the ten (10) per centum fail to meet the requirements in any particular, each and every

spring of the lot or shipment shall be given a similar inspection and test and all springs which fail to meet the specifications in every particular shall be rejected.

All springs shall be free from surface defects and will not be acceptable until such surface defects are removed.

Spring housings shall be made of cast iron and shall be of such dimensions as to permit the proper working of the springs.

Housings and springs shall be attached to the rails by a one and one-quarter (1¼) inch bolt, double nutted and provided with a cotter pin. The bolt shall be fitted with an extra heavy wrought iron pipe collar, extending between the webs of the wing rails of the frog. The followers or bearings for the outer ends of the springs shall be of cast iron of suitable thickness and of proper bevel and clearance to prevent binding in the housings. All housings shall be located at the throat of the frog as indicated on drawings.

13-21. Slip switches, with either rigid center frogs or movable point frogs, as called for, shall conform to the drawings; and material and workmanship shall be as specified for frogs and switches. Where rigid center frogs are called for, the curve connecting rail between the inside slip points shall be securely fastened to the plate under the frog, and bolted to the frog.

13-22. All holes indicated on the drawings shall be provided in all switch points, frogs and rails, for splice bars, separators, switch bar lugs, bonds in manganese rail and all other appurtenances shown on the drawings. They shall conform accurately to the dimensions shown and shall provide a driving fit for frog bolts and the surrounding metal shall be free from burrs or cracks. Holes shall be drilled in open-hearth rail and may be punched in manganese rail, and shall be cylindrical and not conical. No heating of manganese rail will be permitted for the purpose of punching or drilling the holes.

13-23. In the manufacture of rolled manganese switch points, frogs and special rails, care must be taken to so pro-

tect the material in the finished work from excessive heat while burning along the roughing line, that the rail beyond the finishing line shall not be heated beyond a blue temper color on a ground spot where the heat is most intense. The roughing line shall in no case be less than one-eighth (⅛) of an inch from the finished line and the one-eighth (⅛) of an inch or more of metal so heated or damaged shall be carefully ground off.

No heating shall be allowed for the purpose of kinking or bending manganese rail. Open-hearth rails shall not be heated beyond a dull red for such purpose. Rails which are not satisfactorily bent in the first instance and which are rejected therefore by the Inspector, shall not be re-bent to the required position but new rails shall be substituted therefor.

All rails, whether furnished in frogs, switches or in lengths, shall be sawed square to the center line of rail, unless otherwise called for, a variation of more than one-thirty-second (1/32) of an inch not being acceptable, and all burrs shall be removed and ends made smooth. No variation of more than one-quarter (¼) of an inch from the theoretical lengths will be allowed.

13-24. All switch points and frogs after inspection and before shipment shall be painted one coat of black carbon paint. No paint, tar or other covering shall be used before inspection.

13-25. All material shall be given suitable shop marks, designating the portion number and the part number, corresponding to marks given on the drawings, and these markings shall also appear on the drawings furnished by the manufacturer. This marking shall be carefully arranged to insure the proper and easy assembling of the material in the field.

13-26. Before any of the special work is shipped, the several parts shall be assembled and the whole checked by the Inspector to insure proper fit and conformity to the drawings.

13-27. The Contractor shall prepare detail drawings,

and an assembly drawing made to a scale of one-quarter (¼) inch to one (1) foot.

The detail drawings shall show all details, dimensions and bills of material for the complete fabrication of the work, and the assembly drawing shall indicate all shop marks of the various parts of the special work, and a complete list of the parts to be furnished. Two (2) complete sets of prints of these drawings shall be submitted to the Engineer for approval. The Engineer shall give his criticism or approval of such drawings within ten (10) days from receipt thereof, and one set of these prints shall be returned to the Contractor marked approved, or approved as corrected, or such prints of the set as are not so marked shall have any corrections or additions indicated thereon.

The Contractor shall make such revisions to his drawings as indicated and again promptly submit two (2) prints for approval, but in the meantime may proceed with the work, in so far as covered by this approval, unless advised to the contrary.

When drawings are finally approved the Contractor shall be so notified, and shall then promptly forward to the Engineer for his approval signature a set of tracings duplicated from the approved drawings for his files. The Engineer's signature on such drawings will indicate his approval thereof and the work shall be manufactured and inspected strictly in accordance with such approved plans.

SUBDIVISION 14

Malleable Iron

14-1. Rail braces, housing chairs, frog clips, end inclines, head supports for screw spikes and all other articles called for on the drawings or in the specifications, to be made of malleable iron, shall be manufactured in accordance with the drawings and with the following specifications.

14-2. Malleable cast iron shall be made by the open-hearth or air furnace process. The castings shall not contain over six hundredths (.06) per centum sulphur or over two hundred and twenty-five thousandths (.225) per centum phosphorus.

14-3. The tensile strength of a standard American Society for Testing Materials, 1905, test bar shall not be less than forty thousand (40,000) pounds per square inch. The elongation measured in two (2) inches shall not be less than two and one-half (2½) per centum. The transverse strength of such a standard test bar, on supports twelve (12) inches apart, pressure being applied at the center, shall not be less than three thousand (3,000) pounds, deflection being at least one-half (½) of an inch.

14-4. Castings shall neither be "over" nor "under" annealed. They must have received their full heat in the oven at least sixty (60) hours. The "saggers" shall not be dumped until the contents shall be at least "blackhot."

14-5. Castings shall be true to pattern, free from cracks, flaws or blemishes, scale or shrinkage cracks, and accurately fit all adjoining parts. If necessary the castings shall be ground by the manufacturer to insure the fit specified.

14-6. Castings must be shipped in an approved manner to guard against loss or breakage in transit, and wherever possible shall be bundled for convenience in handling at destination.

SUBDIVISION 15

Gray Cast Iron

15-1. Washers, fillers, separators and all other articles called for on the drawings or in the specifications to be made of cast iron shall be manufactured in accordance with the drawings and with the following specifications.

15-2. Cast iron shall be taken to mean gray cast iron made by the cupola process. The chemical composition shall be as follows:

Silicon	1.60 to 1.80 per centum
Phosphorus	.50 to .80 per centum
Sulphur not to exceed	.15 per centum
Manganese	.30 to .60 per centum
Total Carbon	3.00 to 4.00 per centum

Borings as ordered by the Inspector from the broken pieces of the "Arbitration Bar" shall be used for the chemical determinations. In case of dispute, the standard of the American Foundry Men's Association shall be used for comparison.

15-3. The minimum breaking strength of the American Society for Testing Materials "Arbitration Bar" shall be not under three thousand three hundred (3,300) pounds. In no case shall the deflection be under one-tenth (.1) of an inch. The transverse test shall be made with the supports twelve (12) inches apart, load applied at the middle and the deflection at rupture noted. Rate of application of a load shall be from twenty (20) to forty (40) seconds for a deflection of one-tenth (.1) of an inch.

15-4. Castings shall be true to pattern, free from cracks, flaws or excessive shrinkage and accurately fit all adjoining parts. If necessary the castings shall be ground by the manufacturer to insure the fit specified.

15-5. Castings must be shipped in an approved manner to guard against loss or breakage in transit, and wherever possible shall be bundled for convenience in handling at destination.

SUBDIVISION 16

Cast Manganese

16-1. Housing bars, frog and switch inserts and all other articles called for on the drawings or in the specifications to be made of cast manganese shall be manufactured in accordance with the drawings and with the following specifications.

16-2. The chemical composition shall be within the following limits:

Manganese	not less than ten (10) per centum
	not more than fourteen (14) per centum
Carbon	not less than one (1) per centum
	not more than one and forty one-hundredths (1.40) per centum
Phosphorus	not more than ten one-hundredths (.10) per centum

16-3. The physical properties shall be determined as follows: A rough cast specimen three-quarters (¾) of an inch by one-half (½) of an inch shall be bent cold flat around a diameter of one (1) inch to an angle of one hundred eighty (180) degrees without signs of breaking. The bend may be accomplished by pressure or by blows.

16-4. All castings shall be true to pattern and free from cracks, flaws or excessive shrinkage and accurately fit all adjoining parts. If necessary, the casting shall be ground by the manufacturer to insure the fit specified.

16-5. Castings must be shipped in an approved manner to guard against loss or breakage in transit.

SUBDIVISION 17

Installation of All Types of Tracks

17-1. All tracks shall be laid true to the lines given by the Commission and shall conform to the alignment drawings.

17-2. The line on the profile shown on the alignment drawings represents the base of rail at the center line of the track or under the low rail, as specified for the particular type of track. All tracks shall be laid true to the grades given by the Commission, and surfaced for good riding at speed. The track level must be used in surfacing all tracks.

17-3. An approved track gauge shall be used to gauge all tracks. The change in gauge shall be gradual and uniform and be obtained by spreading or pulling in both rails an equal amount in order to retain the theoretical center line of tracks shown on the drawings.

Tracks on tangents and on curves down to and including five hundred and one (501) feet radius shall have a gauge of four feet eight and one-half inches (4′ 8½″) and a flangeway of one and three-quarters inches (1¾″). On all other curves and in special work, the gauge and flangeway shall be as indicated on the drawings.

17-4. On curves not in special work the outer rail shall be elevated as directed by the Commission and as indicated on the drawings, generally in accordance with the following formula:

$$E = \frac{V^2 \times 3.7745}{R}$$ in which

V represents speed in miles per hour, to be determined by Engineer;
E represents superelevation in inches;
R represents radius in feet.

Maximum value of E to be six and one-half (6½) inches. The rate of increase or decrease of run off or approach on unspiralled curves shall be as directed by the Commission and in gen-

eral for elevations of five (5) inches and under shall be one-half (½) inch in thirty-three (33) feet and for elevation over five (5) inches the run off or approach shall not exceed three hundred and thirty (330) feet. The run off or approach shall begin or end at the point of spiral on spiralled curves.

17-5. Rail joints shall be staggered, the joint on one rail coming nearly opposite the center on the other rail. Thirty (30) foot lengths of rails shall be used on the inside of curves when necessary to bring about these conditions. All joints in running rail shall be two (2) tie suspended with the joint midway between the two ties. Joints in guard rail shall be placed between the joints in the running rail wherever possible.

17-6. In laying tracks care must be taken to prevent bumping of rails. The distance between rail ends at all joints shall be gauged according to the temperature at which the rails are laid.

The openings between ends of thirty-three (33) foot rails for different Fahrenheit temperatures shall be as follows:

Temperature (Fahrenheit)	Amount of opening for 33 ft. rail
From 10 deg. below to 14 deg. above zero	5/16 inch
From 14 deg. above to 38 deg. above zero	¼ inch
From 38 deg. above to 62 deg. above zero	3/16 inch
From 62 deg. above to 86 deg. above zero	⅛ inch
From 86 deg. above to 110 deg. above zero	1/16 inch

Observations are to be made of actual temperature at points where rails are to be placed.

The space between the rails at insulated joints where indicated by the Engineer shall be one-half (½) of an inch.

Metal shims, as shown on the drawings, must be used for the purpose of spacing rails at the joints.

17-7. Splice bars as shown on the drawings shall be used in the positions indicated. They shall be greased or oiled to facilitate driving the bar to a snug fit against the head and base of the rail. No bolts shall be placed until such a fit is obtained. The splice bars shall be bolted to the rails with four bolts, which

shall be applied with their heads alternately inside and outside of the rail except on guarded curves, when the bolts shall be applied in the low rails with the heads on the outside of the running rail. No nut-locks will be required at rail joints. The nuts shall be screwed up tight with an approved track wrench. Extra long handles on wrenches will not be permitted. Care must be taken to hold the head tight against the projection in the upper part of the bar to prevent damage to such projection or the head of the bolt while tightening the nut.

17-8. Wherever it is necessary to connect new rails to old rails or to rails of a different section, care must be taken to keep the gauge side and top of the rails continuous. For this purpose step-up or compromise joints of a design and material approved by the Engineer shall be furnished and installed by the Contractor. A short length of the new rail shall be used for the junction rail in the new work.

17-9. All rails to be installed under these specifications, unless otherwise specifically called for, shall conform to the American Railway Association Standard Type "B" one hundred (100) pound section, approved 1912. All running rails in tangents and on curves having a radius of seven hundred and one (701) feet or longer, and in other locations specified, shall be of No. 1 quality open-hearth steel. All running rails in curves of less than seven hundred and one (701) feet radius, and wherever else specified, shall be of manganese steel.

17-10. Guard rails shall be installed against the inside rails of all curves of less than two thousand (2,000) feet radius and shall extend to a point at least ten (10) feet on to the adjacent tangents. All guard rails shall be of No. 1 or No. 2 quality open-hearth steel, and shall be bent inward at their ends for a length of three (3) feet and fitted with a standard end incline. Care must be taken to get a smooth curve at the point of bend.

Standard malleable iron rail braces shall be applied to guard rails at every third tie, and to outside rails at every other tie on all curves of less than seven hundred and one (701) feet radius. These rail braces shall be full spiked to the tie with screw spikes, as shown on the drawings.

17-11. In the process of laying, lifting or surfacing, particular care must be taken to prevent the bending of the rails by the use of construction trains or otherwise. The rails shall be skidded off the cars by the method indicated on the drawings or any other similar method approved by the Engineer and shall in no case be dropped from the side of cars or from any other point. In skidding the rails from the cars care must be taken that they do not strike other rails.

17-12. The rails for use in curves of less than twenty-five hundred (2,500) feet radius shall be properly curved, using an approved rail bending machine. Rails for use in curves of greater radius than twenty-five hundred (2,500) feet may be spiked and sprung to the proper curve. Precautions must be taken to obtain a uniform curve throughout the rail.

17-13. All short lengths of rail furnished by the manufacturer shall be grouped into one part of the work, except such short lengths as are absolutely necessary to fill in on the run off or approach of curves or in any other location approved by the Engineer.

All special length open-hearth rails necessary to complete the work shall be cut in the field by the Contractor and shall be sawed square across the rail. A variation of more than one-thirty-second (1/32) of an inch will not be accepted. All burrs shall be removed and ends made smooth. Use of special length rails will not be permitted unless specifically ordered by the Engineer.

17-14. Special lengths of open-hearth rail cut in the field, as specified above, shall be drilled by the Contractor with circular holes for splice bars, as indicated on the drawings. All guard rails and guarded open-hearth rails shall be drilled in the field for separator bolts. Before such drilling is done the running and guard rails shall be set up on tie-plates and the standard splice bars installed and joint space provided as specified and then the holes shall be drilled through the rails. Such holes shall be spaced not more than three (3) feet centers, conform accurately to the dimensions shown, be free from burrs and be cylindrical and not conical. All holes in rails shall be drilled and not punched.

17-15. The guard rails shall be bolted to the running rails at intervals not exceeding three (3) feet by standard fifteen-sixteenths (15/16) of an inch steel bolts with a nut lock under the nut. The heads of all bolts shall be placed outside of the running rail, and nuts must be screwed up tight with an approved track wrench. Extra long handles on wrenches will not be permitted. Standard separators shall be installed between the guard rails and running rail at each point where these rails are bolted together. The proper size separator shall be installed to insure the flangeway specified.

17-16. Tie plates shall be used under all rails on all ties, except where the type of joint makes a plate unnecessary. Tie plates must be placed with the shoulder tight against the outside base of rail and care must be taken to get a full, level and even bearing on the tie.

Wherever it is necessary to fit, punch or rivet tie plates in the field, fitting, punching or riveting shall be carefully and accurately done to insure a full bearing of all the parts assembled.

17-17. The rails shall be spiked to each tie through a tie plate. No spiking shall be done until after the ties have been carefully spaced and squared across the center line of the track on tangents, and placed in a radial position on curves and the shoulder of the tie plate brought to bear snugly against the base of rail. The spikes shall be placed diagonally on the opposite side of the rails as shown on the drawings. The inside spikes shall be placed on the north or west side of the ties and the two outside spikes on the south or east side of the ties.

The number of spikes to be used per tie on each rail shall be as follows:

1 spike on both sides of both rails on tangents
1 spike on both sides of inside guarded rail on curves
1 spike on outside of outside rail on curves
1 spike on side of guard rail nearest center of track
2 spikes on inside of outside rail on curves
2 spikes on inside of unguarded inside rail on curves

17-18. Cut spikes must be driven normal to the base of rail and straight, and care must be used when spiking to avoid striking the rail or tie plate. The spikes shall not be struck after they have reached a bearing on the rail and the last blow on the spike must be struck lightly so as to avoid breaking the head of the spike or injuring the rail when the spike comes to a bearing on the rail. If, for any reason, a spike is drawn, the hole shall be filled with a hardwood plug. Wherever practicable the spike shall be redriven in a new location. Wherever it is necessary to drive a spike within six (6) inches of the end of a tie, a three-eighths (3/8) of an inch by four (4) inch hole shall be bored in the tie.

17-19. Screw spikes must be screwed normal to the base of rail and straight, and must always be provided with a support for the back of the head. If this support is not rolled on the tie plate, standard clips must be inserted for the purpose of providing such support. Great care shall be taken in making the final turn of the screw not to turn it too far. The last turn shall be so made that the spike just comes in contact with the support. Attention is called to the one-sixteenth (1/16) of an inch clearance which is provided between the top of the base of rail and the bottom of the head of the spike. If it is found necessary to unscrew any of the spikes, care must be taken in replacing not to destroy the thread in the wood. If for any reason a new hole is desired, the old hole shall be filled with a hardwood plug. Under no circumstances shall a screw spike be driven by any other method than by screwing and it shall never be struck or pounded.

17-20. Ties used shall be of the class, dimensions and spacing specified under the various types of track. Ties shall be placed square across the center line of track on tangents and in a radial position on curves. In spacing and squaring the ties before spiking, the rails shall be raised and ties shifted to their proper position without striking or pounding them with mallets, picks or any other implement. Any ties that are split or damaged in laying or placing shall be removed by the Contractor and new material substituted. The heart side of all ties, except beveled ties, shall be turned down. The ends shall

be lined evenly on the side of the track specified under the various types of tracks.

17-21. Joint ties shall be spaced not exceeding ten (10) inches between bearing surfaces at edges under the joint. Intermediate ties shall be spaced equally and so that there will be not more than eighteen (18) inches between edges of two adjacent ties under the rails, except in yards, where twenty (20) inches will be permitted.

17-22. Long ties for the support of the third (or power) rail shall be installed as shown on the drawings and as directed by the Commission and in such manner as not to obtain a greater spacing than ten (10) feet center to center. Care must be taken in placing the third rail ties to obtain the proper distance from the gauge of rail to the third rail supporting end of third rail tie. In the subsurface portion of the Railroad, the third rail ties shall be placed between the columns supporting the structure and never opposite a column.

17-23. Anti-creepers shall be installed with the wedges in such a position that they will prevent the rails from creeping with traffic. Care must always be taken to bring the wedge in contact with the tie before the clamp is driven home. In driving clamps tight they must not be driven with sufficient force to gouge the lower side of the wedge. It is only necessary to obtain a snug fit. Such number of anti-creeping devices shall be provided as may be necessary in the opinion of the Commission. In general, three (3) anti-creepers to the rail shall be installed on tracks alongside of station platforms, and on tracks outside of station platforms one (1) to the rail for each one (1) per centum or fraction thereof of down grade and one (1) to the rail for each two (2) per centum or fraction thereof of upgrade, and in no case shall less than one (1) anti-creeper to the rail be used. The anti-creepers shall be spaced uniform distances apart. Wherever possible those on opposite rails shall be brought to bear on the same tie.

17-24. Passenger bumping posts, of a design approved by the Commission, shall be installed at the ends of tracks where and as shown on the drawings. The posts shall be securely anchored to insure, in the opinion of the Engineer, a sufficient amount of holding power to perform the work for which they are designed.

SUBDIVISION 18

Installation of Type I Track

18-1. Type I Track, a ballasted type of track, shall be used in the subsurface and open cut portions of the Railroad. The track shall be laid in accordance with the general specifications given for the installation of tracks, and with the following specifications of special details and operations herein enumerated as applicable only to Type I Track. This type of track shall be installed where and as shown on the drawings.

18-2. Class A ballast shall be used in Type I Track and shall be thoroughly tamped, using approved track appliances, under the ties from the ends of the ties to a point at least fifteen (15) inches inside of the center of the rails. The long ties for the support of third rails shall be tamped from a point opposite the end of the standard ties to a point at least fifteen (15) inches inside of the center of the rail. The ends of the third rail ties outside of this area shall not be tamped. The rails shall be carefully raised in at least two lifts to the established grade. The ballast must be leveled even with the top of the tie and neatly trimmed before final completion of the work.

18-3. Class A ties, six inches by eight inches by eight feet (6″x8″x8′) shall be used in Type I Track. The long ties for the support of third rail shall be six inches by eight inches by nine feet one inch (6″x8″x9′ 1″). The ends shall be lined on the side of the tracks opposite the third rail location. Eighteen (18) ties shall be used under a thirty-three (33) foot rail, except on sharp curves where it may be necessary to increase this number to prevent exceeding the maximum spacing.

18-4. The superelevation in this type of track shall be obtained by raising the high rail and lowering the low rail one-half (½) of the total amount of the superelevation specified. The line on the profile on the alignment drawings marked base of rail, shall be taken as the line of the base of rail at the center line of the track.

SUBDIVISION 20

Installation of Type III Track

20-1. Type III Track, an all timber type of track, is particularly designed for use on the elevated portion of the Railroad. The track shall be laid in accordance with the general specifications given for the installation of tracks and with the following specifications of special details and operations herein enumerated as applicable only to Type III Track. This type of track shall be installed where and as shown on the drawings.

20-2. Class D ties, eight inches by eight inches by eight feet (8″x8″x8′-0″) shall be used in the Type III Track, except on superelevated curves. The long ties for the support of the third rail shall be nine feet five inches (9′-5″) long. The ends of all ties shall be lined on the side of the tracks opposite the third rail location. The ties shall be spaced approximately eighteen (18) inches center to center throughout the Type III Track. Class D beveled ties, or blocks, eight (8) inches wide and of length and depth indicated on the drawings, shall be used on superelevated curves in Type III Track. The ties shall be carefully dapped and fitted to obtain a smooth and uniform rise in the outside rail.

No ties shall be dapped except where it is necessary to obtain a uniform grade or where there are rivets on top of the girders or under special work. The dapping shall be carefully done where necessary and the surface of the timber made smooth.

20-3. The superelevation of this type of track shall be obtained by raising the outside rail the total amount of superelevation specified. The line on the profile on the alignment drawings marked base of rail shall be taken as the line of the base of low rail.

20-4. Each end of each tie shall be secured to the supporting girders by means of a hook bolt with the nut bearing on an oblong washer. These bolts shall be placed on the center line of the ties and shall be fitted snugly to the girder flanges with the hook square to the web of the girder.

20-5. Where hook bolts cannot be placed in a standard location or where they will be inaccessible if so placed or where they will interfere with the rail or special work, they shall be located as directed by the Engineer, and if so directed they shall be set in cup washers.

20-6. On curves, in special work and in other locations where it is impossible to install hook bolts, lag screws shall be used to secure the ties to the girders. These lag screws shall be driven snug against the flange of the girder.

20-7. Two lines of inside guard timbers and two lines of outside guard timbers shall be laid for each track, except in special work, at stations and on curves where steel guard rail is used. The guard timbers in special work shall be placed as shown on the drawings; two lines of outside guard timbers shall be laid at all stations as indicated on drawings; two lines of outside guard timbers shall be laid on all curves. All guards shall be Class D timbers. All inside guard timbers shall be six inches by six inches (6″ x 6″). All outside guard timbers, except on curves with a radius of less than two hundred (200) feet, shall be six inches by eight inches (6″ x 8″), laid with the eight (8) inch dimension in a vertical position. On curves with a radius of less than two hundred (200) feet the outside guard shall consist of not less than two (2) three (3) inch planks set on edge and securely bolted to each other by three-quarter (¾) inch button head bolts, countersunk in cup washers, placed about eighteen (18) inches center to center and the whole securely fastened to the ties in the manner hereinafter described. Guard timbers shall be placed true to line and position and concentric with the centerline of the tracks, and shall be framed and joined in a careful and workmanlike manner. The timbers shall be selected, as far as possible, of such lengths and shall be placed at such a position as to break joints with the other lengths of guard timbers and with the joints of the running and guard rails of the same track.

20-8. The guard timbers shall be bolted to the ties with bolts in the manner and location shown on the drawings and the nuts placed in standard cup washers. Care must be taken to

place the top of the cup washer flush with or below the top of the timber. All bolts projecting above the surface of the timber shall be cut off flush with the top of such timbers.

20-9. Where standard bolts cannot be installed in guard timbers as specified the guard timbers shall be fastened by means of lag screws set in standard cup washers.

20-10. All holes drilled for bolts and lag screws in ties and timbers and all bolts and lag screws shall be in a vertical position and square to top surface of the tie or timber and shall be placed accurately in the location indicated. Holes for bolts and cup washers shall be bored of a size to insure a driving fit. Holes shall be drilled for all lag screws of a diameter one-eighth (⅛) of an inch less than the diameter of the lag screw at the base of the thread. The auger used for boring holes for cup washers shall be provided with a stop to insure the cup washers being exactly flush with the surface of the timbers.

20-11. All timber bolts shall be dipped, immediately before being placed in position, in tallow.

20-12. Foot walks shall be constructed where and as shown on the drawings, and shall consist of four lengths of slatting laid side by side and continuously, except at special work, stations and any other points where special construction is called for, where they shall be placed as shown on the drawings. The inside walks shall be supported on joists spaced four feet six inches (4′-6″) apart and outside walks on ties twelve feet six inches (12′-6″) long. The slatting shall be Class D two inches by six inches (2″x6″) and of random lengths varying upward in multiples of four feet six inches (4′-6″) from eighteen (18) feet. The joists shall be Class D four inches by eight inches (4″x8″) and eight inches by eight inches (8″x8″) as shown on the drawings by the lengths necessary to span between the girders with full bearing on the girder flanges as indicated on the drawings.

20-13. Every other joist shall be securely fastened to the girders by means of two standard hook bolts as indicated on the drawings.

20-14. Lengths of slatting shall be selected and placed, as far as possible, so that not more than one joint shall fall on the same support. Except at joints, slatting shall be fastened to each support by two (2) twenty (20) penny cut nails. At joints two (2) nails shall be driven in at each end of each piece of slatting. All nails shall be driven with the long diameter of the head with the grain of the wood.

20-15. Wherever track timbers are brought together or rest upon each other as at joints and where guard timbers or slatting rest upon supports, the contact surfaces shall be carefully painted with an approved paint before being assembled.

20-16. After the guard timbers are set in place and completely bolted and fastened to the supporting structure the top surfaces shall be painted one coat of paint. All exposed surfaces at all joints in the guard timbers shall be painted after assembly. All surfaces which are adzed or dapped and the inside of the large holes bored for cup washers shall be covered with a thick coat of paint.

20-17. The paint to be used on the contact surfaces and other parts specified above shall consist of metallic brown pigment having not less than sixty (60) per centum ferric oxide; raw linseed oil and Japan dryer in the proportions of approximately fifty (50) per centum pigment and fifty (50) per centum vehicle and dryer combined. This paint shall be made of first class material and shall be satisfactory to the Engineer.

20-18. Standard hand railing of a quality of material and details shown on the drawings shall be installed on the outside of all outside walks and at any other point indicated by the Commission.

20-19. The various parts of the hand rail shall be carefully fitted together and securely fastened in a first class workmanlike manner to insure against any danger of the parts loosening or rattling after operation.

20-20. The hand rail shall be painted a shop coat, a second coat and a finishing coat, with paint of approved quality and

applied in the manner specified. The finishing coat shall be an olive green matched to sample.

20-21. The shop coat shall consist of a coat of red lead and linseed oil. The paint for the shop coat shall be mixed as needed, and shall be a mixture of the proportion of five hundred (500) pounds of red lead to sixteen and one-half (16½) gallons of linseed oil (two-thirds (2/3) by volume raw and one-third (1/3) by volume boiled).

20-22. Raw linseed oil shall conform to the specifications of the American Society for Testing Materials for the purity of raw linseed oil from North American seed, adopted August 25, 1913.

Boiled linseed oil shall be made of pure linseed oil heated with lead and manganese salts.

When boiled linseed oil is flowed over a plate of glass and allowed to drain in a vertical position, it must dry free from tackiness in fifteen (15) hours at seventy (70) degrees Fahrenheit.

20-23. Red lead for the shop coat shall be of the best quality, free from all adulteration and shall contain not less than eighty (80) per centum nor more than ninety (90) per centum "true red lead" ($Pb_3 O_4$), not over one (1) per centum inert hearth materials (such as silica and alumina) and not more than one-tenth (0.1) per centum metallic lead; the remainder shall be pure lead monoxide (PbO). It must contain no organic coloring matter and when shaken up with water shall show no alkaline reaction. It shall be of such fineness that ninety-nine and one-half (99½) per centum will pass through a standard 200-mesh sieve.

By standard 200-mesh sieve is meant the 200-mesh sieve described in the specifications of the American Society for Testing Materials for Portland Cement, adopted August 16, 1909.

20-24. All iron shall be scraped free from scale and rust, and shall receive one coat of red lead paint as herein specified, before leaving the shop. All surfaces which come in contact or are enclosed shall be painted before being assembled. All

turned or faced surfaces shall receive a coat of white lead and tallow before leaving the shops.

Where the shop coat has become damaged before or after erection, through any cause whatever, it shall be renewed with the same kind of paint as originally used, such renewal to be considered only as a part of the original shop coat.

After erection the metal shall be thoroughly cleaned of all dirt, rust or scale by stiff wire brushes or sand blast, as directed, and afterward dusted and thoroughly and evenly painted with the second coat prescribed herein. No paint shall be applied until the cleaning has been passed upon by an Inspector.

The finishing coat shall be applied at such time after the application of the second coat and before final acceptance of the work, as in the judgment of the Engineer shall be advisable.

20-25. Surfaces of exposed members inaccessible after erection, shall be cleaned and painted before erection.

All recesses that might contain water, or through which water could enter, must be filled with thick paint or a waterproof cement of ground skins before receiving a final painting.

All surfaces so close together as to prevent the insertion of a brush must be painted thoroughly by using a piece of cloth, if necessary.

20-26. Painting in rainy or freezing weather or on wet or damp surfaces will not be permitted.

SUBDIVISION 24

Installation of Special Work

24-1. Special work shall be laid in accordance with the general specifications given for the installation of tracks and for the installation of the particular type of track in which the special work is laid and with the following specifications of special details and operations herein enumerated as applicable only to the installation of special work. Special work shall be installed where and as shown on the drawings.

24-2. Ties of the class and section specified for the type of track in which the special work is laid, and of a length shown on the drawings, shall be installed under all special work. The ties shall be accurately spaced as indicated on the drawings. The ties under single and double slips shall be placed accurately at right angles to a center line drawn between the theoretical point of frogs. No rails shall be spiked to the ties until the spacing and position of ties have been carefully checked and approved by the Engineer.

24-3. Particular care must be taken in raising the rails, frogs and switches to the established grade, and to obtain a good surface throughout. The ties under the frog plates shall be carefully dapped to permit of the installation of the three-quarter (¾) inch bearing plate.

24-4. The material shall be carefully assembled in the field and the parts placed in their position, beginning preferably at the frogs. No work trains shall be operated over the special work until all of the ties and tie plates have been properly placed and the rails set in their position and spiked sufficiently to prevent damaging the material.

24-5. Wherever it is necessary to do fitting in the field all work in connection therewith shall be carefully and accurately done so as not to damage the material and to insure a smooth riding and safe track.

24-6. All drilling required shall be accurately done and the holes made smooth and free from burrs.

24-7. Particular care must be used in unloading and handling material, particularly switch points, to prevent breaking and bending or in any other way damaging the material. Frogs, switches and rails shall not be dropped or thrown from cars but must be lifted or skidded to the ground.