TRAFFIC ENGINEERING STANDARDS

PHILADELPHIA STREETS DEPARTMENT

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To all technical and support staff of the Streets Department's Transportation Divisions

Pennsylvania Department of Transportation (PennDOT) District 6.0

0.0 Preface

0.1 General Standards

The acceptable standards and construction specifications of the Philadelphia Streets Department, Traffic Engineering Division, will be the most recent version of the following documents, except as noted herein, or within separate Traffic Engineering Specifications.

Pennsylvania Code

- 67 PA Code §205 (Municipal Traffic Engineering Certification)
- 67 PA Code §212 (Official Traffic Control Devices)
- 75 PA Code §101 (Vehicle Code)

PennDOT Publications

- Publication 8 – Construction Manual
- Publication 10 – Design Manual Part 1, Transportation Project Development Process
- Publication 13M – Design Manual Part 2, Highway Design
- Publication 14M – Design Manual Part 3, Plans Presentation
- Publication 35 (Bulletin 15) – Approved Construction Materials
- Publication 46 – Traffic Engineering Manual
- Publication 72M – Standards for Roadway Construction
- Publication 111 – Traffic Control – Pavement Markings and Signing Standards TC-8600 and TC-8700 Series
- Publication 148 – Traffic Standards – Signals (TC-8800 Series)
- Publication 149 – Traffic Signal Design Handbook
- Publication 191 – Guidelines for the Maintenance and Operations of Traffic Signals
- Publication 212 – Official Traffic Control Devices
  Publication 212 is Pennsylvania's Supplement to the MUTCD, per 67 Pa. Cade §212.3
- Publication 213 – Temporary Traffic Control Guidelines
- Publication 236 – Handbook of Approved Signs
- Publication 383 – Pennsylvania's Traffic Calming Handbook
- Publication 408 – Highway Specifications
- Publication 638 – District Highway Safety Guidance Manual
- Publication 647M - Civil and Structural Standards for Intelligent Transportation Systems, ITS-1000M Series.

Federal Highway Administration (FHWA)

- Manual on Uniform Traffic Control Devices (MUTCD), 2009 edition

National Cooperative Highway Research Program (NCHRP)

- Report 812 – Signal Timing Manual

0.2 Authority

The Chief Traffic Engineer is authorized by 67 PA Code §205, as the City's municipal traffic engineer, to issue and approve traffic signal plans and permits.

0.3 Engineering Details

The Traffic Engineering Division, in cooperation with the Transportation Design Unit, has developed a series of details, listed as Traffic Engineering (TE0XXX), Interconnect (IC0XXX), Signs (SN0XXX), and Pavement Markings (PM0XXX), on the Streets Department's Downloads and Links web page. In the absence of a standard Streets Department detail, the latest PennDOT details will apply.

0.4 Definitions

All terms utilized will conform to the documents listed in Section 0.1, unless otherwise defined throughout the body of these Standards.

0.5 Deviation from Standards

These Traffic Engineering Standards represent the general operational practices of the Traffic Engineering technical staff and field crews. Deviation from these standards, where required for site-specific issues, are to be justifiable and based upon sound engineering judgment and general conformance with the documents listed in Section 0.1, and as may be otherwise applicable.

0.6 Revision Schedule and Notice

Revisions to these Standards will occur semi-annually, and on an as-needed basis. Changes will be posted by the first day of June and December, to take effect on the first day of July and January, respectively. Posting revisions to a website maintained for this purpose by the Department of Streets will be considered sufficient notice after the initial release of these Standards.

1.0 Traffic Impact Studies

1.1 Functional Classification

The classification of each roadway is defined in GIS, and is based on function. There are two active classification systems in the City of Philadelphia.

- Functional Class, as used by Federal and State agencies for traffic studies
- Complete Streets, as created by the City's pedestrian and bicycle plan, and used by the City of Philadelphia for the planning of certain roadway/footway design elements

1.2 Criteria

A. City of Philadelphia Criteria

Development sites meeting any of the following criteria require Traffic Impact Studies:

- 1,000 trips/day (500 vehicles/day)
- 50 trips/peak hour (entering)
- 50 trips/peak hour (exiting)
- All grade schools (K-12) subject to new development, relocation, expansion, enrollment increases of 40% or more, or changes in name or ownership.
- As required by the Chief Traffic Engineer, or an authorized designee.
- As required by other City agencies (ex. Air Management or Zoning)
    - Air Management Regulation 10 requires a traffic impact study based on the number of parking spaces being created, and/or commercial vehicle trips. The varying criteria and requirements for the study are codified within the regulation.

B. Special Criteria for All Traffic Impact Studies

- All Traffic Impact Studies will assume current land use is vacant land, except where current use is proposed to be expanded within the same parcel(s).
- All modal splits need to be justified by a neighborhood-specific study/survey.
- All traffic impact studies must include pedestrian impacts, including identifying key generator and destinations in proximity to the study area.
- Projects required to submit a Traffic Impact Study for any reason are subject to §11-900 of the Philadelphia Code (Complete Streets Approval).

1.3 Format Requirements

- All TIS reports will provide a concise executive summary, including all pre-and post development conditions provided in a table format for comparative purposes. The executive summary will at all times be located at the beginning of the TIS.
- All traffic mitigation measures will be clearly listed in the executive summary, including measures accommodating impacts by bicycles (count as autos), and pedestrians.
- All congestion mitigation measures shall be clearly stated.

2.0 Intersection Design

2.1 Warrants

Warrants are approved by the Traffic Engineering Unit (TE). Volumes and crashes are evaluated over a 3 year period. Any single 12-month period during this period may be used to justify a multi-way stop sign/traffic signal, per the criteria referenced below. If the sign/signal is existing, data may be used from the 3-year period prior to the installation of the sign/signal. The following criteria are used, in accordance with the PA Code:

A. Multiway Stop Signs

Criteria for the use of multiway stop signs are listed in the MUTCD, Section 2B. The Commonwealth of Pennsylvania permits additional warrants, as provided by 67 Pa. Code § 212.106 (Additional warrants for Stop Signs (R1-1) and Yield Signs (R1-2)).

B. Traffic Signals

There are eleven (11) warrants for traffic signals, which are as identified in 67 Pa. Code §212.302 (Traffic-control signals). Warrants 1 through 9 are as defined in Sections 4C.02 through 4C.10 in Part 4 of the MUTCD, and the tenth and eleventh warrants as defined in 67 Pa. Code §212.

2.2 Channelized Right Turn

A. Yield vs. Stop Control

- Install a yield sign unless there is a high pedestrian volume or visibility conflict. Existing movements will be re-evaluated to determine proper control.

2.3 Unconventional Intersection Treatments

The Department of Streets and Pennsylvania Department of Transportation encourage innovative transportation solutions and consideration of unconventional intersection treatments such as but not limited to roundabouts. Due to the complexity associated with roundabouts, such alternatives require coordination with the Department and PennDOT as necessary.

A. Roundabouts

- Signal warrant analysis should be performed for unsignalized intersection in accordance with the MUTCD and Section 2.1, above. The peak hour warrant shall only be applied in unusual cases, including but not limited to trip generators that attract or discharge large numbers of vehicles over a short period of time.
- As soon as it is determined that a signal is a mitigation option, coordination should be initiated with the Department and PennDOT as necessary. The coordination shall included:
    - Evaluation of the use of a roundabout in lieu of a signal
    - The limits of the traffic signal system to be analyzed
    - Performance requirements
    - The method of analysis
    - Technology and maintenance issues
    - Installation and maintenance agreements

- Roundabouts shall be considered at all locations under signalization consideration. Refer to NCHRP Report 672 - Roundabouts: An Informational Guide, Second Edition, 2010 and PennDOT Publication 414 - Guide to Roundabouts for more information.

B. Neighborhood Traffic Calming Circle

Criteria for this item are currently in development.

C. Other Traffic Calming

Criteria for this item are currently in development.

3.0 Data Collection

All information will be transmitted to consultants as follows:

Streets Department Unit	**Resources Provided**
City Plan Section	City Plans
Right of Way Unit	Highway Supervisors Plans
Customer Service, via Streets Department Website: www.philadelphiastreets.com	Standard Details, Department Standards
City Website (links to available resources)	Philadelphia Code, Department Regulations
Design Unit	All Data not listed above

3.1 Volumes

A. If corridor borders two counties, additional counts can be obtained through the Delaware Valley Regional Planning Commission (DVRPC).
B. All counts obtained by the Design Unit, or a consultant, must be submitted to Traffic Engineering, and DVRPC in a format currently acceptable to both agencies.

3.2 Traffic Count Collection

Every project requires both manual and automated counts in 15-minute increments.

A. Manual

Manual counts should be taken at, but not limited to, intersections where we are evaluating geometric or phasing changes or where high turning movements are likely present (arterials). The counts should be taken 7-9 AM or 4-6 PM unless the anticipated peak is mid-day (i.e. shopping centers). Manual counts include pedestrians. If a consultant is designing the project, counts are quantified by man-hours.

B. Automated Counts

Automated counting equipment is generally installed over a 48-hour period to record volumes and vehicle classifications. Several automated counts should be included in the data collection for every project to provide a more accurate picture of the 24-hour conditions. This information is invaluable because timings are typically developed for AM peak, PM peak, and off-peak hours.

3.3 Crashes

- At a minimum, obtain 3-year crash data from PennDOT reportable data. Non-reportable crash data can be obtained from Traffic Engineering for a fee ($10 per location). See the Appendix for non-reportable crash code descriptions.
- If a consultant is designing project, the proposal should include condition diagrams for a handful of intersections with the highest accident rates.
- If the corridor borders another county, also obtain data from the appropriate municipality and/or PennDOT.
- Collision diagrams are to conform to the latest requirements of the FHWA and PennDOT.
- All crash data is to include dates.

4.0 Software

4.1 Turning Plans/Templates

- All proposed radii must be checked for turning radius of appropriate design vehicle using AutoTurn or similar software.
    - See the Appendix for guidelines on design vehicles for turning radii at intersections.
    - The oversteer function in AutoTurn may be only be used with advanced approval from Traffic Engineering. Oversteering in this case is defined as turning a design vehicle more sharply than may be possible in actual traffic conditions.
- Turning plans for onsite circulation for loading docks and parking lots may be discontinuous and slower than expected travel speeds for roadways.
- Turning plans for roadway geometries should be continuous and reflect actual expected travel speeds anticipated by the subject vehicle. The design speed must be noted on all turning plans.
- Provide existing and proposed turning maneuvers that properly reflect conditions. Do not worsen existing turning maneuvers in any proposed condition.

4.2 Capacity Analysis

- Capacity must be checked using Synchro. A copy of the file must be submitted to the City along with any plan or traffic impact study submission.
- Consultants are required to use software compatible with Synchro, Version 8.
- Report Presentation:
    - Impact on level of service must be provided in summary form for each movement, and include a comparison between the existing and proposed conditions.
    - No LOS of F will be accepted for individual moves, and no intersection LOS lower than D will be accepted. If LOS-F currently exists, then overall delay should be reduced, or maintained (in all instances).

5.0 Signal & Interconnect Plan Layout & Permitting

5.1 Survey Information

A. Signal Plan

- All existing street furniture, building line (if setback is not too great), ROW line and curb line, paving material or grass areas, driveway locations, curb cut ramps (driveways, service and/or ADA ramps), inlets, manholes, utility boxes, street grades, existing pavement markings on all legs (if the marking scheme is being modified, the transition to existing markings must be shown) and existing signs must be shown on signal plan.
- Include all utility information, including the design call number(s) provided by PA-One Call.
- Do not show any existing signal equipment at the intersection which will be removed on the signal plan. If the equipment to be removed is not reflected anywhere in the plan set, it must be located in the 'Remove Existing Signal Equipment' specification.
- Any existing signal equipment that is not near the intersection (i.e. mid-block detectors/junction boxes) should be shown on the plan.
- If conditions are being adjusted through a separate roadway plan, only the proposed conditions should be reflected on signal plan (i.e. final curb lines, ramps, and inlet locations). Include all ADA corner curb ramps, as well as any applicable “no-pedestrian crossing” signs. Curb realignment or island reconstruction will require a separate roadway plan. Only proposed and existing curb (to remain) is to be shown on the signal plan.

B. Sign Inventory

- Locations of street name, regulatory and advisory signs (e.g. speed limit, school crossing, and bike signs). Parking signs included in the Standard Details may be included in the sign inventory, however:
    - PPA parking signs (e.g. green hour restrictions, HC signs, etc) and all SEPTA signs are to be excluded from any sign inventories associated with City-owned street signs. They may be included in developer’s site plans, noting coordination regarding approvals for the installation and replacement are the jurisdiction of the Philadelphia Parking Authority and SEPTA, respectively.
- Depending on the scope of work, additional sign locations may be required (i.e. replacement of street light poles).

5.2 Utility Information Required

A. Traffic Signal Plans

- Name, location and size of all underground facilities, shown as background/shaded/washout.
- Pole and/or manhole numbers which are part of the signal system.

B. Roadway Plans

- As required by the Right of Way Unit.

C. Interconnect Plans

- Wood pole locations, pole numbers, location and name of utility in which interconnect will be installed, identification of manholes and/or poles which are part of the signal system, and duct assignments.
- If there are no wood poles, existence and condition of utility ducts will be verified by the City prior to the start of design.

5.3 Additional (Other) Information

- The following data can be provided by Traffic Engineering:
  - School crossing locations
  - Existing interconnect locations
  - School locations
  - Cross-street arterials
  - Mast arm locations
  - Police/fire facilities
- Note nursing homes, senior centers, transit routes; churches, school flasher locations, recreation centers, parks, and all other City facilities.
- Traffic Engineering will provide the following supplemental information:
  - Existing pavement marking, traffic signal and interconnect plans. The fee for all drawings is $10 per intersection.

5.4 Traffic Signal Plan Requirements

Include the following information on the traffic signal plan:

- See Standard Details for sample phasing, weekly program chart, and wiring diagram.
- Phasing, Timing, and Color Sequence Chart
- Weekly Program Chart, if intersection has multiple programs or is part of an interconnected corridor.
- Wiring Diagram
- Volumes. Provide turning movements. We do not adjust for growth in design but for the purposes of the Categorical Exclusion, we can use 0.0% per year over ten (10) years.
- Signal Indications
- Street name sign details and any other special details specific to intersection. If there is no room on the signal plan, the details may be shown elsewhere in the plan set.
- Materials List
- Legend

- Sign Tabulation (for signs related to the traffic signal operation only, including quantity, description, series, symbol, and size) Symbols used for standard signs must conform to those listed in Appendix A.
- Standard details, such as detection system. These may be included elsewhere in the plan set.
- Include posted speed on signal plan and design speed on cover sheet.
- Include distance to the nearest signalized intersection.
- Include service points, approach grades, underground utilities (w/depths and dimensions, shown in gray/washout), adjacent trees, pavement markings; significant physical features (i.e. trolley tracks, limit of structures, etc).

5.5 Fiber Optic Interconnect Plan Information

The following information must be included on the plan:

- Curb lines and ROW lines.
- Signature line for Traffic Engineering.
- Any wood poles, manholes, controllers, mast arms, junction boxes, and termination cabinets affecting the network. Include identification numbers for poles and manholes.
- Existing & proposed underground and/or aerial fiber interconnect. Clearly label underground and aerial fiber runs.
- Reflect underground utilities on the plan if underground interconnect is in close proximity to other facilities. This includes intersections and any mid-block locations which may apply.
- Existing interconnect on cross streets. If interconnect is to be replaced between the corridor and an adjacent intersection, that intersection must also be shown on the plan.
- If interconnect is installed in a utility duct, show assignments on the plan.
- If interconnect is installed in City conduit, show detail on the plan, including the size/diameter of the conduit.
- Label interconnect loops exceeding 30-feet on the plan.
- Include the following notes on the plan:
    - Conduit for traffic signals and conduit for fiber optic cable will be installed in the same trench, wherever applicable.
    - Loop 30' of cable on wood pole or in junction box closest to the controller unless otherwise noted on plan. The standard junction box for controllers is 39” OD x 18”, as included in the technical specifications.
    - Removal of existing interconnect cable is required, and will be considered incidental to the installation of all new interconnect cable.
    - All fiber optic interconnect cable must be installed and connected to the traffic signal controller through either a mast arm, or D-Pole. The installation of City of Philadelphia conduit to wood poles is prohibited.

- All new fiber will be labeled at every wood pole, manhole, junction box, and other fixed asset, as follows below. The exact dimensions, material and placement of all tags will be addressed within the technical specifications.

City of Philadelphia Traffic System Fiber Optic Communications Cable DO NOT MISHANDLE

5.6 Professional Engineer Required

Each plan must be signed and sealed by a professional engineer, licensed in the Commonwealth of Pennsylvania.

5.7 Drawing Scale

- Use 20 scale (1 inch=20 feet) for signal plans. If the intersection layout does not fit on a 20 scale plan, use a 30 scale (1 inch = 30 feet).
- Use 100 scale (1 inch = 100 feet) for fiber optic interconnect plans. 50 scale (1 inch = 50 feet) may be used for shorter project lengths.

5.8 Approval Block

- Signal Plans must have an approval block for the City's Chief Traffic Engineer.
- Approval blocks for PennDOT approval are only required when directed by Traffic Engineering.

5.9 Application Required

- The City of Philadelphia's Chief Traffic Engineer is the only municipal agent who can issue and approve traffic signal permits for City-owned traffic signals.
- All work performed by third parties (i.e. non-Streets Department personnel), are required to obtain a permit from Traffic Engineering. Plans and supporting documents will conform, and utilize, all documentation required by PennDOT; including:
  - Traffic Impact Study & warrant analysis.
  - PennDOT TE-160 Form (Application for Traffic Signal Approval) – Applicant will complete Section A (Applicant's (Municipal) Contact Information) with their own information, and omit the resolution included with the form.
  - Engineers estimate of cost
  - Applicants will be required to enter into a private paving agreement, the requirements for which are outside the context of these guidelines. Contact the Streets Department, Right of Way Unit, for additional guidance.

6.0 Traffic Signal Hardware

While the need for conformance to MUTCD and PennDOT Standards cannot be stressed enough, Engineering Judgment must be exercised in the usage and placement of all traffic signal hardware.

6.1 Standard Coating Colors

Powder coating is the required application method for all hardware coatings, when possible. The preferred finish is semi-gloss.

A. National Park Service Brown (Federal Standard No. 20040)

- Standard color for all new C-Posts, D-Poles, Mast Arms & Controller Cabinets
- Includes all caps, split bases, and mounting hardware.

B. Federal Yellow

- Standard color for all signal heads & visors (exterior only)

C. Federal Black

- Standard color for all signal head back plates & louvers, rectangular rapid flash beacon flashing bars, signal head visor (inside).

D. Natural Metal (no coatings)

- Standard color for school flasher controller cabinets, rectangular rapid flash beacon controller cabinets
- Also applies to most pipes, elbows, brackets, bolts, bands, and u-bolts; all of which will be aluminum, galvanized or stainless steel, as required by the technical specifications.

6.2 Mast Arm (See Also Standard Details)

A. Usage

- If roadway width is greater than 44 feet, or where the existing street geometry negatively impacts signal visibility.
- Exercise judgment on roadways between 40 and 44 feet.
- Maintain continuity of hardware within a corridor:
    - Continue using post-mounted signals wherever feasible, and no mast arms have been installed near the signal being modified.
    - Upgrade post-mounted signals to mast arms, wherever other signals in the corridor have mast arms, regardless of street width.
- Mid -block signal.
- At multi-leg or complex intersections.
- Consider mast arms to correct visibility issues when there is an offset in the roadway or where there is a significant change in roadway width.

B. Size

- Lengths (feet): 10, 15, 20, 25, 30, 35, 40, 45.
- Avoid the use of 50 foot mast arms (or larger) whenever possible.
- Arm is mounted from 19 to 20 feet, as specified by the manufacturer, to provide 16-1/2 foot vertical clearance of signal heads.

- Arm lengths should be made to provide flexibility in field location of the pole and future changes to the intersection. Each arm should extend to the double yellow line, with five (5) feet of additional arm length specified to allow for field modifications related to utility conflicts with the foundation location.

C. Placement (Subject to Field Spotting During Construction)

- Pole should be oriented such that the overhead signal heads are between 40 and 150 feet from the stop bar.
- Minimum three (3) foot setback from curb line.
- Avoid the installation of a mast arm on an island. If island installation is necessary, maintain an eight (8) foot setback from the travel lanes on all sides and ensure island is curbed.
- Ensure placement does not conflict with any known underground utility lines
- Ensure placement does not obstruct pedestrian pathway.
- Do not install pole on curb radius. There may be an exception if the placement outside of a large radius has an adverse effect on signal visibility.
- There must be a minimum of six (6) feet of lateral clearance between the arm and any trolley wires.

D. Foundation

- Foundation size is dependent upon the arm length: Sizes are defined in the specifications.
- Spread foot foundations may be required where there are shallow facilities. Each project must be evaluated for the foundation type and include a minimum quantity of one (1) spread foot foundation.
- Any foundations which do not conform to current PennDOT standards must be detailed on the plan.

E. Street Lighting - See the street lighting section for guidance.

6.3 C-Post (See Also Standard Details)

A. Size

- 20 foot: The only size currently being installed by the City.
- 13 foot: Any existing 13 foot C-posts must be replaced with 20 foot C-posts.

B. Placement (Subject to Field Spotting During Construction)

- Minimum 3-foot setback from curb line.
- If C-post is installed on an island, maintain an 8-foot setback from travel lane on all sides and ensure island is curbed.
- Ensure placement does not conflict with any known underground utility lines
- Ensure placement does not obstruct pedestrian pathway.
- Do not install pole on curb radius. There may be an exception if placement outside of a large radius has an adverse effect on signal visibility.
- Do not install on medians with barrier curb less than 4-feet wide or medians with mountable curb less than 8- feet wide.

C. Foundation

- No foundation required. Directly buried 42 inches underground. Depth is pre-determined by the pre-manufactured knockout in the post.

D. Other

- If installed in an unpaved area, a 3 foot x3 foot x 4 inch thick concrete pad must be constructed at the base of the pole, payable under a separate item (for City contracts)

6.4 D-Pole (See Also Standard Details)

- Locations are subject to field spotting during construction
- Use for the following addition applications:
  - In place of a C-post when combining with a street light. Poles are 30-feet long, with a street light extension. Luminaire and traffic signal are powered separately. See Section 15 for additional guidance.
  - Where detection equipment is to be installed, and no mast arms are available for mounting purposes.
  - When running overhead wire *only* when wood poles are not available (primarily interconnect).
- Foundation is the same as that of a 25-foot mast arm (7800-series).
- Placement criteria are the same as a C-post (See Section 6.3B).
- The street light bracket and luminaire are separate pay items (for City contracts).

6.5 Pedestal Pole (See Also Standard Details)

- Use when the 3-1/2 foot (42 inch) subsurface clearance required for the C-post installation cannot be attained.
- Poles are 17 feet long.
- Refer to PennDOT TC drawings for foundation construction.
- Placement criteria are the same as that of a C-post.

6.6 Signal Heads

Conform to the MUTCD and PennDOT Pub 149 (Chapter 6), with the following preferences:

A. General

- Two signal faces are required for the through movement and must be located within a 40 degree cone (20 degrees to the right and 20 degrees to the left) at the center on the approach, at the stop bar. (The center of the approach is defined as the middle of the collective approach lanes, excluding exclusive turn lanes, parking lanes, and bike lanes.)
- Placement
  - Signal heads should be between 40 and 150 feet beyond the stop bar.
    - Supplementary signal heads should be installed if any criteria in section 6.6E are met.
  - At least one face, preferably all faces, must be located beyond the center of the intersection.
  - Overhead signal heads should be at least two (2) feet from edge of curb line or outer edge of parking lane.
  - The left approach overhead signal heads should be located between center and the right edge of the left lane.
  - Maintain a minimum distance of three (3) feet between opposing signal heads.
  - Minimum distance between overhead signal heads for the same approach is eight (8) feet, though twelve (12) feet is preferable. In the case of a multiple lane approach, ensure the right signal head is mounted at the center of the right lane.

B. Overhead Signal Heads

- Use overhead signals at intersections upgraded with mastarms,(as per section 6.2A)
- Overall, a minimum of two (2) overhead signal heads is preferred, unless placement criteria cannot be met.
- Where overhead signals are used, a minimum of one (1) overhead signal face per lane is preferred.
- In absence of exclusive turn signals, the signals on the mastarms must be visible for drivers waiting in the middle of the intersection to complete the turn. This can generally be accomplished by placing mastarms behind crosswalks

C. Post Mounted Signal Heads

- See Standard Details.
- A center median mounted signal may serve as a far left signal or an exclusive left turn signal.
- Must be mounted in-board, unless construction is not feasible or otherwise directed by Traffic Engineering.
- A maximum of two (2) signal heads per upright is preferred. Do not install more than three (3) total signal heads on any upright (C-Post, D-Pole, Pedestal Pole, or Mast Arm).

D. Signal Heads for Turning Movements

- For each turning lane controlled by an exclusive phase, there must be a separate signal.
- Use a 3-section head for a protected-prohibited movement (using a red arrow).
- Use a 4-section head for lag phases, when the turning and thru movements end together.
- All other configurations require a five (5) section head.
- Appropriate signage must accompany the signal face.
- A 5-section left turn signal should be located between the middle and the right edge of the left turn lane, in the direction of traffic flow. Ensure a 3 foot lateral clearance is maintained between opposing left turn signals.
- A 4-section head or 5-section head can be used as a primary signal head for through traffic.
- A right turn signal will be located to the right of the left edge of the exclusive lane. Signals may be post mounted.
- A 5-section head with a right turn signal is to be used as a primary signal head.
- Flashing yellow arrows (*MUTCD Section 4D.18*)
  - MUTCD has adopted the use of flashing yellow arrows for the permitted portion of the protected/permitted phase left turn movement. This standard is expected for adoption by PennDOT in late 2017 or early 2018.
  - This standard will replace the circular green signal for permissive left turns (i.e. where opposing through movements is permitted).
  - Traffic Engineering may permit use to emphasis pedestrian right of way on high volume crosswalks.

E. Supplemental Signal Heads

- Supplementary signals are to be installed under the following conditions:
  - A supplemental near-side signal will be required when the primary signal heads are between 150 and 180 feet, if required by Traffic Engineering, and if the primary signal heads are beyond 180 feet in all circumstances.
  - When vehicular signals are in a position which would not adequately serve pedestrians, and no pedestrian signal heads are proposed, additional three-section signal heads for pedestrians must be installed.
  - If at least one far-side signal is not visible to provide adequate stopping sight distance on the approach, a near side supplementary signal must be installed (i.e. post mounted signals or winding roadway).
- Supplementary signals to be installed in accordance with MUTCD Section 4D.14B.

F. Pedestrian Signal Heads

Hand/ man signals must be installed under the following conditions:

- All intersection crossings greater than 26 feet, curb to curb.
- All intersections with an exclusive pedestrian phase.
- When the crossing is designed to be made under two separate intervals. This is often utilized on divided highways.

- Hand man signals may be installed under the following conditions:
  - At established school crossings.
  - When the vehicular indicators would confuse pedestrians.
  - When pedestrian volumes exceed 100 pedestrians/hour for any four (4) hours in a 24-hour period.
  - When there is a pattern of pedestrian crashes. There is no specific number for this but one (1) per year for three (3) consecutive years may be used as a minimum.
  - For consistency along a corridor.
- Do not install pedestrian hand/man signals if the corresponding pedestrian phase is permitted/clear during all phases of signal operation.
- When hand/man signals are not utilized and post-mounted signals are not otherwise being installed, eight (8) inch post mounted signal heads are required for each pedestrian crossing.

G. Accessible Signals

Installation is based on a demonstrated use of an intersection by visually impaired individuals, usually associated with institutions. Traffic Engineering will provide direction on appropriate locations.

H. Size of Lens

- Do not install different size lenses in a single signal face.
- 12" lenses will be used in all cases, except where 8 inch lenses are permitted (see below).
- 8” lenses can be used where there use conforms with MUTCD Section 4D.07. Traffic Engineering only approves the use of the following Options:
  - *The circular indications in a supplemental near-side signal face:*
    - *The circular indications in a supplemental signal face installed for the sole purpose of controlling pedestrian movements (see Section 4D.03) rather than vehicular movements; and*
    - *The circular indications in a signal face installed for the sole purpose of controlling a bikeway or a bicycle movement.*

I. Retrofit

- For new construction, install a new signal head rather than retrofit lenses.

J. Shielding of Signal Faces

- All signal heads are equipped with tunnel visors under the current City standard. PennDOT requires a note on the signal plan indicating which heads require tunnel visors according to their guidelines (same as louver guidelines listed below).
- Vertical louvers may be used to accomplish the following:
  - Aid in directing the signal indication specifically to approaching traffic. The direction of the lovers must be noted.
  - Shield the lens from approaches other than the intended approach to avoid confusion.
- Distance limiting signals (i.e. horizontal louvers) are used to restrict the area from which the signal is visible.
  - The designated area from which the signal will be visible must be highlighted on the plan to ensure proper construction.
- The signal heads to be equipped with louvers must be called out on the plan as either vertical or horizontal/distance limiting.
- Backplates are used with all overhead signals.
- Optically programmed heads are not to be used.

K. Strobes

The use of strobes is no longer permitted by PennDOT. They are to be removed whenever signal heads are being changed out as a part of any signal project.

6.7 Conduit

A. General

- Three (3) inch Schedule 40 PVC is used for all new conduit runs for signal cable, except under trolley tracks, where 3" steel conduit is required.
- Maintain ground connections with conduit. Continue using steel for remainder of any run requiring a steel conduit (such as under tracks).
- Most of the existing conduit is two (2) inch steel.
- 20-conductor cable was the standard cable for conduit until the release of the 2018 edition of these Standards, and will continue to be used on older hardware. Standards for the use of 20-Conductor are as follows:
  - No more than two (2) 20 conductor cables can run in an existing or new three (3) inch conduit.
  - No more than one (1) 20 conductor cable can run in two (2) inch conduit.
- 30 Conductor will replace 20-conductor cable wherever new cables are run. Standards for the use of 30-conductor cable are as follows:
  - No more than three (3) 30 conductor cables can run in an existing or new three (3) inch conduit.
  - No more than one (1) 30 conductor cable can run in two (2) inch conduit.
- The preference is to run signal and service cable in separate conduits for new construction.
- Do not run fiber in the same conduit as signal or service cable.
- Utilize the same trench for separate conduit runs whenever possible.

- If conduit is installed in a grassy area which may be exposed to vehicular traffic (i.e. Fairmount Park), consider installing steel conduit.
- Elbows must be used when the direction of the conduit changes. Elbows and conduit are payable under separate items.
- Conduit runs will be reflected on plans as straight lines, not as arcs.
- Total conduit bends are not to exceed 360 degrees in any single run, to be defined as a cable pull between the point of entering the conduit to the point from which it is to be pulled.
- Identification tape
  - All identification tape will be a minimum of 6” wide x 5 MIL thick polyethylene with detectable aluminum foil core, conforming to ASTM D2103 and D882, with permanent colors conforming to the APWA color codes for underground utilities.
  - For 3-inch traffic signal conduit: 'CAUTION ELECTRICAL LINE BURIED BELOW' spaced at regular intervals.
  - For 4-inch traffic interconnect conduit: ‘CAUTION BURIED FIBER OPTIC CABLE’ at regular intervals.

B. Interconnect

- 4" steel conduit is the standard for all new fiber optic interconnect installed in City. This standard replaces the 4” PVC standard previously used. See section on interconnect.
- If the project crosses an arterial on which interconnect has not yet been installed, consider including a conduit between the junction box closest to the arterial and the controller for future-use.

C. Detection

- Micro-loops use 3" PVC conduit and wire loops use 1" PVC conduit. See section on loop detectors.

D. Track Street

- Buried track must be identified from the 1954 Philadelphia Transportation Company Track map.
- Use 3" steel conduit under a track structure, exposed or buried. This work is payable under a separate item, Steel Conduit Under Track Structure. Avoid connections between PVC and steel conduit by running steel conduit for the entire run where it is used (i.e. between junction boxes or poles/posts)

6.8 Junction Boxes

- Material
  - Any junction box installed outside of the roadway area will be composite with a heavy-duty lid, rated Tier-22 for both the junction box and the lid. Refer to: *NSI/SCTE-77 2013 "Specification for Underground Enclosure Integrity" Tier 22 Rated Loadings. Design load 22,500 lbs. & minimum test load of 33,500 lbs.*
  - Any junction box installed in the roadway will be 12" x 18” x 12” steel, with a minimum of four (4) lid bolts.

- The standard composite junction box size is:
  - 12" x 18" x 12" deep is the standard junction box size for traffic signals.
  - 17” x 30” x 18” deep is used where six (6) or more conduit enter the box.
  - 39” Dia Lid x 18” deep is used for all traffic signals adjacent to the control cabinet.
- It is preferable to install junction boxes outside of the roadway area.
- Install a junction box within 10 feet of each controller, mast arm, and D-pole.
- Run all signal cable connecting to a signal pole or controller through a junction box. Signal cable running to a C-post is not required to run through a junction box.
- If the number of conduits entering a C-post exceeds three (3), install a junction box.
- Junction boxes are used in a loop detection system. See section on loop detection for configuration.
- No traffic signal cable splices are permitted within any junction box.

6.9 Wiring

- Electrical Service Wire
  - Generally 2 conductor, 6 gauge wire, Type UF.
  - If power source is underground, run electrical service wire from manhole to junction box to controller. Only direct connections, with no splicing, are permitted.
  - If power source is overhead and there is a mast arm on the same comer, run electrical service wire overhead from the wood pole to the mast arm, down through the mast, to the junction box to the controller. Only direct connections, with no splicing, are permitted.
  - If power source is overhead and there is no mast arm on the same comer, use triplex cable if aerial run exceeds 25-feet, the cable is spanning over the roadway, or is attached to SEPTA poles. Because bare wire cannot run through a metal pole, the triplex cable must terminate at the top of the signal support and UF cable will run through the pole. The connection between the two cables is incidental to the triplex cable item in City contracts; however, the cables are payable under separate items.
- 30-conductor cable has been adopted as standard. It replaces 20-conductor cable in most applications.
  - Run 30-conductor wire from pole base to pole base. Add an additional 6' per run
  - Ensure that the 30-conductor cable is sufficient for the signal heads it is serving. If additional wire is required, install a 5, 7, 20 or 30 conductor cables, as required. The cable must be color coded, as identified on the wiring diagram, to identify which cable runs to each pole.
- Signal heads operating on the same circuit run the same wire. Each vehicle phase uses three wires. Each pedestrian phase uses two wires. Permitted/Protected turning movements will use between 1-3 wires. Reserve 3 wires as spares and 1 wire is a common.
- 5 conductor runs from base of pole to 3 section signal head or pedestrian head. Each signal head is wired separately.

  - Post Mounted: runs from base of pole to each signal head mounted at ten (10) feet minimum. Add an additional five (5) feet per run.
  - Overhead Mounted: runs from base of pole, up 20', out to signal head. Add an additional five (5) feet per run.
- 7 conductor cable runs from base of pole to 4 or 5 section signal head. Add an additional five (5) feet per run. If there is a possibility of a future exclusive left turn phase, run 7 conductor, instead of 5 conductor, to the farthest overhead signal head.
- 3 conductor cable runs from the base of the pole to the push button. Use four (4) feet per run.
- All aerial service wire must have a drip loop of additional wire where it enters the traffic signal pole.

6.10 Controller

- At the time of this document's publication, Traffic Engineering is evaluating, with the intention to adopt, the Advanced Transportation Controller (ATC) as the replacement the current 170 solid state traffic signal controller. Upon adoption of that evaluation and development of an approved master specification, all traffic signal upgrades will be required to use the new ATC standard. Traffic Engineering does not currently intend to phase out the Caltrans controller cabinet specifications, into which the new ATC controllers are compatible.
- See Signal Controller Cabinet Comparison Table, below. Typically, use a Type 170 base mounted solid state controller, cabinet sizes as follows:
  - 332 – Standard cabinet to allow for a fiber optic Ethernet network connection and UPS (4 hours operating + 4 hours on flash). This is the standard cabinet for arterial roadways.
  - 333SD combination cabinet – termination cabinets, where fiber network hubs are installed (intersections of two fiber cables), and space must be provided to fit a UPS (8 hours operation + 4 hours on flash). The 333 cabinet will therefore be the standard where signalized traffic corridors intersect, space permitting.
  - 336S – Only on local/collector routes, where fiber interconnect may or may not exist, and no UPS are required. Due to the limited cabinet size with respect to UPS capacity, the use of 336 controller cabinets must be approved for use by Traffic Engineering.
  - Post mounted controllers may still be used in areas susceptible to flooding, restrictive spaces, or replacements, as determined by the Construction Engineer.

All new controllers will be equipped with:

  - Emergency Generator Adaptors
  - Uninterrupted Power System (UPS battery backup) on all signals where a 332 or 333 type cabinet is being installed.
  - Emergency Preemption / Transit Signal Prioritization (TSP) Detectors
  - Fiber Optic Patch Panel (also include all necessary cabling where fiber optic connections are planned with the installation of the new controller).
  - ATMS (Advanced Traffic Management Software) which is known as Kimley-Horn Integrated Transportation System (KITS). These services are to be provided by Kimley-Horn and Associates, Inc.
- Placement of a base mounted controller:
  - Install within right-of-way lines.
  - Preferred three (3) foot setback from curb line.
  - Ensure placement does not conflict with any underground utility lines.
  - Ensure placement does not obstruct pedestrian pathway.
  - Ensure placement is not in a vulnerable location. May consider installing by the building line. If a street is one-way, the least vulnerable position is nearside.
  - Placement should allow safe maintenance access with visibility of signals.

- If corridor is shared with a county and proposed location is on the county side, approval must be obtained by the Township Engineer.
- Additional cabinet base extensions/skirts must be used in areas prone to flooding.

Signal Controller Cabinet Comparison Table

Cabinet Type	Size (H x W x D)	No. Load Switches	Double Door	Type of Mounting	Input Slots	No. Flashers	No. Ftrs	Cabinet Spec.	Rack Spec	Vehicle Phases	Pedestrian Phases
332	**66 24 30**	**12**	**Y**	**B**	**28**	**2**	**4/5**	**Caltrans**	**Caltrans**	**8**	**4**
333	**54 43 26**	**12**	**Y**	**B**	**28**	**2**	**4/5**	**Special**	**Caltrans**	**8**	**4**
336S	**46 24 22**	**12**	**Y**	**B, S, P**	**14**	**2**	**4/5**	**Special**	**Caltrans**	**8**	**4**

Notes:

- No. Load Switches: 6 additional switches possible for the 332, 333 and 336S cabinets by adding Model 420 Auxiliary Output File – *Each phase requires a separate load switch.*
- Type of Mounting: B = Base, S = Side or Back of Pole Mounting, P = Pedestal Mounting

Each Input Slot will accommodate one (1) 2-channel input device.

6.11 Actuation

A. General

- Through movements on interconnected corridors are usually not actuated.
- The actuation of a cross street should be considered when the peak volume is less than 60 vehicles per hour, pedestrians require a special phase, or there is a driveway.
- Actuate protected left turn phases unless a steady, high volume renders actuation ineffective.
- If a street is actuated, detection of bicycles is highly desirable.
- Several types of detection systems are currently being used and evaluated.
- The short wire loop will be used only as directed by Traffic Engineering. The long wire loop is no longer being utilized for new construction because bicycles are not effectively detected under this configuration. The systems currently being utilized are listed below.

B. Video (Overhead) Detection

- Video detection is the preferred method of detection.
- Install cameras and controller hardware per manufacturers' specifications.
- Use video detection systems that require the use of the fewest number of cameras at each intersection.
- The use of single, whole intersection video detection and traffic monitoring systems is the preferred method of detection for signals with more than 2 zones of detection, or as existing traffic conditions may warrant. Such systems typically use fish eye (horizon to horizon) lenses, and include real time traffic counting, monitoring, management, and reporting capabilities, as listed in the technical specifications.

C. Short Wire Loop

- Install loop sensor wire three inches (3") below the top of the roadway surface. Depth must be indicated on plan detail.
- Configuration:
  - See Standard Details.
  - Consists of (3) modified 6 x 6 foot wire loops installed for each approach. Maintain a three (3) foot clearance from the edge of the travel lane and extend loop three (3) feet beyond the stop line. If the width of the travel lane is insufficient for this configuration, reduce the width of the loop accordingly.
  - Install a curbside junction box for each detector
  - Run one inch (1") conduit from the junction box to the edge of the roadway
  - Run loop sensor wire from the junction box to detection area and back to the junction box. The loop sensor wire runs through the one inch (1") conduit from the junction box to the edge of roadway
  - Run loop sensor wire through detection area 3 times to achieve adequate sensitivity

- Run lead- in cable from junction box to controller without splicing through three inch (3”) conduit. Can install the cable in the same conduit as signal cable
- Amplifier- Number of channels is based on number of detectors.

D. Microloop

- *The use of microloops is no longer favored by Traffic Engineering. The information contained below, therefore, is solely for maintenance purposes of existing microloops.*
- Installed 21-inches below roadway base. Depth must be indicated on plan detail
- Configuration:
  - Generally consists of (3) detectors for the approach, running perpendicular to the travel lane.
  - Detector lead-in cables run for each detector from the controller to a junction box. The lead-in cable can run in the same conduit as the service cable.
  - Each loop detector will require a junction box.
  - Three inch (3”) PVC conduit is run between junction boxes.
  - Three inch (3”) PVC from junction box is run to termination point in roadway.
  - The probes and carriers for all 3 detectors are quantified as a single item, 'Non-Invasive Microloop Detector Set'.

6.12 Pedestrian Push Buttons

- Pedestrian push buttons are only to be used where permitted on the approved traffic signal plans, and approved by the Chief Traffic Engineer.
- All push buttons must have a latching LED indication, per current PennDOT requirements.
- Conform to the PennDOT 6.0 ADA Guidelines document, with the following preferences, as they are currently permitted:
  - It is preferred to install all push buttons within 10 inches of the flat landing area of the ADA ramp.
  - Alternately, push buttons are permitted within 10 feet of the flat landing area of an ADA ramp, provided it is accessible.
  - Push buttons and push button signs must be oriented perpendicularly to the relevant crossing.
  - In all cases, the use of pedestrian push button pedestals is not permitted at any location without the approval of the Chief Traffic Engineer.

6.13 Emergency and Transit Pre-emption & Detection

- Emergency pre-emption and transit preemption will be installed standard wherever new traffic signal controllers are installed.
- Emergency actuation, such as at firehouses, will be evaluated on a case-by-case basis for all first responder facilities.
- Coordination with SEPTA regarding transit actuation/detection will be coordinated by Traffic Engineering or the Streets Design Unit.

6.14 Electrical Service Connection

- Use overhead PECO source if available; otherwise, use underground PECO source.
- Plans must include wood pole number or PECO manhole number.
- All service points must be approved by PECO during final design. A service tap application to PECO will be required.
- For City contracts
  - Overhead service connections can be made by Contractor, payable under the 'Aerial Electrical Service Connection' item.
  - Underground taps must be made by PECO, payable under 'Underground Electrical Service Connection' item (City Contracts). Also include a 'Utility Manhole Modification' item.
  - The cost for PECO services must be confirmed with PECO.
  - Multiple manhole modifications will be paid as a single manhole modification for both electrical connections (traffic signal and street lighting).
- If there is a street lighting luminaire installed on a traffic pole, the service is connected separately and paid separately.

7.0 Traffic Signal Programming

Traffic Engineering deviates from PennDOT Publication 149, choosing to conform, generally, with the more conservative criteria set forth in the MUTCD and ITE Traffic Engineering Manual for the content of this section.

7.1 Movement, Sequence, and Timing Chart

See City of Philadelphia Standard Details for typical layout.

A. Phasing

- All phases must conform to the following, regardless of coordinated street:
  - NB thru 2
  - SB thru 6
  - EB thru 4
  - WB thru 8
  - NB left 5
  - SB left 1
  - EB left 7
  - WB left 3
- Assign a phase number to an exclusive right turn phase.
- Minimum criteria for signalization of left turn movements are listed on Chapter 3 of Publication 149. If intersection meets minimum volume and conflict factor requirements for a left turn phase, evaluate capacity and crashes to determine need. Meeting minimum PennDOT requirements does not by itself justify the installation of the signal, as capacity analysis must not show a negative impact to overall level of service at the intersection.
- All phasing must work with the existing controller and hardware.

B. Timings

- **Cycle Length**
  - 60 seconds is the preferred cycle for best accommodation of pedestrians.
  - Cycle lengths of 90 seconds or 120 seconds can be used if needed to maintain mandatory minimums, or for use in progression along a corridor.
  - In order to achieve a progression, all intersections must have the same cycle length.
  - Cycle lengths for electromechanical controllers must be 60 seconds or 90 seconds.
- **Electromechanical Controllers**
  - Timings for electromechanical controllers are computed as a percentage of the total cycle length. Therefore, all intervals must be equal to a multiple of 0.01xCycle Length.
  - When writing electromechanical signal timings the following must be calculated for each interval: Total Time, Percentage, Pin Setting
  - Pin settings are calculated by adding the current and previous intervals for each interval.
  - All electromechanical controllers are limited to running one program all day, pre-timed.
- **Vehicular Clearance Intervals**
  - The City of Philadelphia uses the ITE formulas for yellow and all-red clearance intervals.
  - All Clearance Interval Calculations must be submitted to the City of Philadelphia Traffic Engineering on the 'City CCI' Excel sheet for review. A copy of the blank CCI worksheet will be made available upon request by the District Traffic Engineer.
  - For all electronic controllers, Y+AR must equal an integer. Calculate individual values to 2 decimal spaces. When choosing values, round up to 1 decimal space.
  - Separate calculations must be made for all phases (not movements)
    - **Yellow (Y) change interval** (Y=t+(1.47v)/(20+64.4g), where t=reaction time, g=percent grade on approach, and v=design speed
      - T=1.0s
      - Design Speed(v) in mph:
        - Use the posted speed plus 10 MPH unless the 85% speed is known. If known, use 85% speed rounded up to the next 5 MPH speed.
        - For left turn phases: Use speed limit.
        - For approaches to T-intersections: Use speed limit unless high speed turns are available due to geometry
      - Percent grade (g) to one decimal space. Use the actual approach slope using 100ft minimum distance. Do not use spot grades.

- In all cases the yellow should be at least 3 seconds long.
- **All-Red (AR) change interval** (AR=W+L/1.47v),
  - Practical Vehicle length(L) = 20ft
  - Clearance distance(W) in ft:
  - This is to be measured from the Stop bar to the end of farthest travel lane (bike lane or vehicular travel lane) in conflict with the following phase.
  - If a pedestrian crosswalk is more than 20 feet from the end of farthest lane and the phase is followed by that crosswalk's phase, the distance from the stop bar to the middle of the crosswalk should be used.
  - Design Speed (v) in mph: Use the posted speed limit for the All-Red calculation.
  - All-Red intervals should not be less than 1.8 seconds

- **Pedestrian Clearance Intervals (PCI)**
  - Calculated for phases without pedestrian signal heads
    - PCI = Minimum Green = 3s+(L/walking speed)
    - L = distance from curb to the far edge of the farthest travel lane of the following movement.
    - Walking speed = 3.5ft/s standard or 3.0ft/s at locations where high volumes of children or elderly are present. Confirm with Traffic Engineering what is appropriate before proceeding.
  - Calculated for signals with pedestrian signal heads
    - PCI = FH + Y + AR or FH = PCI – Y – AR
    - Flashing Hand, FH = L/walking speed
    - L = distance from curb to the far edge of the farthest travel lane of the following movement.
    - Walking speed = 3.5ft/s standard or 3.0ft/s at locations where high volumes of children or elderly are present. Confirm with Traffic Engineering what is appropriate before proceeding.
    - The minimum FH is 5s.
  - Additional Notes
    - For the purpose of calculating L, if parking is allowed and no edge line designated, assume the parking lane is 7 feet wide
- Minimum Green Times
  - For minimum green time for phases without pedestrian signal heads, see the previous section.
  - The standard minimum green time for phases with pedestrian signal heads = 7s (M)an+ FH. Values of 5s or 6s M can be used at the discretion of the reviewing engineer.
- Actuated Intersections
  - Minimum green time is 3 seconds. (if pedestrian phase does not exist or is actuated)
  - Passage (or extension) = 3 seconds.
  - Maximum = determined through capacity analysis.
  - For use in SYNCHRO corridor timing, assume all phases are called for maximum times.

C. Flashing Operation

- Yellow is typically flashed for the major street and red flashes for all other approaches.
- If volumes are equal or there is a high crash rate, both streets are to flash red.
- Arrows and man/hand signal heads may not flash. They must be turned off.

7.2 Signal Coordination and Progression

- Traffic control signals within 0.5 miles of one another along a major route should be coordinated; however, signal coordination need not be maintained across signal systems operating on different cycle lengths.
- A time-of-day chart is required for all electronic controllers, even if there is only one event. See Standard Details for typical layout.
- Use multiple programs only when the cross street demand exceeds the minimum time. Use multiple events in the time-of-day chart if progressions/offsets vary by time of day, not different programs.
- When there are multiple programs, the standard numerical assignments are as follows:
  - Program 1: off peak
  - Program 2: am peak
  - Program 3: pm peak
  - Program 4: special
- Offsets are generated by traffic software and/or time space diagrams if there is a progression along the corridor. Solid state controller operation requires offsets reference the beginning of the yellow interval. Electromechanical offsets (also known as R1) reference the end of the green interval of the coordinated phase, expressed as a percent of the cycle length. Offsets are to be listed on the plan and a note referencing the baseline should be included.
- If the corridor crosses any coordinated arterials, Traffic Engineering will provide the tie in point.
- Corridor may be split at critical locations or any intersections utilizing a different cycle length. Traffic Engineering will determine which intersections will split the progression.
- Design speed when modeling a corridor is to be determined based on the following:
  - If travel time speeds are collected in the field, use the speeds recorded on each segment.
  - Else, design speed shall be equal to the speed limit unless directed otherwise by Traffic Engineering

8.0 Interconnection Design

8.1 Types

- Fiber Optic Cable is currently used on all new traffic signal design projects, involving signal corridor, or in proximity to a fiber optic corridor. See Fiber Network Section.
- 120 V Cable is 14 gauge copper wire. Currently existing on most coordinated corridors.
- Twisted Pair Communication Cable-20 gauge copper wire. Very few corridors have this cable.

8.2 Location

- The order of preferred location is as follows:
  - Overhead on a utility pole.
  - Underground, in proposed City conduit.
  - Underground, in Verizon duct. Other utilities may be considered but they must be evaluated and approved for specific usage.
  - In certain cases (i.e. very short runs), we can examine the possibility of erecting D-poles for interconnect.
- The location will have a significant impact on the scope of work; therefore it should be determined prior to the execution of a design contract.

8.3 Fiber Network

A. Fiber Optic Cable

- The interconnect will consist of 12 or 48 single-mode fibers running between local controllers and a variable number of single-mode fibers running between termination cabinets (backbone).
- The fiber count for the backbone is outlined on the Communications System Master Plan. The exact fiber count for the self-healing rings must be provided by Traffic Engineering.
- An existing post mounted controller can only accommodate the connection of 6 fibers in and out. See specifications for base mounted controllers.
- Fiber optic cable is not to be spliced.
- Fiber optic cable may only be connected to a solid state controller.
- Electromechanical controllers will require the installation of copper interconnect cable.

B. Installation

- General
  - Removal of existing interconnect cable is required, and is to be considered incidental to the installation of all new interconnect cable in all City contracts.
  - All aerial fiber optic interconnect cable must be installed and connected to the traffic signal controller through either a mast arm, or D-Pole. The installation of City of Philadelphia conduit to wood poles is prohibited.

- All new fiber will be labeled at every wood pole, manhole, junction box, and other fixed asset.
- For the 12-fiber interconnect, spool the greater of 30-feet or five percent (5%) of the run on a pole or in a junction box closest to controller. If proposed spool is greater than 30-feet, indicate the length on the plan. Do not spool on mast arm.
- For the backbone, spool according to the following guidelines:
  - Fiber will be spooled at each termination point.
  - Distance between spools will not exceed 1000-feet. If the distance between termination cabinets is greater than 1000 feet, spool at additional locations.
  - The minimum spool at each location is 30-feet.
  - The total amount of fiber spooled must exceed five percent (5%) of the total run. If necessary, install additional lengths of fiber at the middle locations to achieve 5%. Do not spool more than 50-feet at termination points.
  - If quantity is greater than 30-feet, show the length on the plan.
  - The interconnect and controllers should be installed on the same side of the street, whenever possible.
  - If installing conduit for intersection connections (i.e. from a manhole or utility pole to a junction box/controller) only, use 3" PVC conduit.
  - The interconnect should run from mast arm pole/utility pole/ manhole/ City conduit to a junction box, to the local controller, back to the junction box and mast arm pole/utility pole/ manhole/ City conduit. NEVER run fiber interconnect in the same conduit as service or signal cable.
  - See Standard Details for connection details when fiber is terminated.
  - Interconnect must be labeled at every pole, junction box, and manhole as per the regulations of the Public Utilities Commission (PUC).

- Overhead
  - The maximum spacing of poles should match PECO standard (approximately 75-feet). If spacing exceeds 125-feet, consider the installation of an additional D-pole.
  - Minimum pole mounting height is 21-feet.
  - Cable must be mounted at a minimum of 18-feet at the maximum sag point across intersections and driveways.
  - Interconnect should run from the wood pole to the mast arm and down the mast arm pole to junction box, whenever possible. See Standard Details.
    - If and where directed by Traffic Engineering, where fiber must be run up a wood pole, include three (3) inch steel conduit, extending one (1) foot above the sidewalk, with a PVC shield 19 feet above the top of conduit. See Standard Details.

- Messenger wire is to be called out as incidental to interconnect item on City contracts.
- Sag is specified by the cable manufacturer and mounting height is established by the pole owner at the time of construction.
- Interconnect will be installed in four (4) inch steel conduit from the pole to the junction box to the controller.
- Use self-supporting dielectric cable & hardware for installations on SEPTA poles. Install Figure 8 cable in all other cases unless otherwise directed by the Traffic Engineering.

- Underground, Verizon
  - Verizon will prove their ducts and install pull wire and any necessary innerduct during the design phase. This will be incorporated in to the Consultant contract for City contracts. If the City is designing the project, alternative methods of payment will have to be investigated.
  - If Verizon assigns a multi-pack, innerduct is not required.
  - When not included in the same cable (i.e. 48-strand cable), the backbone fiber and 12-fiber interconnect can run in the same innerduct. The size of the innerduct will be determined by the size of the cable.
  - Interconnect will be looped in junction boxes, not in the Verizon manholes.
  - For City contracts, each Verizon manhole will require modification, paid under Utility Manhole Modification.
  - A Verizon representative must be present whenever a manhole is being opened and (for City contracts) paid under Third Party Services, Verizon.
  - Include duct assignments on plan.
- Underground, City Conduit
  - *This section does not apply to runs from a pole or manhole to a controller.*
  - Run fiber conduit in roadway whenever possible to decrease construction costs. Junction boxes will still be located in the footway.
  - There will be two (2) four-inch (4") steel conduits installed in a trench on top of each other. The lower conduit is a spare and the upper conduit will contain the backbone and local fiber interconnect. A multi-compartment, flexible, fabric innerduct will be installed in the occupied conduit.
  - Ensure that specified conduit size can accommodate cables designated for installation.
  - If street lighting conduit is also being installed under the project, install two inch (2") PVC conduit in the same trench on top of the Traffic Engineering conduit.
  - Always include detectable identification tape in the conduit trench, as included in the specifications.

C. Network Connection

- Direct Connection
  - The fiber network is being restructured to incorporate direct connections to a central system. Each corridor will be connected to one

of several designated corridors in accordance with the Philadelphia Streets Department fiber network. If a direct connection is not plausible, use one of alternative methods listed below.

- Building Connection
    - The preference is to run fiber to any Streets Department facility connected to CityNet. If this is not feasible, run fiber to any police station, fire station, or other City facility connected to CityNet.
    - The interconnect will run directly from the junction box or manhole through the building to a communications server. No termination cabinet is required.
    - If the communications server is more than 50-feet from the exterior wall, the outdoor cable must be spliced with an indoor cable through a splice box. The indoor cable will run to the communications server.
    - The City will complete the connection between the communications server and the CityNet system.
- Telephone Drop
    - Telephone drops are no longer used in the City of Philadelphia.

D. Connection Across A Bridge

- If the corridor runs over a bridge, the preferred method remains (1) overhead and (2) in Verizon or other utility duct.
- There may be available ducts in or under the bridge. Permission to utilize a duct must be granted by the utility and/or bridge owner.
- If poles or duct are unavailable, conduit can be attached to the underside of the bridge, with approval of the bridge owner. A cost analysis must be performed before making a determination on this option.

E. Junction Boxes

- Junction boxes should be located in the footway, if possible. Any boxes installed in the roadway must be steel.
- The standard junction box used for interconnect is the 39" circular composite box, 24" deep. Space constraints may mandate the use of a smaller box.
- Minimize the use of junction boxes by sharing with those for a pole or controller, whenever possible.
- Install circular junction boxes in the following instances:
    - When City conduit is being installed, a circular junction box will be installed next to the traffic signal controller at every signalized intersection.
    - If fiber loop is required and the interconnect is in City conduit or a Verizon manhole.
- If the run exceeds 500-feet, install a rectangular composite junction box as a pull box. Do not loop fiber in these boxes.

F. Termination Cabinet

- Termination cabinets will be installed in all intersections crossing arterials.
- If either project limit is in the middle of a corridor, an additional cabinet will be installed towards the limit for a future connection.

- If the distance between termination cabinets exceeds two (2) miles, consider installing an additional cabinet.
- Install an outdoor rated splice enclosure at the nearest PECO wood pole when transitioning between overhead and underground fiber. If transition occurs mid-block, evaluate the cost of running the overhead fiber underground to the nearest intersection versus the installation of a mid-block termination cabinet. The installation of a termination cabinet for transitions may not be necessary if only 12-fiber cable is being installed.
- The installation of a termination cabinet is in addition to a local controller. Combine the cabinet with the controller whenever possible.
- When locating the termination cabinet, consider vulnerability of position, amount of available space for technician to work, pedestrian path, existing utilities, and City right-of-way.
- Termination cabinet will be powered by electrical service wire running from the local controller. There will be only one power tap per intersection.

8.4 Reconnection of Existing Interconnect

A. General

- The reconnection of existing interconnect is incidental to the controller item.
- If the controller is being relocated, the interconnect must be replaced to nearest controller.

B. 120 Volt

- If run underground, use three inch (3") PVC conduit.
- Cable can run in the same conduit as signal cable, if necessary. Separate conduit is desirable.
- The interconnect should run from the local controller or termination cabinet to the junction box to the controller at an adjacent intersection.
- See the technical specifications for how to add a solid state controller to an existing 120 volt copper interconnect.

C. Twisted Pair

- If run underground, use three inch (3") PVC conduit.
- Cable can run in the same conduit as signal cable, if necessary.
- The interconnect should run from the adjacent intersection to the junction box to the local controller or termination cabinet.

D. Fiber

- Run new fiber from the adjacent intersection to the junction box to the local controller/termination cabinet.
- Fiber can only be connected to solid state controllers.

9.0 School Flashers

- Traffic Engineering is the authorized agency regarding the approval and permitting of all school flashers.
- Incorporate school flashers on federal projects for all schools which currently do not have them.
- Traffic Engineering will provide design for Streets' Design Unit or consultant to incorporate into project.
- Use of PennDOT 7800 series poles and foundations is approved for use on mast-arm mounted school flashers.

10.0 Traffic Calming

- Refer to PennDOT Publication 383 and the Complete Streets Manual.

10.1 Project Ranking System

Guidance regarding traffic calming associated with pavement markings is provided separately.

CRITERIA	POINTS	BASIS FOR POINT ASSIGNMENT
Speed	0 – 30	Extent by which 85th percentile speeds exceed posted speed limit; 2 points assigned for every 1 mph
Volume	0 – 20	Average daily traffic volumes (1 point assigned for every 120 vehicles)
Crashes	0 – 10	1 point for every crash reported within past 3 years
Elementary or Middle Schools	0 – 10	5 points assigned for each designated school crossing guard location on the block
Pedestrians Generators	0 – 15	5 points assigned for each public facility like parks, rec centers, playfield, high schools, business, strip mall, etc. generating a significant number of pedestrians, abutting the block
Pedestrian Access	0 – 5	5 points assigned if there is no continuous sidewalk on either side of the street
High Injury Network (Vision Zero)	0 – 10	10 points assigned if the block falls within High Injury Network (HIN) as developed under Mayor's Vision Zero initiative

Snow emergency routes in many cases also serve as the City's emergency evacuation routes. Some traffic calming measures on a snow emergency route may be discouraged for third-party development projects, but encouraged for corridor-wide capital improvement projects. Similarly, most traffic calming measures cannot be considered on arterial highways and State Routes.

10.2 Approved Traffic Calming Measures

The following measures are currently approved for use on City Streets. All proposed traffic calming measures are subject to approval of Traffic Engineering, as coordinated by the Right of Way Unit. See also the Right of Way Improvement Standards for additional information.

Measures Currently Approved for Use

Traffic Calming Measure	*Pub. 383 Page No.*	*Complete Streets Section*	*Approval via*
Curb Extensions (Bump-outs/Bulb-outs)	*26*	*4.9.4*	*City Plan Action*
On-Street Parking (Lanes)	*33*	*4.7.3*	*Ordinance of City Council (typical)*
Raised Speed Reducers (Speed Humps, Speed Cushions/Speed Pillows, Raised Intersections)	*38, 48, 50*	*4.7.2*	*Traffic Engineering*
Raised Crossings/Crosswalks	*68*	*4.9.11*	*Traffic Engineering*
Raised Medians/Pedestrian Refuges	*71*	*4.7.3, 4.9.5*	*Right of Way Unit*
Signs & Pavement Markings	*75*	*References MUTCD*	*Traffic Engineering*
Gateways (not a stand-alone treatment)	*32*	*No specific section*	*Variable*

10.3 Traffic Circles and Roundabouts

- Traffic circles and roundabouts are considered by Traffic Engineering to be traffic controls, and not traffic calming. Their implementation is subject to the approval of Traffic Engineering, which can be coordinated as part of the City Plan Action necessary to complete the curb line changes as well as any Right of Way dedications.
- Prepare roadway and signing & pavement marking plans in accordance with PennDOT and Streets Department standards.
- Refer to PennDOT standards regarding these traffic controls.

11.0 Signage

These standards will apply to all signs for which the Department of Streets is responsible to install and maintain.

11.1 General

- See Appendix A for guidelines on signs commonly used. Use symbols listed in Appendix A for sign designations on all plans.
- Refer to the MUTCD, latest version, and/ or PennDOT Publication 236M. All parking and street name signs are special, as noted in Appendix A.
- Any sign pertaining to the intersection design must be included on the signal plan. This includes regulatory and street name signs. All other signs, such as parking, bike lane, center lane left, or speed limit signs, must be shown on a separate pavement marking and signing plan.
- Ensure that speed limit and school signs are included in the scope of work for traffic signalization projects.
- Overhead sign heights & widths are to be 6-inches larger than post-mounted signs.
- Retroreflectivity
  - The Traffic Engineering Division replaces all existing signs with retroreflective signs conforming to current MUTCD and PennDOT requirements.
  - All new signs will conform to current PennDOT retroreflectivity requirements, regardless of sign type, or entity responsible for replacement.
- Mounting Height
  - The minimum installed height for all street signs will be 8-feet (measured from finished grade/sidewalk to bottom of sign), unless otherwise approved by the District Traffic Engineer.
  - Guidance: The 7-foot minimum height established within the MUTCD, Section 2A.18 (Mounting Height) does not generally provide signs sufficient protection from vandalism, and are often blocked by parked cars. Riders/plaques may be below the 8-foot standard, but must be above 7-feet.
- Utilize existing posts for sign placement whenever possible, including utility poles.
- New sign posts will conform to current MUTCD and PennDOT breakaway standards. See the Standard Details for the current City standard.
- Whenever possible, combine signs and plaques/rider assemblies onto a single sign blank.
- Removal and Replacement of Street Signs by Contractors
  - Any project involving the temporary removal of any signs will receive written approval from the District Traffic Engineer prior to removal. Projects subject to plan review approval will not be considered an acceptable alternative to written approval for sign removal by the District Traffic Engineer.
  - Any sign or sign post not to be replaced will either be returned to the Traffic Engineering Division, or recycled; as directed by the District Traffic Engineer.

- Signs and sign posts that are to be replaced will be replaced with signs and posts meeting all applicable standards.
- An inventory of all existing signs and the plans for their removal/protection/replacement/etc will be included on any construction documents prepared for the project and subject to approval by the Department of Streets.

11.2 Street Name Signs

A. Metro Street Name Signs

- Street name signs must be in accordance with Standard Details SN0101 and SN0102.
- Sign details for all faces, specific to intersection, must be shown on the plan.
- All street name signs and designators (i.e. St, Rd, Dr, etc) must be confirmed from the City Plan.
- Hundred block numbers are to be shown for all approaches on all Metro street name signs, even when no property fronts the segment.
- Cut sheets and street name sign layouts must be submitted to the Traffic Engineering Construction Engineer for approval prior to fabrication. See specifications for current contact information.
- Direction:

  The following can be used as a rough guide in determining the direction of a street:

  - These corridors are considered North-South, and any street crossing them most likely runs East-West:
    - Roosevelt Boulevard (Northeast of Tacony Creek)
    - Broad Street
    - Ridge Avenue
    - Germantown Avenue
  - All corridors with a numbered or lettered street name and 'Street' designation are considered N/S and anything crossing most likely runs East-West.
  - All corridors with a numbered street name and 'Avenue' designation are considered East-West.
- Street Name Cardinal Direction Designation:
  - Include the 100 block in all applicable directions on one or two sides of the cardinal direction designation.
  - The 'N,S,E,W', or vertical line, designation should be on all metro street name signs based on the direction in which they are addressed. The following corridors designate the boundaries street name designations:
    - North-South:
      - Market Street. Any street North of Market receives an 'N' designation and any street South of Market receives and 'S' designation.
    - East-West:
      - Front Street. Any street East of Front receives an 'E' designation and any street West of Front receives and 'W' designation.

    - Germantown Avenue (North of Windrim Avenue)
    - There are additional minor baselines throughout the City.
  - Vertical Lines (i.e. “1000 | 1100”) that are located:
    - On all East-West streets
      - North of the Wissahickon Creek
      - North of the Tacony/Frankford Creek
    - On all streets running diagonally where the N, S, E, W designations may be confusing.
    - On boundary streets separating the N-S, E-W designations noted above (i.e. Market, Front, Germantown)
- Riders:
    - One Way: One-way streets must receive the 'one way' rider, regardless of the direction of the street. The use of one-way riders supersedes all other riders.
    - Highway Designations: State and US Routes must be placed as riders on all metro signs. Use appropriate directional arrows and “To” as required.
    - Arterials & Park Roads: All arterial streets and Park Roads will receive the 'arterial' or ‘park road’ rider, unless there is a highway or one-way designation.
    - Cautionary riders are used for informational purposes (ex. No Outlet, Loop Street, etc).
    - Dedication (“AKA”) riders: Authorization is required for new AKA riders.
    - Dimensions and colors of all signs and riders can be found in the specifications.
    - Two-Street Name Riders: For use where a street changes names. Use arrows as needed to convey location of each street.
- Placement
    - Install back to back metro street name signs at appropriate locations.
    - Street name signs are installed for the minor street at every intersection.
    - Street name signs are installed for major streets, if the hundred block changes, for all streets at a signal or an all-way stop, and at the end of a corridor.
    - When placing a street name sign, visibility is the most important factor in determining location. Beyond visibility, vulnerability and pole availability are considered. Preferences are as follows:
      - Install street name signs diagonally across from each other.
      - Install street name signs far- side.
      - Install street name signs on the mast arm poles, D-poles, or other poles with foundations.
      - Install 2 sign assemblies, if viable.
      - If there are mast-arms on all comers, place for visibility.
      - If mast arms are being installed on select comers (C-posts on all others), install 4-sign assemblies on the mast arms.

        - If new street name sign poles are required, install 4 sign assemblies.
      - Use existing poles which will accommodate signs whenever possible.
- Number of Signs
    - Two 4-sign assemblies at all signalized intersections.
    - At least one 4-sign assembly at intersections controlled by an all-way stop.
    - Two 2-sign assemblies at all intersections where the main street is *40 feet or wider*.
    - One 4-sign assembly at all intersections where a change in hundred block occurs on the street which is not stopped.
    - One 2-sign assembly, for the minor street, at intersections which do not meet any of the criteria listed above.
- The use of the Liberty Bell symbol will be as directed in the Standard Details.

B. Overhead Street Name Signs

- Overhead street name signs are to conform to the MUTCD and PennDOT Pub 236 standards. See Standard Details for overhead street name sign sizes.
- Signs are double-sided when mounted below the mast arm, and single sided when mounted to the mast arm.
- The installation of overhead street name signs does not affect the placement of metro street name signs.
- Install signs between the right signal head and the curb line.
- Include cardinal direction designations, and hundred blocks, per the standards for Metro street name signs.

C. Other Owners (Private Roads/Driveways)

A. Street name signs for private streets and driveways are designated by green lettering on white background.
B. If a corridor is shared with another county, the type of street name signs installed on the county side must be coordinated with the Township Engineer.

11.3 Regulatory & Parking Signs

See Appendix A for detailed guidance by sign type.

12.0 Pavement Markings

Updates to Traffic Engineering's Pavement Markings Guidelines is in development, with an anticipated release date in early 2019.

12.1 Plan Presentation & Coordination

- All pavement markings relevant to the intersection (lane lines, transition, etc.) must be shown on the traffic signal plan.
- If there is a separate pavement marking plan in the project, the markings reflected on the signal plan must be consistent with those on the pavement marking plan. Where discrepancies between the traffic signal and pavement marking plan exist, the pavement marking plan will be used.

12.2 Line Striping

A. Material

- Thermoplastic pavement markings are required on all asphalt roadways.
- Contrast thermoplastic are to be used for long lines on concrete roadways.
- All other line striping materials are subject to approval of the Chief Highway Engineer.

B. Long Line Striping Preferences

- White: Six inch (6") on all arterial roadways, including the following road types: Urban Arterial, Civic Ceremonial, Auto Oriented Commercial/Industrial, Walkable Commercial Corridors, and High Volume Pedestrian. All State Routes.
- Four inch (4") white on local and collector roadways, including all road types not listed above.
- Yellow:
  - 4" on all local and collector streets.
  - 6" single yellow on arterials and selected roadways.
  - *A study is underway to evaluate the use of 6" double yellow line striping on all State Routes, subject to approval by PennDOT on or after 2020.*
- If vehicular traffic is permitted in two directions, install (2) 4" yellow lines, spaced one (1) foot apart (double yellow) dividing directional traffic flow as follows:
  Streets with lanes 11-feet wide or less and that function as collectors or arterials require striping of the full block(s), unless otherwise determined by Traffic Engineering.
  Install double yellow around curves.
- White edge striping is required on:
  - Uncurbed roadways, and to delineate parking lanes, on roadways 34 feet or wider.
  - Bumpouts, and medians/ islands (right side of travel lane)
- Yellow edge striping is required on:
  - Center medians/islands (left side of travel lane).
- Parking "X" boxes, where installed, will delineate a twenty to thirty foot (20'-30') long no-parking zone. Using lateral white pavement markings, matching the width of the parking lane stripe.

C. Crosswalks and Stop Bars

- Crosswalks and stop bars to conform to Standard Detail PM0101 (Typical Intersection Pavement Marking Detail)
  - Stop bar at stop control shall be at 4 feet from the edge of crosswalk.
  - Stop bar at a traffic signal control shall be at 12 feet from the edge of the crosswalk.
- Decorative crosswalks are not maintained by the Streets Department, and require a maintenance agreement with the party responsible for maintenance. All such crosswalks will be contained within two (2) six inch wide (6") white thermoplastic crosswalk stripes, as required by MUTCD and PennDOT standards.
  - Guidance regarding decorative crosswalks can be found in PennDOT Publication 447 - New Product Evaluation for Low Volume Local Roads.

D. Stenciled Lettering and Symbols

- When options exist, preference will be given to symbols and lettering for which Highway crews have existing stencils/templates (i.e. wherever possible, match pavement markings to use symbols, lettering, etc, currently is use throughout the City).

12.3 Lane Widths

Travel Lanes: Residential streets: 10 feet (Preferred)

Streets with Bus Route: 11 feet (Minimum)

Major Arterial Streets with heavy truck traffic: 12 Feet (Minimum)

Bike Lane: 5-6 feet (Standard)

13.0 Parking and Traffic Flow Restrictions

- Changes to parking include installation, removal, or restriction of parking.
- Any substantial change to existing parking, as determined by the District Traffic Engineer or direction of traffic flow requires an ordinance and must be coordinated with City Council. The request to City Council should be submitted by Traffic Engineering. Streets' Design Unit will handle coordination with the Philadelphia Parking Authority, and SEPTA for City-contracted signal and reconstruction projects. Traffic Engineering will handle all coordination for resurfacing projects.
- If it is a new street, any restriction on parking or traffic flow requires an ordinance.

14.0 Maintenance & Protection of Traffic (MPT) *(aka Temporary Traffic Control, TTC)*

- MPT will be accordance with PennDOT Publication 213.
- If possible for City Contracts, address MPT through specification and avoid a plan. City Contractors, and all other permit applicants, will be required to submit MPT plans at the time a Street Closure Permit Application is submitted to the Right of Way Unit.
- Temporary signals and/or temporary signal plans are not necessary unless otherwise directed by either Traffic Engineering, or the Right of Way Unit. In all cases, approval of the Chief Traffic Engineer is required.
- Work hour restrictions are provided by the Right of Way Unit.
- The contractor's ownership obligation must be stated for each project. For example, the specification must state if the Contractor will assume ownership at the start of construction for the entire project or at the start of construction for the intersection.

15.0 Street Lighting

This section applies only to street lighting, as it applies to Traffic operations.

- If there is a street light pole within approximately 50-feet to a new traffic signal pole, evaluate the removal of this pole and the installation of the bracket and luminaire on a mast arm or D-pole.
- When a bracket and luminaire are installed on a mast arm or D-pole, the following apply for the service tap:
  - The luminaire and traffic signal are powered separately.
  - Street lighting service wire is installed in 2" PVC conduit. Conduit will not be shared with traffic signal service cable.
  - Street lighting service wire will not run overhead from a wood pole to a mast arm; even if the signal cable is running overhead.
  - If service is running from a wood pole, the service wire will run down the wood pole and underground to the base of the mast arm or D-pole.
  - See Standard Details.
- For appropriate bracket lengths and luminaires, see Standard Details.
- Avoid/Reduce Clutter
  - Remove nearby street light poles, and place street light onto mast arm.
  - Reduce the number of sign posts, existing street trees that impact signal function, and any other street furniture that impacts sight visibility or safe travel through the intersection. Coordinate with affected stakeholders as required.

16.0 Driveways

The material composition of driveways is addressed within the Right of Way Improvement Standards.

16.1 Acceptable Driveway Locations (All Intersections, as measured from the stop bar):

- 150 feet from the approach to a traffic signal
- 60 feet from the approach to a stop controlled or uncontrolled intersections
- 60 feet from the exit (downstream corner) of any intersection
- Submission for a new driveway located on an arterial street shall accompany sight distance triangle for all approaches. It shall be prepared in accordance with current PennDOT Form M-950S, Driveway Sight Distance Measurements.

16.2 Additional Requirements

- The Streets Department is not obligated to approve the location of any existing cuts at any site subject to redevelopment or change of ownership.
- Existing curb cuts may also be removed for future development at the direction of the Streets Department Traffic Engineering Unit.
- All commercial driveways shall be approved by the Streets Department Traffic Engineering Unit.
- Streets Department Right-of-Way Unit will stamp all approved curb cuts prior to zoning approval, in accordance with the Zoning Code.

Appendix A

Traffic Sign Guidelines

Legend	Series	Standard Size (Inches))	Symbol	Placement / Comments	Publication
Begin One Way	R6-6	24x30	BO	Just after intersection at which one-way condition begins, on the right side	PennDOT Pub 236
Begin Right Turn, Yield to Bikes	R4-4	36 x 30	BY	Place at the transition Use only for exclusive right turn lanes crossing an exclusive bike lane. Not for shared bike/right turn lanes.	PennDOT Pub 236 MUTCD
Bike Lane Ahead	R3-17 R3-17AP	24 x 30 (Combined Sign & Plaque)	BA	Place in advance of the intersection at which the bike lane begins	MUTCD
Bike Lane	R3-17	30 x 24	BL	Place at periodic intervals along a designated bike lane that is also marked out with appropriate pavement marking symbols.	PennDOT Pub 236
Bike Lane Ends	R3-17 R3-17BP	24 x 30 (Combined Sign & Plaque)	BE	Place in advance of the intersection at which the bike lane ends Use only when a bike lane drops permanently from a corridor. Not to be used when a bike lane drops at an intersection (i.e. to accommodate a turn lane), and picks up again	MUTCD
Bicycle Lane Shifts	Special See Standard Detail SN0203	24 x 30	BS	Place in advance of the transition Use only for drastic, unexpected shifts in a bike lane. Do not install for standard transitions resulting from the introduction of an exclusive right turn lane.	N/A
Bikes May Use Full Lane	R4-11	30 x 30	BM	Place along roadways (without bike lanes) where bicycles are present, and no shoulder is available.	PennDOT Pub 236
Caution: Trolley Tracks (For Bikes)	Special See Standard Detail SN0203	30 x 30	BT	Place in advance of trolley tracks crossing a bike lane Only install when the intersection of bike lane and track is less than 80 degrees	N/A
Center Lane Left Turn Only	R3-9B	24 x 36	CL	Mid-block, every block; at a minimum replace existing signs	PennDOT Pub 236

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
Do Not Enter	R5-1	30 x 30 (post mounted) 36 x 36 (overhead)	D	Post mounted – Place right side of approaching motorist; may install a 2nd sign on the left side in conditions warrant. Overhead mounted – Place one overhead, and one post mounted on the right side of approach Use when street is changing direction from 2-way to 1-way, when there is a street one way into a complicated intersection, or when it is physically possible to enter a one-way pork chop island the wrong way. Do not use to denote the one way traffic operation of a street.	PennDOT Pub 236
Educational Sign – Push Button for Walking Person Signal	R10-3E	9 x 15	QP	This sign is being phased out, and should be replaced in R10-3. See "Push Button for Walking Person" R10-3 for guidance.	MUTCD
Educational Sign – Walking Person Signal	R10-3E (Mod)	9 x 12	QC	Place parallel to crossing, on pole closest to the crossing Use at non-actuated crossings controlled by hand-man signals. Sign is modified to eliminate "Push Button to Cross" and corresponding Arrow.	PennDOT Pub 236
End One Way	R6-7	24 x 30	EO	On the left and right side, between the 'two way traffic ahead' sign and the intersection at which traffic pattern changes	PennDOT Pub 236
End School Zone	S5-2	24 x 30	SZ	Place at the end of reduced speed zone, see 'School Sped Limit' criteria May use 'School Speed Limit' sign in lieu of 'End School Zone'. Use both for High Schools.	MUTCD PennDOT Pub 236
Object (Hazard) Marker	OM1-3 (formerly W16-1D)	18 x 18	HM	Place at beginning of median, island or bridge pier. Note: this is a blank yellow sign.	PennDOT Pub 236
Keep Left	R4-8	24 x 30	KL	See 'Keep Right' criteria	PennDOT Pub 236 MUTCD

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
Keep Right	R4-7	24 x 30	KR	Place in advance of obstacle (i.e. median or column) If sign is being installed on a median and there is no significant transition in the vehicular path, use 'Hazard marker' sign instead	PennDOT Pub 236 MUTCD
Lane Use Control	R3-8 series (varies)	Varies See PennDOT Pub 236	O	Place on pole nearest to the beginning of the queue line Used when an intersection approach has multiple turn lanes. If overhead turn signs are being installed, do not use this sign.	PennDOT Pub 236
Left Turn Only	R3-5L	30 x 36	AF	Overhead, place 80-200 feet in advance of stop bar If any, one of the thru lanes is becoming an exclusive only lane, install an overhead turn sign for each lane. Otherwise, this sign is optional	PennDOT Pub 236
Left Lane Must Turn Left	R3-7LA R3-7L	R3-7A: 24 x 48 R3-7L: 30 x 30	M	On pole nearest the beginning of the queue line Use R3-7A if space permits, otherwise R3-7L	PennDOT Pub 236
Left Turn Signal	R10-10L	Post: 24 x 30 Overhead: 30 x 36	P, OP	Place one (1) sign per head, adjacent to appropriate head Use when exclusive 3 section signal is present. Post mounted signs not addressed in Pub 236.	PennDOT Pub 236
Left Turn Yield on Green	R10-12 (Mod)	Post: 24 x 30 Overhead: 30 x 36	V,OV	Use adjacent to all 4 & 5 section signal heads with left turn arrows. Use this version on all projects, *unless* required by PennDOT. *Sign modification omits the green ball.* Post mounted signs not addressed in Pub 236.	PennDOT Pub 236 MUTCD
Left Turn Yield on Green	R10-12	Overhead: 30 x 36	VP	Use in place of R10-12(Mod) on all projects, *where required* by PennDOT.	PennDOT Pub 236 MUTCD
All Way Stop Plaque	R1-3P	18 x 6	AW	Place below stop sign, at multiway stop intersections. Only use 'All Way' do not use '3-Way' or '4-Way'	PennDOT Pub 236 MUTCD

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
No Left Turn	R3-2	Post: 24 x 24 Overhead: 30 x 30 Posted Speed 40mph or greater: 36 x 36	H, OH	Post mounted signals – nearside right and far left side Overhead signals – overhead near left hand signal head and far side left. Do not place in combination with overhead one way signs. Divided highway – near side and far side on median if median width is greater than 4-feet. If overhead signals are present, install on nearside median, overhead and nearside right corner.	PennDOT Pub 236
No Parking Any Time Double Arrow	Special See Standard Detail SN0204	12 x 18	PC	Placement depends on existing poles; as a rough guide, signs should be mid-block and 100 to 200 feet apart	N/A
No Parking Left Arrow	Special See Standard Detail SN0204	12 x 18	PA	Place at limit of no parking zone. These signs are not installed for standard corner clearance.	N/A
No Parking Right Arrow	Special See Standard Detail SN0204	12 x 18	PB	Place at limit of no parking zone. These signs are not installed for standard corner clearance.	N/A
No Pedestrian Crossing	R9-3	Standard: 18 x 18 Streets 50+ feet wide: 24 x 24	Q	Place on the far side of roadway or on median, clearly in the pedestrian line of sight	PennDOT Pub 236 MUTCD
No Right Turn	R3-1	Post: 24 x 24 Overhead: 30 x 30 Posted Speed 40mph or greater: 36 x 36	G, OG	Post mounted signals – nearside right. Overhead signals – overhead near right hand signal head. Do not place in combination with overhead one way signs. Only one is required, but may post two if conditions warrant. Do not use where it is redundant with a one way sign	PennDOT Pub 236

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
No Stopping Bus Zone Double Arrow	Special See Standard Detail SN0204	12 x 18	PU	Limit of no stopping zone	N/A
No Stopping Bus Zone Left Arrow	Special See Standard Detail SN0204	12 x 18	PT	Limit of no stopping zone	N/A
No Stopping Bus Zone Right Arrow	Special See Standard Detail SN0204	12 x 18	PS	Limit of no stopping zone	N/A
No Stopping Double Arrow	Special See Standard Detail SN0204	12 x 18	PF	See 'No Parking – Double Arrow' criteria	N/A
No Stopping Left Arrow	Special See Standard Detail SN0204	12 x 18	PD	Limit of no stopping zone	N/A
No Stopping Right Arrow	Special See Standard Detail SN0204	12 x 18	PE	Limit of no stopping zone	N/A
No Trucks	R5-2	24 x 24	NT		PennDOT Pub 236
No Trucks or Busses	R5-3-4 Special "Fairmount Park Drive" Plaque	30 x 36 (Combined Sign & Plaque)	NTB	For use on all Park Roads and roads leading to park roads, except state highways. "Fairmount Park Drive" plaque is brown with 4" white lettering, installed above the R5-3-4 as a single assembly.	PennDOT Pub 236

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
No Thru Trucks Assembly	R5-2 Special "No Thru Trucks" plaque	24 x 36 (Combined Sign & Plaque)	NTT	On streets as determined by a traffic study, or restricted via legislation. The "No Thru Trucks" plaque is necessary to clarify commercial vehicle restrictions on several State Routes and City Highways that restrict trucks, but allow buses (ex: Henry Avenue).	PennDOT Pub 236
No Turn On Red	R10-11 R10-11 (Mod) R10-11B	Post: 24 x 30 (24 x 24 as conditions warrant) Overhead: 30 x 36	R, OR	Place within ten (10) feet of appropriate signal head. If this cannot be accomplished, erect one far side and one post mounted near side, right. See PennDOT Publication 201, Section 62 for Criteria. Use R10-11 on State Funded projects. Use R10-11 (Mod – No Red Dot) on City funded projects, and standard maintenance. Use R10-11B for crossings of narrow roads, as determined in the field.	PennDOT Pub 236
No Turn On Red, 6AM to 6PM	R10-101 (6AM-6PM)	Post: 24 x 30 Overhead: 30 x 36	T, OT	See 'No Turn on Red' criteria At a minimum, install at intersections with documented high pedestrian volumes (i.e. school crossings, etc)	PennDOT Pub 236
No Turns	R3-3	Post: 24 x 24 Overhead: 36 x 36	J, OJ	See 'No Left Turn' criteria. Do not use where it is redundant with a one way sign.	PennDOT Pub 236 MUTCD
No U-Turns	R3-4	Post: 24 x 24 Overhead: 30 x 30	K, OK	See 'No Left Turn' criteria.	PennDOT Pub 236 MUTCD
One Way Left Vertical	R6-2L	Post Mounted: 24 x 36 Overhead: 30 x 36	OB	Generally mounted overhead, supplement with pole mounted horizontal sign	PennDOT Pub 236

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
One Way Left Horizontal	R6-1L	Standard: 36 x 12 Roads 40mph Speed Limits or Faster: 54 x 18	B	Two signs are required for each approach, preferred locations are nearside right and farside left. Location of street name signs, available posts, or visibility may mandate different locations. If there is an overhead vertical one way sign, only one post mounted sign is required. Combine one way sign with street name sign wherever possible. No not install for pedestrians or where one way condition does not present any turn prohibitions for approaching traffic.	PennDOT Pub 236 MUTCD
One Way Right Horizontal	R6-1R	Standard: 36 x 12 Roads 40mph+ Speed Limits: 54 x 18	C	See 'One Way Left – Horizontal' criteria	PennDOT Pub 236 MUTCD
One Way Right Vertical	R6-2R	Post mounted: 24 x 36 Overhead: 30 x 36	OC	See 'One Way Left – Vertical' criteria	PennDOT Pub 236
Philadelphia Parking Authority Signs	Special		PPA	These signs are owned and maintained by the Philadelphia Parking Authority. Unless otherwise shown herein, they are generally identified by green lettering on white background. Only existing signs may be shown on plans presented to the Streets Department for agency approval.	
Pedestrian Crossing (Assembly)	W11-2 (Ped X-ing), W16-9P (Ahead Plaque) W16-7 (Arrow)	W11-2: 30 x 30 W16-9P: 24 x 12 Sizes increase on roads with 40mph limit or greater	Pedestrian Crossing: QA, Plaque: AH or AR	Place at locations where pedestrian activity may be unexpected by motorists, or uncontrolled crosswalks. Ahead Assembly: On the right side of the approach, in advance of any uncontrolled pedestrian crossing. Arrow Assembly: At all uncontrolled crosswalks, on the right side of the approach; arrow points at crosswalk. May also be used on the left, in addition to the required right side. Background color is fluorescent yellow/green.	PennDOT Pub 236 MUTCD

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
Push Button for Walking Person	R10-3	9 x 12	QW	Place parallel to crossing, on pole closest to the crosswalk. Use at all actuated intersections controlled by pedestrian signal heads.	PennDOT Pub 236
Reserved Parking	R7-8	12 x 18	HP	These signs are owned and maintained by the Philadelphia Parking Authority. Cannot be installed by any party other than the PPA. Only existing signs may be shown on plans presented to the Streets Department for agency approval.	
Right Lane Must Turn Right	R3-7R	R3-7R: 30 x 30	N	Place on pole nearest to the beginning of the queue line.	PennDOT Pub 236
Right Turn Only	R3-5R	30 x 36	AG	See 'Left Turn' criteria	PennDOT Pub 236
Right Turn Signal	R10-10R	Post Mounted: 24 x 36 Overhead: 30 x 36	S, OS	One (1) sign per exclusive signal head, adjacent to appropriate head. Required for 3-section and 5-section turn signal heads.	PennDOT Pub 236
School Crossing	S1-1	S1-1: 30 x 30	School Crossing: SA	Sign without assembly to be placed at traffic signals and all-way stops. Place on right side of approach at all designated school crossings. At traffic signals, place at crosswalk. At all-way stops, place in advance of STOP sign at an appropriate distance such that the STOP sign is properly visible.	PennDOT Pub 236 MUTCD
School Crossing (Assembly)	S1-1 W16-7 (arrow) W16-9P (Ahead)	S1-1: 30 x 30 W16-7 and W16-9P 24x12	School Crossing: SA Arrow: AR Ahead: AH	Sign with assembly to be placed at all uncontrolled school crossings. Assembly with arrow rider to be placed on the right and left side of street at the crosswalk. Assembly with 'Ahead' rider to be placed at the proper distance per MUTCD Ch.2C on the right-hand side of the road.	PennDOT Pub 236 MUTCD

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
School Speed Limit (Assembly)	S4-3P (School Panel), R2-1 (Speed Limit), S4-2P (When Children are Present)	24 x 48 (Combined Sign & Plaque)	SL	At the beginning of the reduced speed/school zone. School speed limit signs are also used for high schools. The custom plaque "During Opening Closing and Recess" will be phased out as replacements occur.	PennDOT Pub 236 MUTCD
SEPTA Route Signs			SP	These signs are owned and maintained by SEPTA. Only existing signs may be shown on plans presented to the Streets Department for agency approval.	N/A
Share the Road	W16-101	30 x 30	SR	Place along roadways (without bike lanes) where bicycles are present, and a useable shoulder is available for bicycles.	PennDOT Pub 236
Speed Limit	R2-1	24 x 30 (fewer than 3 lanes) 30 x 36 (3 or more lanes)	L	Place mid-block, distance between signs should not exceed 1500 feet. Also install immediately after arterial crossing and reset spacing. Install on all signalized corridors. Traffic Engineering will justify the limit.	PennDOT Pub 236
Stop	R1-1	30 x 30	A	Right side is mandatory. Left side is preferred and mandatory where right side visibility is low. The only signs which me be installed on the same pole, visible on the approach, as a stop sign are street name signs and one way signs. Other signs may be installed on the back of stop signs, but cannot be visible from the stop sign's approach.	PennDOT Pub 236 MUTCD
Stop Here on Red – Left	R10-6L	24 x 30	SL	On the right side of roadway. Must be supplemented with a stop bar.	PennDOT Pub 236
Stop Here on Red – Right	R10-6R	24 x 30	SR	On the left side of roadway or median. Must be supplemented with a stop bar.	PennDOT Pub 236
Straight – Through	R3-5A	30 x 36	AH	See 'Left Turn' criteria	PennDOT Pub 236

Legend	Series	Standard Size (Inches)	Symbol	Placement / Comments	Publication
Tow Away Zone Plaque	R7-201AP	12 x 6	TZ	These signs are owned and maintained by both the Streets Department, and the Philadelphia Parking Authority. They are permitted only where legislation permits their use. Can be combined with any other parking sign as a single blank.	PennDOT Pub 236 MUTCD
Two Way Traffic	W6-3	30 x 30	TT	Just after intersection at which two-way condition begins, on the right side. Although the MUTCD does not call for the use of this sign for this condition, the City has adopted it. 30 x 30 is standard due to special issues with PennDOT standard 36 x 36.	PennDOT Pub 236
Two Way Traffic Ahead	Previously R6-10 Special See Standard Detail SN02XX	Standard: 24 x 30 Overhead: 36 x 48	WT	On the right and optionally on the left in advance of intersection at which two-way traffic begins.	PennDOT Pub 236 (version 2006)
Use Crosswalk Left Arrow	R9-3BL	18 x 12	UL	At banned crossings, on the pole closest to the crossing which is to be utilized.	PennDOT Pub 236
Use Crosswalk Right Arrow	R9-3BR	18 x 12	UR	See 'Use Crosswalk Left Arrow' criteria	PennDOT Pub 236
Yield	R1-2	30 x 30 x 30	Y	Place at both nearside corners of the approach. May be accompanied by yield line markings.	MUTCD

Appendix B

List of Current Traffic Engineering Details

Traffic Engineering (TE0XXX)
TE0101 – 20’ C-Post / Street Name Sign Pole
TE0102 – C-Post Split Base Assembly
TE0201 – D-Pole
TE0202 – D-Pole Foundation
TE0203 – D-Pole Spreadfoot Foundation
TE0301 – Pedestal Pole
TE0501 – Mastarm Details
TE0601 – Signal Head
TE0701 – Traffic Signal Service Detail
TE0703 – D-Pole Service Tap & Direct Bury Tap
TE0801 – Sample Phasing, Timing & Color Sequence Chart

Interconnect (IC01XX)
IC0102 – Interconnect Wiring Detail
IC0103 – Interconnect Drop from Mast Arm Pole
IC0104 – Conduit Installation Detail

Signs: Street & Traffic (SN0XXX)
SN0101 – Metro Street Name Standard
SN0102 – Overhead Street Name Sign
SN0203 – Bicycle Lane Shifts
SN0204 – No Parking/Stopping Sign
SN0301 – Traffic Sign Post Mounted
SN0302 – Assembly of Sign Brackets

Pavement Markings (P01XX)
PM0102 – Typical Crosswalk / Stop Bar detail
PM0103 – Bike Legend Detail
PM0105 – Left Turn Detail
PM0106 – Bus Zone and Legend Detail
PM0108 – Rail Road Detail

Appendix C

Pavement Marking Guidelines

THIS SECTION IN DEVELOPMENT FOR 2019 RELEASE

Appendix D

Crash Code Descriptions

PHILADELPHIA CLASSIFICATION CODES FOR VEHICLE ACCIDENTS

Non-Reportable	Property Damage Only-No Death, Injury, or Towing
3711	Property Damage Only-Not including City, State, or Federal Property
3712	Leaving the Scene-No Solvability Factors
3713	Involving a bicycle
3714	Involving a pedestrian
3715	Involving a truck
3716	Involving a motorcycle
3717	Involving a Driver Under the Influence
3718	Involving a Police Department Vehicle
3719	Police Vehicle vs Police Vehicle
3720	Police Vehicle vs DUI
3722	Involving other city vehicles
3723	Damage to City, State, or Federal Property-Other than vehicles
3724	Leaving the Scene-With Solvability Factors
3740	HazMat Courier-Without a Spill
3741	HazMat Courier-With a Spill

Reportable	With Injury and/or Towing
3725	With Injury, with or without Towing
3726	With Towing Only
3727	Leaving the Scene
3728	Involving a Bicycle
3729	Involving a Pedestrian
3730	Involving a Truck
3732	Involving a Motorcycle
3733	Involving a Driver Under the Influence
3734	Involving a Police Department Vehicle
3735	Police Vehicle vs Police Vehicle
3736	Police Vehicle vs DUI
3738	Involving other City vehicles
3739	Damage to City, State, or Federal Property-Other than vehicles
3742	HazMat Courier-Without a Spill
3743	HazMat Courier-With a Spill

Appendix E

Guidelines for Utilizing Design Vehicles
for Turning Radii at Intersections

INTERSECTING STREET TYPE	Arterial	Collector	Residential
Arterial	WB-50, unless larger vehicles are known to utilize the intersection. WB-67 on common/designated truck routes.	City Bus (1)	SU (2)
Collector	City Bus (1)	SU (2)	SU (2) (4)
Residential	SU (2)	SU (2) (4)	School bus (3)

(1) If a smaller radius for the bumpout is required for design purposes, to be reviewed individually by PSD. If the turn is a part of a regular SEPTA route, to be designed utilizing SEPTA turning guidelines (see below).

(2) City Bus if the turn is a part of a regular SEPTA route -to be designed utilizing SEPTA turning guidelines

(3) To be checked to also accommodate SU turns (adjacent lanes encroachments may be accepted)

(4) If estimated trucks turns frequency is less than once per week, design for school buses instead

Additional notes:

- If there is any other design vehicle that is known to routinely utilize an intersection (for instance, a tour or coach bus,) the geometry is to be verified for that vehicle.
- Design for intersections with heavy pedestrian volumes needs to be coordinated with the Philadelphia Streets Department in early stages.
- In all cases, the proposed intersection geometry must support emergency vehicles, such as fire trucks. For emergency vehicles, lane encroachments are allowed; overhang encroachments into the curb are allowed, provided that there are no vertical obstacles within the area of encroachment.
- In all cases, if the existing intersection geometry accommodates a design vehicle without encroachments into adjacent lanes, the final layout is to accommodate it as well.
- No encroachment into opposing lanes can be accepted as part of the proposed condition.
- If turns at a specific intersection are part of a designated SEPTA route, the design is to account for the specific bus type (single unit or articulated) that serves the route, and for the turning procedure in accordance with the SEPTA manual.

Below, for informational purposes, are the current turning guidelines for SEPTA bus drivers. Be sure to check with SEPTA for the latest:

BOXING BUS FOR RIGHT TURNS

- On a non-articulated bus, position the bus 2 feet from the right curb. When the bus is 20 feet from the corner, swing out 6 to 10 feet to the left. When the number two door of the bus reaches the corner curb line,
- begin your right hand turn. This will be adjusted slightly when operating an articulated bus. Consult your Instructor for boxing an articulated bus.

CLEARANCES

- When passing other vehicles either parked or moving, you must ensure you have proper clearance. Stay three feet from parked autos so drivers won't open doors into the path of the bus. If you are unsure of a clearance, stop, get out and check, then proceed with caution. Be especially watchful for protruding objects. Clearance is especially important when you are making a turn.
- There is an overhang on the bus. Some obstacles that can be cleared during a straight movement may be struck on a turn. On a non-articulated bus, the points of clearance for a left turn are right front and left rear. For a right turn, they are left front and right rear. On an articulated bus, the points of clearance for a left turn are right front, left middle, and left rear. For a right turn, they are left front, right middle, and right rear.