The purpose of this packet is to provide guidance on designing and reviewing traffic signal plans. The format, legends, TEM tables/charts, page layouts, and sample details presented shall be used and followed as shown. Additionally, auto table/Cadig shall be used to fill in all tables (including calculation spreadsheets). Failure to provide in such format may result in submittals not being approved.

Office of Traffic Operations
Signal Design Reference Packet
Rev 2 04/17/2015

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Design files and spreadsheets are available for download and use on the Office of Traffic Operations website:
REFERENCES FOR TRAFFIC SIGNAL DESIGN PROJECTS

**ODOT Signals Documents and Publications**

- **Office of Traffic Operations Handbook***
- **Traffic Authorized Products List (TAP)**
- **ODOT Qualified Products List (QPL)**

**Traffic Academy**

  - Part 4, Highway Traffic Signals
  - Part 5, Traffic Control Devices for Low-Volume Roads
  - Part 6, Temporary Traffic Control
  - Part 7, Traffic Control for School Areas
  - Part 8, Traffic Control for Railroad and Light Rail Transit Grade Crossings
  - Part 9, Traffic Control for Bicycle Facilities

**Traffic Engineering Manual (TEM)**

- Part 4 – Signals
- Part 12 – Zones and Traffic Engineering Studies
- Part 13 – Intelligent Transportation Systems (Fiber Optics)

**Sign Designs and Markings Manual (SDMM)**

- 632 – Traffic Signal Equipment
- 633 – Traffic Signal Controllers
- 732 – Traffic Signal Material
- 733 – Traffic Signal Controller Material

**Supplements**

- 1063 – Signal Construction Personnel Requirements (631, 632, 633)
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**Supplemental Specifications**

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- 804 – Fiber Optic Cable and Components
- 805 – GPS Clock Assembly
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- 202120 – Foundations
- 202310 – Protective Coating of Overhead Sign Support Sections
- 203011 – Controller Cabinet Generator Power Panel
- 203012 – Battery Backup System (BBS) Generator Power Panel
- 203020 – Prepare to Stop When Flashing [PTSWF] Sign Installation
- 203324 – Sepac Input File Information for 332 and 336 Cabinets
- 206010 – Typical Pole Entrance Fitting
- 206011 – Aerial Cable Placement Methods
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- 206015 – Typical Loose Tube Cable Installation
- 206016 – Cable Construction
- 207560 – Radio Interconnect Details
- 208320 – Uninterruptible Power Supply (UPS) and Controller Cabinet Foundation
- 208321 – Uninterruptible Power Supply (UPS) Foundation Retrofit
- 208340 – Breakaway Transformer Base Connector Design
- 208350 – Diamond Interchange 3-Phase Operation
- 208351 – Diamond Interchange 4-Phase Operation

**Traffic Standard Drawings** (Available upon request to the Office of Traffic Operations)

- Strain Pole and Mast Arm Camera Mount

**Location & Design Manual Volume 1 - Roadway Design**

**Location & Design Manual Volume 2 - Drainage Design**

**Location & Design Manual Volume 3 - Highway Plans**

*Note: Refer to the most current version.*
### DETAILED DESIGN/REVIEW SUBMISSION STAGES

#### SCOPE

- ☐ Is consultant pre-qualified for basic and/or signal system design?
- ☐ Were the plans reviewed, submitted and stamped by the prequalified individual?
- ☐ Developer Signal Agreement (Completed and Accepted)
- ☐ Village Signal Permit (Documentation and Approvals)
- ☐ Does the project involve any of the following:
  - ☐ Emergency Vehicle Preemption
  - ☐ Rail Road Coordination/Preemption
  - ☐ Coordinated with Rail Commission
  - ☐ PTZ Cameras
  - ☐ HAWK Signals
  - ☐ Does the project involve any of the following:
  - ☐ Emergency Vehicle Preemption
  - ☐ Rail Road Coordination/Preemption
  - ☐ Coordinated with Rail Commission
  - ☐ PTZ Cameras
  - ☐ HAWK Signals
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  - ☐ Rail Road Coordination/Preemption
  - ☐ Coordinated with Rail Commission
  - ☐ PTZ Cameras
  - ☐ HAWK Signals

#### STAGE 1

- ☐ Title Sheet
- ☐ Plan and Profile Sheets
- ☐ Signal Warrants
- ☐ Signal Pole Locations
- ☐ Conceptual Maintenance of Traffic
- ☐ Revised Systems Engineering Analysis for Intelligent Transportation Systems (ITS) Projects (TEM 1301-3)
- ☐ Proprietary Item Approvals
- ☐ Coordination with Utilities (If poles are to be used for interconnect)
- ☐ Determine type of detection (radar, video, loops)

#### STAGE 2

- ☐ Title Sheet
- ☐ Maintenance of Traffic Sequence of Operations
- ☐ Revised Systems Engineering Analysis for Intelligent Transportation Systems (ITS) Projects (TEM 1301-3)
- ☐ Signal Plan Sheets
  - ☐ Base plan drawn to scale of 1:20 including:
    - ☐ Roadway base lines
    - ☐ Underground and overhead utilities
    - ☐ Overhead power lines should include their voltage
  - ☐ Check stop bar locations with WB-62 turning template
  - ☐ Traffic signal pole locations and skew angles, if required
  - ☐ Identify reference numbers for all poles
  - ☐ Signal head locations and direction; Identify the following:
    - ☐ Signal heads having turn arrow lenses
    - ☐ Louvers or special optically programmed features
    - ☐ Signal head sizes
    - ☐ Reference numbers for all signal heads
  - ☐ Signal controller location and orientation
  - ☐ Detector Locations
    - ☐ Radar detection chart
    - ☐ Traffic signal detector chart (Form 496-4)
    - ☐ Underground conduit and pull boxes

#### STAGE 3

- ☐ Systems Engineering Analysis for Intelligent Transportation Systems (ITS) Projects (TEM 1301-3)
- ☐ Signal Plan Sheets
  - ☐ General Notes
  - ☐ Estimated quantities
  - ☐ Special details
  - ☐ Pole orientation chart
  - ☐ Wiring diagram; Shall indicate the following:
    - ☐ Type of cable
    - ☐ Number of conductors connecting each signal head, pedestrian head, detector, push button, etc.
    - ☐ Coordination timing; Shall be in seconds
    - ☐ Timing summary (coordination)
    - ☐ Railroad preemption
    - ☐ Interconnection

- ☐ Cost Estimate
### Supplemental Specs

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### Standard Construction Drawings (Typical)

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### Traffic Standard Drawings

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<td>☐ TBD</td>
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### FHWA Proprietary Equipment Approvals (For ODOT Use Only)

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<td>☐ Detector</td>
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* Designates **REQUIRED** Signal Notes

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### DESIGNER NOTES:

- **FOR OTO NOTES, PLEASE CONTACT THE OFFICE OF TRAFFIC OPERATIONS.**
- **‘AS PER PLAN’ NOTES AND ITEMS ARE USED WHEN MODIFICATIONS ARE MADE TO THE BASE ITEM/STANDARD NOTE. TYPICAL EXTENSION NUMBERS ARE 1 HIGHER THAN THE ORIGINAL ITEM. CHECK CONSTRUCTION ITEM MASTER FOR EXACT NUMBERS.**
### PAY ITEMS (TYPICAL)

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<td>Conduit, Jacked Or Drilled, [Specify Size]</td>
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<tr>
<td>625</td>
<td>26251</td>
<td>EACH</td>
<td>Luminaire, Conventional, 250w HPS, 120 Volt, As Per Plan</td>
</tr>
<tr>
<td>625</td>
<td>29000</td>
<td>FT</td>
<td>Trench</td>
</tr>
<tr>
<td>625</td>
<td>30700</td>
<td>EACH</td>
<td>Pull Box, 725.08, 18&quot;</td>
</tr>
<tr>
<td>625</td>
<td>30706</td>
<td>EACH</td>
<td>Pull Box, 725.08, 24&quot;</td>
</tr>
<tr>
<td>625</td>
<td>32000</td>
<td>EACH</td>
<td>Ground Rod</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Vehicular Signal Head, [LED], Black, X Section, 12&quot; Lens, 1-Way, Polycarbonate With Backplate, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>20731</td>
<td>EACH</td>
<td>Pedestrian Signal Head [LED], [Countdown], Type D2, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>25000</td>
<td>EACH</td>
<td>Covering Of Vehicular Signal Head</td>
</tr>
<tr>
<td>632</td>
<td>25010</td>
<td>EACH</td>
<td>Covering Of Pedestrian Signal Head</td>
</tr>
<tr>
<td>632</td>
<td>26601</td>
<td>EACH</td>
<td>Pedestrian Pushbutton, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>26500</td>
<td>EACH</td>
<td>Detector Loop</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>FT</td>
<td>Signal Cable, X Conductor, No. X AWG</td>
</tr>
<tr>
<td>632</td>
<td>64010</td>
<td>EACH</td>
<td>Signal Support Foundation</td>
</tr>
<tr>
<td>632</td>
<td>64020</td>
<td>EACH</td>
<td>Pedestal Foundation</td>
</tr>
<tr>
<td>632</td>
<td>65200</td>
<td>FT</td>
<td>Loop Detector Lead-In Cable</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>FT</td>
<td>Power Cable, X Conductor, No. X AWG</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>FT</td>
<td>Service Cable, X Conductor, No. X AWG</td>
</tr>
<tr>
<td>632</td>
<td>70001</td>
<td>EACH</td>
<td>Power Service, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Signal Support, Type TC-81.21, Design XX, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Combination Signal Support, Type TC-81.21, Design XX, As Per Plan</td>
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<tr>
<td>632</td>
<td>77231</td>
<td>EACH</td>
<td>Signal Support, Mechanical Damper For TC-81.21 Mast Arm (Greater Than 59&quot; In Length)</td>
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<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Strain Pole, Type TC-81.10, Design XX</td>
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<tr>
<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Combination Strain Pole, Type TC-81.10, Design XX, As Per Plan</td>
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<tr>
<td>632</td>
<td>VARIES</td>
<td>EACH</td>
<td>Pedestal, X, Transformer Base</td>
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<tr>
<td>632</td>
<td>90101</td>
<td>EACH</td>
<td>Removal Of Traffic Signal Installation, As Per Plan</td>
</tr>
<tr>
<td>632</td>
<td>90400</td>
<td>EACH</td>
<td>Signaling, Misc.: CDMA Modem, Furnish Only</td>
</tr>
<tr>
<td>633</td>
<td>01551</td>
<td>EACH</td>
<td>Controller Unit, Type TS2/A2, With Cabinet, Type TS1</td>
</tr>
</tbody>
</table>

### PAY ITEMS (TYPICAL)

- 633
- 01580
- EACH
- Controller Unit, Type TS2/A2, With Cabinet, Type TS1

- 633
- 01661
- EACH
- Controller Unit, Type 2070E, With Cabinet, Type 332, As Per Plan

- 633
- 01671
- EACH
- Controller Unit, Type 2070E, With Cabinet, Type 336, As Per Plan

- 633
- 67000
- EACH
- Cabinet Riser

- 633
- 67100
- EACH
- Cabinet Foundation

- 633
- 67200
- EACH
- Controller Work Pad

- 633
- 71000
- EACH
- Flasher Controller

- 633
- 75001
- EACH
- Uninterruptible Power Supply (UPS), 1000 Watt, As Per Plan

- 804
- 15000
- FT
- Fiber Optic Cable, 18 Fiber

- 804
- 15010
- FT
- Fiber Optic Cable, 24 Cable

- 804
- 15020
- FT
- Fiber Optic Cable, 48 Cable

- 804
- 20010
- FT
- Fiber Optic Cable, Armored, 18 Fiber

- 804
- 20034
- FT
- Fiber Optic Cable, Armored, 24 Fiber

- 804
- 20044
- FT
- Fiber Optic Cable, Armored, 36 Fiber

- 804
- 20050
- FT
- Fiber Optic Cable, Armored, 48 Fiber

- 804
- 32990
- EACH
- Fiber Optic Patch Cord, 2 Fiber

- 804
- 34012
- EACH
- Termination Panel, 12 Fiber

- 804
- 34013
- EACH
- Termination Panel, 24 Fiber

- 804
- 34026
- EACH
- Termination Panel, 36 Fiber

- 804
- 34030
- EACH
- Termination Panel, 48 Fiber

- 804
- 37000
- EACH
- Splice Enclosure

- 805
- 00100
- EACH
- Global Positioning System Clock Assembly

- 809
- 66000
- EACH
- Closed Loop Arterial Traffic Signal System

- 809
- 66010
- EACH
- Centrally Controlled Arterial Traffic Signal System

- 809
- 66020
- EACH
- Highway Rail/Traffic Signal Pre-Eption

- 809
- 66030
- EACH
- Traffic Signal System With Emergency Vehicle Pre-Eption

- 809
- 66040
- EACH
- Traffic Signal System With Transit Priority

- 809
- 66050
- EACH
- Adaptive Traffic Signal Control System

- 809
- 68900
- EACH
- Side-Fired Radar Detector

- 809
- 69000
- EACH
- Advance Radar Detection

- 809
- 69100
- EACH
- Stop-Bar Radar Detection

- 809
- 69110
- EACH
- Stop-Bar And Advance Radar Detection

- 815
- 30000
- EACH
- Spread Spectrum Radio

**Note:** Pay Items listed are TYPICAL. Go to the ODOT Item Master for complete list.

**DESIGNER NOTE:**

- Plans that include Fiber Optic Cable shall be submitted to ODOT for review.

---

**SIGNAL DESIGN/REVIEW CHECKLIST**

- Spread Spectrum Radio
- Stop
- Advance Radar Detection
- Side
- Arctic Traffic Signal Control System
- Global Positioning System Clock Assembly
- Closed Loop Arterial Traffic Signal System
- Centrally Controlled Arterial Traffic Signal System
- Highway Rail/Traffic Signal Pre-Eption
- Traffic Signal System With Emergency Vehicle Pre-Eption
- Traffic Signal System With Transit Priority
- Adaptive Traffic Signal Control System
- Side-Fired Radar Detector
- Advance Radar Detection
- Stop-Bar Radar Detection
- Stop-Bar And Advance Radar Detection
- Spread Spectrum Radio
TYPICAL SIGNAL NOTES (ITEM 442 & 642):

442-2  POWER SUPPLY FOR TRAFFIC SIGNALS
442-3*  SIGNAL ACTIVATION
442-4  632 REMOVAL OF TRAFFIC SIGNAL INSTALLATION
442-5  632 INTERCONNECT CABLE, MSSC./BY SIZE, WITH SUPPORT MESSANGER, AS PER PLAN
442-6  632 LOOP DETECTOR UNITS, BY TYPE, AS PER PLAN
442-7  DETECTION MAINTENANCE
442-9  WIRING INSPECTION
442-9  632 LOOP DETECTOR LEAD-IN CABLE, DIRECT BURIAL
442-10  632 COMBINATION SIGNAL SUPPORT, TYPE TC-601 AND SIGN SUPPORT, TC-WITH LIGHT POLE EXTENSION
442-11  632 COMBINATION STRAIN POLE, TYPE TC-6130 AND SIGN SUPPORT, TC-WITH LIGHT POLE EXTENSION
442-12  STRAIN POLE AND PEDESTAL FOUNDATION ELEVATIONS
442-13  632 VEHICULAR SIGNAL HEAD, LED, BLACK, IBY TYPE, WITH BACKPLATE, AS PER PLAN
442-15*  GUARANTEE
442-16  633 ALTERNATE BID ITEM
442-18  635 PEDESTRIAN SIGNAL HEAD (LED, COUNTDOWN), TYPE DD, AS PER PLAN
442-19  637 RELIAMP EXISTING SIGNAL SECTION WITH LED LAMP UNIT, BY LENS TYPE, AS PER PLAN
442-20  635 CONTROLLER UNIT, TYPE 620E, WITH CABINET, IBY TYPE, AS PER PLAN
442-21  635 CONTROLLER, MASTER, TRAFFIC RESPONSIVE, AS PER PLAN
442-22  CONTROLLER UNIT, TYPE TS2/42, WITH CABINET, TYPE TS2, AS PER PLAN
442-25  633 PREEMPTION
442-26  633 PREEMPTION RECEIVING UNIT
442-27  633 PREEMPTION DETECTOR CABLE
442-28  635 PREEMPT PHASE SELECTOR
442-29  633 PREEMPT CONFIRMATION LIGHT, LED
442-50  PULL BOX, 24" X 35" X 26"
442-51  632 POLE ENTRANCE FITTING
442-52*  GROUNDING AND BONDING
442-40  633 UNINTERRUPTIBLE POWER SUPPLY (UPS), BATTERY REPLACEMENT
442-41  633 UNINTERRUPTIBLE POWER SUPPLY (UPS), 5000 Watt, AS PER PLAN
442-45  632 SIGNAL SUPPORT, MECHANICAL DAMPER FOR TC-521L, MAST ARM GREATER THAN 55' IN LENGTH, AS PER PLAN
442-46  632 SIGNAL SUPPORT, IBY TYPE, AS PER PLAN
442-47  632 SIGNALIZATION, MSSC./UNLASH AND RELASH MESSANGER WIRE
442-48  GENERAL ELECTRICAL REQUIREMENTS FOR SOLAR-POWERED DEVICES
46-42*  MAINTENANCE OF TRAFFIC SIGNAL/FLASHER INSTALLATION

* DESIGNATES REQUIRED SIGNAL NOTES

SPECIALTY SIGNAL NOTES:

OTO  SIGNAL OPERATION CHANGED
OTO  632 SIGNAL SUPPORT FOUNDATION
OTO  632 SIGNALIZATION, MSSC./CELLULAR MODEM, FURNISH ONLY
OTO  809 ADVANCE RADAR DETECTION
OTO  809 STOP-BAR RADAR DETECTION

DESIGNER NOTE:
ANY SPECIALTY, NEWLY CREATED, OR MODIFIED NOTES FROM THOSE LISTED IN THE TEM SHALL BE REVIEWED, ACCEPTED, AND/OR PROVIDED BY THE OFFICE OF TRAFFIC OPERATIONS.
NOTES:
1) THE SIZE OF THE UPS FOUNDATION MAY VARY BASED ON THE CABINET SIZE PROVIDED.
2) UPS FOUNDATION ELEVATION SHOULD MATCH CABINET FOUNDATION ELEVATION.
3) THE UPS CABINET SHALL BE MOUNTED FLUSH UP AGAINST THE SIGNAL CABINET AND SEALED.
4) CONDUIT AND WIRING FROM THE SIGNAL CABINET TO THE UPS SHALL BE INSTALLED THROUGH THE CABINET RISER.

SEPARATE BID ITEMS:
633 CABINET RISER
635 CONTROLLER WORK PAD, AS PER PLAN
635 CABINET FOUNDATION, AS PER PLAN
633 UNINTERMITTENT POWER SUPPLY (UPS)
633 CONTROLLER UNIT, TYPE ........ WITH CABINET, TYPE ....
ITEMS REQUIRED IN PLAN VIEW

- 20 SCALE
- CHECK STOP BAR LOCATIONS WITH MB-62 TURNING TEMPLATE
- DETECTORS/DETECTION ZONES
  - LABELED BY ASSOCIATED PHASE (DLA, DB, DIA, DB, DIA, 34)
  - ALL MOVEMENTS SHALL BE ACTIVATED
- SIGNAL HEADS WITH CORRECT PLACEMENT (SEE SAMPLE SIGNAL HEAD PLACEMENTS PER CTO DRAWING)
  - LABELED BY ASSOCIATED PHASE (24A, 24B, 44A, 44B, 64, 56, etc.)
  - SPECIFY TYPES (LED, COUNTDOWN, TYPE 23)
  - SPECIFY VISOR TYPE: CUTAWAY OR OPEN BOTTOM TUNNEL
  - SPECIFY COLOR: BLACK OR YELLOW
- PEDESTRIAN FACILITIES (ADA COMPLIANT)
- PEDESTAL/PUSHBUTTON CONFIGURATION
  - LABEL PEDESTAL SUPPORTS AS PS-#
    - NUMBER WITH THE # CORNER - 1, SW-1, NE-4, SE-4, FOR CONFIGURATIONS WITH ONLY 2 OR 3 SUPPORT POLES, NUMBER ACCORDINGLY FOLLOWING THE SAME ORDER (EX. IF NW CORNER IS MISSING, SW1)
  - CURB RAMPS (NOTES: CROSSWALKS CANNOT SHARE RAMPS)
- SIGNAL SUPPORTS
  - LABELED AS SP-*
  - NUMBER STRAIN POLES ACCORDING TO SWISS OUTPUT DIAGRAM, FOR MAST ARMS, NUMBER WITH THE # CORNER - 1, SW, NW, NE, SE, FOR CONFIGURATIONS WITH ONLY 2 OR 3 SUPPORT POLES, NUMBER ACCORDINGLY FOLLOWING THE SAME ORDER.
  - LOCATED WITH THE FOLLOWING CONSIDERATIONS
    - WITHIN THE RPM
    - REMOVED FROM LOCATION OF DITCHES OR DRAINAGE AREAS
    - OUTSIDE THE LED MANUAL CLEAR ZONE REQUIREMENTS
    - PEDESTRIAN PUSHBUTTON ACCESS AND PEDESTRIAN SIGNAL VIEWING ANGLE
    - UNDERGROUND OBSTRUCTIONS
    - OVERHEAD OBSTRUCTIONS (NOTES: THE UTILITY COMPANIES REQUIRE DIFFERENT CLEARANCES BETWEEN THE POLE AND THEIR POWER LINES BASED ON THE VOLTAGE LEVELS CARRIED ON THE OVERHEAD LINES)
    - ARE NEW SUPPORTS LOCATED AT LEAST 5 FEET FROM EXISTING SUPPORTS TO BE REMOVED

- EXISTING & PROPOSED RW
- LOCATION OF POWER SERVICE IDENTIFIED
- CONDUITS & PULLBOXES
  - INCLUDE SIZE, LENGTH, AND NUMBER & TYPE OF CONDUCTORS WITHIN
  - SHOULD HAVE SEPARATE FOR LIGHTING CIRCUITS

PULLBOX TABLE

<table>
<thead>
<tr>
<th>PULL BOX</th>
<th>STATION</th>
<th>SIDE</th>
<th>OFFSET</th>
<th>SIZE (IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**SIGNAL TIMING CHART (ITEM FORM 496-3)**

**INTERSECTION MAINTENING AGENCY:**

<table>
<thead>
<tr>
<th>START UP</th>
<th>DUAL ENTRY</th>
<th>PHASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>START IN</td>
<td>REST IN RED</td>
<td>RING 1</td>
</tr>
<tr>
<td>TIME FOR FLASH OR ALL RED</td>
<td>OVERLAP</td>
<td>A</td>
</tr>
<tr>
<td>FIRST PHASES</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>COLOR DISPLAYED</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**INTERVAL OR FEATURE**

<table>
<thead>
<tr>
<th>CONTROLLER MOVEMENT NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

**DIRECTION**

- Start
- Minimum Green Initial (SEC)
- Maximum Green (SEC)
- Maximum Green Switch (SEC)

**PEDESTRIAN CLEARANCE**

- Max. Green (SEC)
- Yellow Change (SEC)
- Minimum (SEC)
- Maximum (SEC)

**RECALL**

- Maximum (ION/OFF)
- Minimum (ION/OFF)
- Pedestrian (ION/OFF)
- Maximum (ION/OFF)
- Minimum (ION/OFF)
- Pedestrian (ION/OFF)
- Memory (ION/OFF)

*VOLUME DENSITY CONTROLS

**NOTES:**

- All movements shall be actuated, the primary thru movement should have win recall active to rest in green.
- For protected-permissive phases, implement call omits to avoid yellow ball trap.
- Enable #3 & #7 detector switching to allow #3 & #7 to extend #4 & #8 when allocated green time for left turn phases are exhausted.
- Enable detector switching to extend #4 & #8 with #3 & #7 loops once left turn phases are exhausted.
- Countdown pedestrian signals shall go to zero on yellow per MUTCD Figure 6E-2.
- Radar detector units forulumina zone detection shall place a constant call to the controller when vehicles travel times to the stop bar are between 2.5 and 8 seconds. Speed trigger shall be set for vehicles traveling 35 mph and greater.
- Radar shall have queue detection configured and a zone placed at 100-200 feet from stop bar for slow moving vehicle extensions. Speed trigger shall be set at 1/4 mph.
- All detector delays shall be placed in the controller.

**TRAFFIC SIGNAL DETECTOR CHART (ITEM FORM 496-4)**

**RADAR DETECTION CHART (ITEM FORM 496-4)**

**TRAFFIC SIGNAL PLAN DETAILS**

**DESIGNER NOTES:**

- Label all phases by direction, ped and overlap
- Mainline phases 2 & 6
- All movement delays shall be placed in the controller.
PLAN DETAILS FOR STRAIN POLES (ITEM FIGURE 498-3B)

<table>
<thead>
<tr>
<th>REFERENCE SHEET NO.</th>
<th>STATION &amp; OFFSET</th>
<th>POLE NO.</th>
<th>DESIGN NO.</th>
<th>POLE WEIGHT (LF)</th>
<th>SPAN WIRE TYPICAL LENGTH</th>
<th>SPAN WIRE SPACE (FT)</th>
<th>INDEX LINE ANGLE (DEG)</th>
<th>PEDESTRIAN SIGNALS</th>
<th>PEDESTRIAN PUSH BUTTONS</th>
<th>CONTROLLER</th>
<th>POWER SERVICE</th>
<th>CABLE ENTRANCE FT FROM TOP</th>
<th>LUMINARIE BRACKET</th>
<th>INTERCONNECT POLE SPACE (IN)</th>
<th>2&quot; CAPPED</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

*SEE ITEM 441-8

PEDESTRIAN SIGNAL HEADS, PUSH BUTTONS, AND ASSOCIATED SIGNS SHALL BE MOUNTED AS PER TC-85.30 ON THE SUPPORT POLE.

PLAN VIEW FOR TYPICAL SPANWIRE (BOX) DETAIL

- 1 FT MIN TO OP MAX (CLEARANCE PER TC-85.22)
- TETHERED PER TC-85.21

NOTES:
- ALL ANGLES ARE MEASURED CLOCKWISE.
- THE INDEX LINE GOES THROUGH THE CENTER OF THE HANDHOLES.

POLE DIAGRAM

SUPPLEMENTAL SIGNAL HEADS SHALL BE MOUNTED AS PER TC-85.30 ON THE SUPPORT POLE.

NOTE:
- TOP OF SIGNAL SUPPORT AND PEDESTAL FOUNDATIONS SHALL BE LEVEL WITH THE SIDEWALK ELEVATION WHERE 20' LANDINGS ARE ADJACENT; ELSEWHERE, FOUNDATIONS SHALL BE 6" TO 9" ABOVE GRADE PER TC-532.20
### COORDINATION TIMING CHART (ITEM FORM 496-5)

<table>
<thead>
<tr>
<th>Splits (g+1) in Seconds</th>
<th>Offset 1 (Sec)</th>
<th>Offset 2 (Sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase</strong></td>
<td><strong>1</strong></td>
<td><strong>2</strong></td>
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<tr>
<td><strong>Direction</strong></td>
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<td>-</td>
</tr>
<tr>
<td><strong>Plan No.</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection 1</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection 2</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection 3</strong></td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Intersection 4</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection 5</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection 6</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### CORRIDOR LAYOUT

- **Intersection 1**
- **Intersection 2**
- **Intersection 3**
- **Intersection 4**
- **Intersection 5**
- **Intersection 6**

### COORDINATION TIMING PLANS

<table>
<thead>
<tr>
<th>Day(s) of Week</th>
<th>Plan Name</th>
<th>Hours</th>
<th>Cycle/Split/Offset</th>
<th>Cycle Length (Sec)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Notes:**
- Offsets are measured from reference phase(s) numbered "End of green/beginning of yellow."  
- Master intersection offset reference is always equal to zero.  
- ∑(t0+g) = ∑(g+g) and ∑(g+g) = ∑(t0+g)

### DESIGNER NOTES:
- Be sure to clarify at a minimum Mon-Fri & Sat-Sun plan. (Recommend labeling AM Peak, Mid Day, PM Peak, Off Peak, etc.)  
- Hours are given in military time.  
- Split times and offsets given in % are not accepted.
### Vehicular/Ped Volume Chart (Item Form 496-18)

<table>
<thead>
<tr>
<th>Phase</th>
<th>1</th>
<th>2</th>
<th>3/4</th>
<th>4/5</th>
<th>5/6</th>
<th>6/7</th>
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<tr>
<td><strong>Direction</strong></td>
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<tr>
<td><strong>Intersection 1</strong></td>
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<td><strong>Intersection 2</strong></td>
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<td><strong>Intersection 6</strong></td>
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</table>

### Count Information
- **Month/Year:** -
- **Day of Week:** -
- **Time Periods:** -
- **Total Number of Hours:** -
- **Method of Obtaining Counts:** -
- **Type of Count:** -

### Notes:
- Volumes are per hour
- Corresponding timing plans shown on coordination timing charts

### Designer Notes:
- Vehicular volumes include passenger, a commercial, and B & C commercial
- Counts older than three (3) years may only be used with approval from the Office of Traffic Operations.
## CLEARANCE INTERVALS

<table>
<thead>
<tr>
<th>FACTORS</th>
<th>TRAFFIC SIGNAL</th>
<th>PEDESTRIAN</th>
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<tr>
<td></td>
<td>CALCULATED</td>
<td>FINAL CLEARANCE</td>
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### NOTES:
- Grade is measured from the stop bar to 200' behind the stop bar
- For LT movement, use speed of 25 MPH
- Y+AR interval shall not exceed 7 sec unless prior approval is given
- All phase pairs shall have the same Y+AR times. Latching Lefts shall have Y+AR times equal to the mainline through phase.

**DESIGNER NOTE:**

REQUIRED FOR PLAN REVIEW ONLY. DO NOT INCLUDE THIS SHEET IN THE DESIGN PLANS.
### MAST ARM POLE HEIGHT CALCULATIONS

<table>
<thead>
<tr>
<th>SUPPORT NO.</th>
<th>ARM</th>
<th>NO. BRACKET ARMS</th>
<th>LUMINAIRE LENGTH (IN BRACKET ARMS)</th>
<th>NUMBER OF BRACKET LUMINAIRE/SIGN</th>
<th>ATTACHMENT DISTANCE FROM SUPPORT POLE</th>
<th>SIGNAL HEAD TYPE</th>
<th>SIGNAL HEAD TYPE (IN)</th>
<th>SIGNAL NO.</th>
<th>SIGNAL HEAD TYPE (IN)</th>
<th>MINIMUM HEIGHT OF POLE</th>
<th>MAXIMUM HEIGHT OF POLE</th>
<th>MINIMUM ALLOWABLE DISTANCE TO MAST</th>
<th>MAST NO.</th>
<th>HEIGHTE OF EXPOSURE</th>
<th>POLE HEIGHT OF EXPOSURE</th>
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</tbody>
</table>

### MAST ARM DESIGN CALCULATIONS

<table>
<thead>
<tr>
<th>SUPPORT NO.</th>
<th>ARM</th>
<th>NO. BRACKET LUMINAIRE/SIGN</th>
<th>LUMINAIRE/BRACKET ARM LENGTH</th>
<th>SIGNAL NO.</th>
<th>ATTACHMENT DISTANCE FROM SUPPORT POLE</th>
<th>SIGNAL HEAD TYPE (IN)</th>
<th>AREA</th>
<th>ATTACHMENT LENGTH X AREA</th>
<th>TOTAL MAST ARM LENGTH</th>
<th>DAMPER REQUIRED</th>
<th>AREA MOMENT FACTOR</th>
<th>DESIGN NO.</th>
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### TWO ARM SUPPORT DESIGN NO.

<table>
<thead>
<tr>
<th>SUPPORT NO.</th>
<th>ARM</th>
<th>DESIGN NO.</th>
<th>POLE SIZE</th>
<th>POLE DESIGNATION</th>
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</thead>
<tbody>
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</table>

### NOTES:
- CALCULATIONS SHOULD BE CHECKED AGAINST CROSS SECTIONS. BE SURE TO TAKE INTO CONSIDERATION CRITICAL PAVEMENT ELEVATIONS UNDER SIGNAL HEADS AND THE CROWN/SLOPE OF THE ROADWAY.
- FOR MAST ARMS LESS THAN OR EQUAL TO 48', ASSUME A 0' RISE, FOR MAST ARMS GREATER THAN 48' IN LENGTH, ASSUME A 0.5' RISE. FOR NON-STANDARD MAST ARMS, CHECK WITH THE MANUFACTURER FOR APPROPRIATE RISE. IT IS UP TO THE DESIGNER TO DETERMINE WHETHER THE ASSUMED IS APPLICABLE.
- FOUNDATIONS SHALL BE LEVEL WITH THE SIDEWALK WHEN ADJACENT TO ADA CURBING, OTHERWISE THE TOP OF FOUNDATION SHOULD BE 27" ABOVE GROUND LEVEL.
- TYPICAL HEIGHT FROM MAST ARM TO TOP OF POLE WITHOUT EXTENSION IS 1.5', WITH EXTENSION IS 3.5' OF POLE + 10" EXTENSION.
- SECTION HEADS MUST BE CENTERED ON YELLOW DUE TO MID MOUNTING BRACKET.
- ALL SIGNALS IN THE INTERSECTION SHALL BE CENTERED ON THE SAME COLOR FOR CONSISTENCY.
- AREA OF SIGNAL HEADS FOUND USING TABLE 497-5.
- FOR DIMENSIONS OF STANDARD SIGNS, PLEASE REFER TO THE SIGN DESIGNS AND MARKINGS MANUAL.
- FOR TOTAL MAST ARM LENGTH, ADD 5' LENGTH BEYOND THE CENTER OF THE FARthest SIGNAL, OR 3' LENGTH BEYOND THE EDGE OF THE FURTHEST SIGN.
- DESIGN NUMBERS SHALL BE DETERMINED USING TABLES 440-3 & 440-4.
NOTES

- A minimum of two through signal faces is always required for the primary movement.

- The required signal faces for through traffic on an approach shall be located not less than 8 feet apart measured horizontally perpendicular to the approach between centers of the signal faces.

- If a protected-permitted left-turn mode is used with shared signal face... it shall be located over the projection of the lane line between the left-turn and through lanes.

- Any primary signal face for an exclusive turn lane should be located over the center of each exclusive turn lane. It shall not be positioned any further to the right of the extension of the right-hand edge of the exclusive turn lane or any further to the left than the extension of the left-hand edge of the exclusive turn lane.

- For approaches of 45 MPH or greater, with two or more through lanes, provide one signal face per through lane. (See Table 4D-1 of ODOT)

- For approaches of 45 MPH or greater, with two or more total approach lanes, add a supplemental signal head.

- Signal faces mounted at the side of the roadway with curbs at least 15 feet from the bottom of the housing or attachments shall have a horizontal offset of not less than 2 feet from the face of vertical curb or edge of shoulder if no curb.

- Near sided, support pole mounted, supplemental heads should be considered when truck volumes are greater than 20%, or if sight distance is limited.

* See 2012 O MUTCD Section 4D.10 for additional layouts
ODOT
Typical Signal Head Placements

Single Lane Approach

Protected/permissive left, thru/right or Unprotected left, thru/right

Thru/left, protected/permissive right (overlap) or Thru/left, permissive right

Protected only left, thru/right

Two Lane Approach

Notes:
- Signal head configuration may vary depending on preference.
- Per OMUTCD 4D.11, a minimum of two primary signal faces shall be provided for the signalized turning movement that is considered to be the major movement from the approach.

* See 2012 OMUTCD Section 4D.10 for additional layouts
ODOT
Typical Signal Head Placements

3 Lane "T" Intersection
Center heads over approach lanes
Center heads over approach lanes
5 unit w/ LT & RT Arrows

Protected/permissive left, thru, right turn lane
Center over lane lines

Center heads over approach lanes

Protected only left, thru, right turn lane
Center heads over approach lanes

Protected only left, thru, right turn lane (w/ overlap)
Center head over approach lane

Protected/permissive left, thru, thru/right
Center over lane lines

Protected only left, thru, thru/right
Center heads over approach lanes

* See 2012 MUTCD Section 4D.10 for additional layouts
ODOT
Typical Signal Head Placements

- Center heads over approach lanes
- 2' right of lane line
- Over edgeline
- * Spacing could vary depending on lane width, 8' minimum.
- 2'

Dual left, thru/right

- Center heads over approach lanes
- 2* left of lane line
- Over center line
- * Spacing could vary depending on lane width, 8' minimum.
- 2'

Thru/Left, Double Right

- Center heads over approach lanes
- Center over lane lines
- 3 or 5 unit head

Protected/permissive left, 2 thru, right turn lane

- Center heads over approach lanes
- 3* left of lane line
- Center head over approach lane
- * Distance between heads shall be consistent; 8' minimum.
- 3*

Protected only left, 2 thru, right turn lane

- Center heads over approach lanes
- Center head over approach lane
- * Distance between heads shall be consistent; 8' minimum.
- 3*

Protected only left, 2 thru, right turn lane (w/ overlap)

- Center heads over approach lanes
- Center head over approach lane
- * Distance between heads shall be consistent; 8' minimum.
- 3*

Dual left, thru, thru/right

* See 2012 OMUTCD Section 4D.10 for additional layouts
ODOT
Typical Signal Head Placements

Center heads over approach lanes

Dual left, 2 thru, right turn lane

Center heads over approach lanes

3' left of lane line
Center over lane line

* Distance between heads shall be consistent.

Dual left, 2 thru, right turn lane (w/ overlap)

* See 2012 OMUTCD Section 4D.10 for additional layouts