Index 17743 Standard Mast Arm "D" & "E" Assemblies

Design Criteria

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition (LTS-6); ***Structures Manual*** Volume 3, FDOT Modifications to LTS-6; ***Structures Manual*** Introduction, I.6 References.

Design Assumptions and Limitations

The maximum span length of Standard Mast Arm Assemblies is 78 feet. See the ***PPM***, Volume 1, Chapter 29 for additional information.

See notes on the ***Design Standard*** and ***Structures Manual*** Volume 3.

Design all mast arm traffic signal assemblies with backplates in accordance with the ***PPM***, Volume 1, Section 7.4.17

Standard mast arm assemblies comply with the minimum requirements and design criteria shown on ***Design Standards*** Index 17745.

Standard Mast Arm Assemblies: Mast arms that utilize all pre-designed components for the selected Load Trees shown in Figure 1.

Standard Mast Arm assemblies are limited to 110,130 or 150 mph design wind speeds with one of the load tree configurations shown in Figure 1, and either single arm, single arm with luminaire, or double arms with arm orientations of 90° or 270° only.

Foundations and base plates for standard mast arm assemblies are pre-designed based on the following soil criteria:

Classification:	Cohesionless (Fine Sand)
Friction Angle:	30 Degrees
Unit Weight:	50 pcf (assumed submerged)
N-blowcount:	15

When the designer considers soil types at the specific site location to be of lesser strength properties than shown above, an analysis is required. Auger borings, SPT borings, or CPT soundings may be used as needed to verify the assumed soil properties, and at sites confirmed to be uniform, a single boring or sounding may cover several foundations. Borings in the area that were performed for other purposes may be used to confirm the assumed soil properties. Unique site circumstances may require the foundation variables to be modified from those shown on Index 17743. Accomplish this by completing the "Special Drilled Shaft Data" in the "Standard Mast Arm Assemblies Data Table". The Geotechnical Engineer must justify the differing foundation criteria to the District Structures Design Engineer during the design phase of the project.

To use standard mast arm assemblies:

1. Confirm that the information furnished by the signal designer in the "Mast Arm Tabulation Sheet" meets the geometric and load tree limitations shown in Figure 1.
2. Follow the procedure described in the design examples in the ***PPM***, Volume 2, Chapter 24, complete the necessary information required in the "Standard Mast Arm Assemblies Data Table" and include in the Traffic Plans.

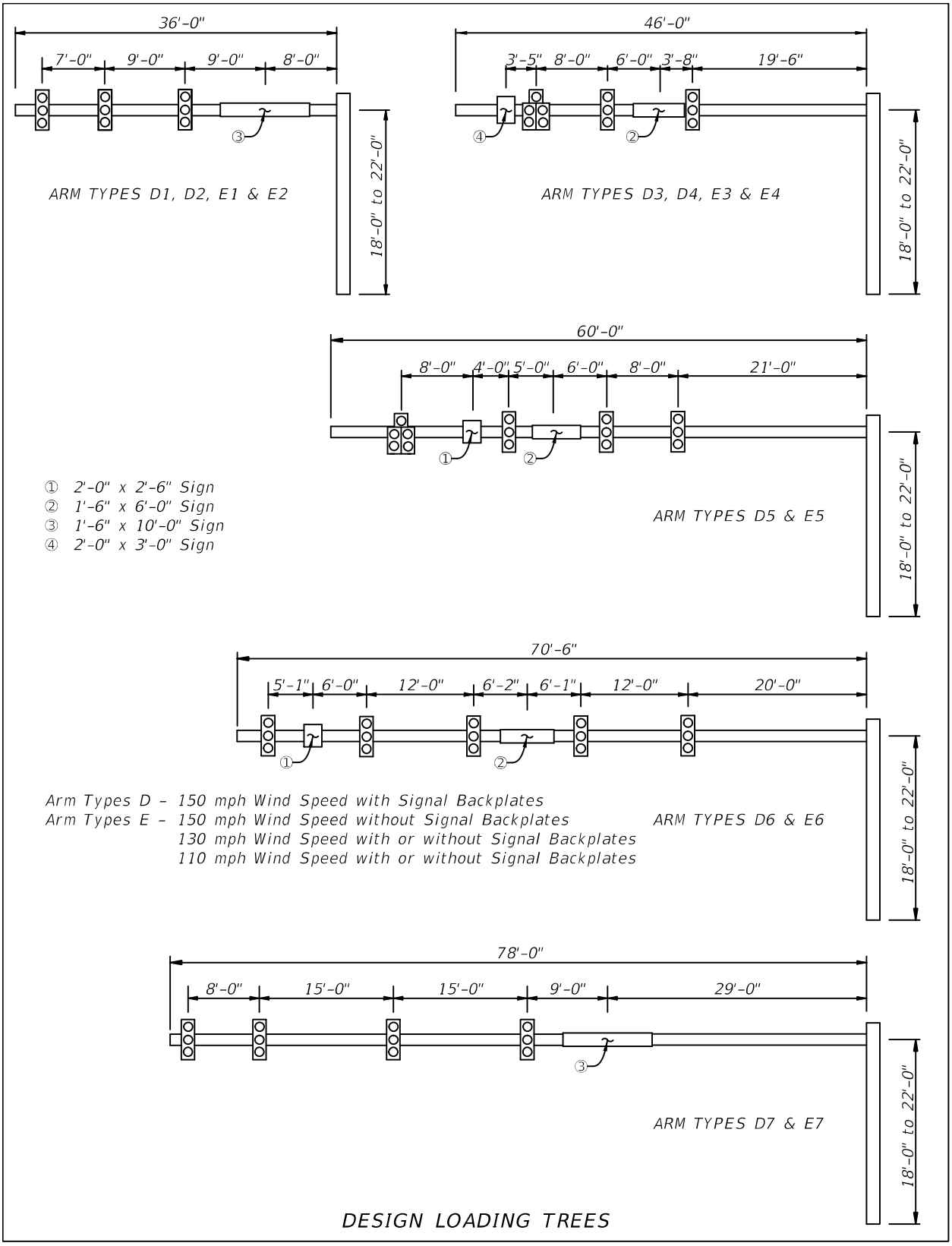
Standard Mast Arm Assemblies for Site-Specific Loadings: Mast arms for unique loadings but which utilize all pre-designed components.

The FDOT Mast Arm Program will select component parts from those shown on Index 17743 for site specific load configurations differing from those shown in Figure 1.

In order to be eligible for utilization of pre-designed component parts, the mast arm assemblies must utilize only arms and poles from the components listed in the tables on Index 17743. As for standard mast arm assemblies, the foundation design is included with the pole selection and needs no further information.

Design and detail standard mast arm assemblies utilizing pre-designed component parts in the plans in the same manner as for standard mast arm assemblies by use of the "Standard Mast Arm Assemblies Data Table" cell. Similarly, because all pre-designed component parts are used, shop drawings are not required.

Figure 1


36'-0"
7'-0"
9'-0"
9'-0"
8'-0"
③
18'-0" to 22'-0"
ARM TYPES D1, D2, E1 & E2
46'-0"
3'-5"
8'-0"
6'-0"
3'-8"
19'-6"
④
②
18'-0" to 22'-0"
ARM TYPES D3, D4, E3 & E4
60'-0"
8'-0"
4'-0"
5'-0"
6'-0"
8'-0"
21'-0"
①
②
18'-0" to 22'-0"
ARM TYPES D5 & E5
① 2'-0" x 2'-6" Sign
② 1'-6" x 6'-0" Sign
③ 1'-6" x 10'-0" Sign
④ 2'-0" x 3'-0" Sign
70'-6"
5'-1"
6'-0"
12'-0"
6'-2"
6'-1"
12'-0"
20'-0"
①
②
18'-0" to 22'-0"
ARM TYPES D6 & E6
Arm Types D – 150 mph Wind Speed with Signal Backplates
Arm Types E – 150 mph Wind Speed without Signal Backplates
130 mph Wind Speed with or without Signal Backplates
110 mph Wind Speed with or without Signal Backplates
78'-0"
8'-0"
15'-0"
15'-0"
9'-0"
29'-0"
③
18'-0" to 22'-0"
ARM TYPES D7 & E7
DESIGN LOADING TREES

Plan Content Requirements

The signal designer completes the Mast Arm Tabulation Sheets, and the structures designer completes the Standard Mast Arm Assemblies Data Table, both of which will be included in the plans. These are the only plan sheets required for mast arm assemblies which meet the Department's Standard. The structures data table may be placed on a signal plan sheet, if space permits. Mast arm assemblies that do not meet the mast arm standard will require a special design (See Index 17745). See Introduction I.3 for more information regarding use of Data Tables.

The following instructions are for use with the Mast Arm Tabulation Sheets:

1. Each mast arm assembly is identified by a unique ID number.
2. Dimensions 1-5 are for signals and dimensions A-E are for signs. Record the distance from the edge of the pole, at ground level, to the center of the signal or sign.
3. Signals may be mounted vertically or horizontally. Indicate the mounting in the appropriate column in the table.
4. The entire line for arm #2 and the space for the angle between dual arms are left blank for single arm assemblies.
5. All arms and poles will be galvanized. If a color is required, indicate the color in the table, otherwise leave blank.
6. Starting at the pole, select the signals and/or signs that match the configuration you are tabulating. The spaces representing the signs or signals not used will be blank. Example 1: If no sign is located between the pole and signal 1, the spaces for Sign A would be blank. Example 2: A configuration for three signals and one sign between signal 1 and signal 2 - Only the spaces for signals 1, 2, 3 and sign B would be completed; the others will be blank.
7. Record the number of sections in each signal head in the space following the distance to that head.
8. Record the height and width of each sign in the space following the distance to the sign.
9. When double arm poles are used for a skewed intersection, the standard design should be used whenever possible. The standard orientation for arm #2 is 90 or 270 degrees measured in a counter clockwise direction from arm #1. The normal orientation of the mast arm is perpendicular to the roadway. Adjustments in mounting hardware can compensate for a skew angle of approximately 15 degrees or more from the normal, depending upon the attachment method. The designer should verify the mounting hardware capability before specifying an arm with a skew greater than 15 degrees.
10. The arm mounting height should be calculated to provide a minimum vertical clearance of 17'-6" from the roadway crown elevation to the lowest sign or signal. A standard signal section is approximately 14" square. Therefore the length of a 3-section head is about 42" and a 5-section is about 70". The use of back plates will add about 6" to each side of the signal head. Additionally, approximately 3" should be added to the end of the signal head to compensate for the attachment hardware. The

designer should coordinate with the maintaining agency to insure the signal assembly and all appropriate hardware has been considered in determining the vertical clearance. The maintaining agency can also provide guidance on the vertical or horizontal mounting of the signal assemblies. This information may be used to determine the arm mounting height.

11. The standard handhole location is 180 degrees from arm #1. Other handhole locations must be noted in the Special Instructions.

12. A free swinging internally illuminated street name sign may be attached to the Upright by an independent bracket arm if the sign area does not exceed 18 square feet and weigh more than 144 pounds. The Structures Design Engineer must review other signs attached to the pole or any size sign of this type attached to the signal mast arm.

13. The "Special Instructions" Table is used to tabulate pedestrian buttons and pedestrian signal locations and handhole locations when the handholes are not in the standard location. Tabulate the ID No. and the orientation of the pedestrian buttons and signals in degrees measured counter clockwise from arm #1. The handhole location should be left blank if the handhole is in the standard location (see note 11).

14. Arm #1 is the arm for a single arm assembly or the longer arm for a double arm assembly. If the arms are equal length, arm #1 is over the project roadway.

STANDARD MAST ARM ASSEMBLIES DATA TABLE																			Table Date 01-01-12
STRUCTURE ID NUMBERS	ASSEMBLY NUMBERS (1)	FIRST ARM			SECOND ARM			UF (deg)	LL (deg)	POLE				SPECIAL DRILLED SHAFT (4)					
		ARM TYPE	FAA (2) (ft.)	FBA (2) (in.)	ARM TYPE	FAA (2) (ft.)	FBA (2) (in.)			POLE TYPE	UAA (3) (ft.)	UB (ft.)	UCA (3) (in.)	DA (ft.)	DB (ft.)	RA	RB	RC	RD (in.)

TABLE NOTES [Notes Date 07-01-14]:

1. *Assembly Number Legend*

   Single Arm:
   Arm Type - Pole Type = D# - S#
   = E# - T#

   Double Arm:
   First Arm Type - Second Arm Type - Pole Type = D# - D# - S#
   = E# - E# - T#

2. *If an entry appears in columns "FAA" and "FBA", a shorter arm is required. This is obtained by removing length from the arm tip. For these cases the mast arm length shall be shortened from "FA" to "FAA" and the tip diameter shall be increased from "FB" to "FBA".*

3. *If an entry appears in columns "UAA" and "UCA", a shorter pole is required. This is obtained by removing length from the pole tip. For these cases the pole height shall be shortened from "UA" to "UAA" and the pole tip diameter shall be increased from "UC" to "UCA".*

4. *The foundations for Standard Mast Arm Assemblies are pre-designed and are based upon the following conservative soil criteria which covers the great majority of soil types found in Florida. Only complete the "Special Drilled Shaft" data information if site conditions dictate drilled shafts with additional foundation capacity.*

   Classification = Cohesionless (Fine Sand)
   Friction Angle = 30 Degrees (30°)
   Unit Weight = 50 lbs. / cu. ft. (assumed saturated)
   N-blowcount = 15

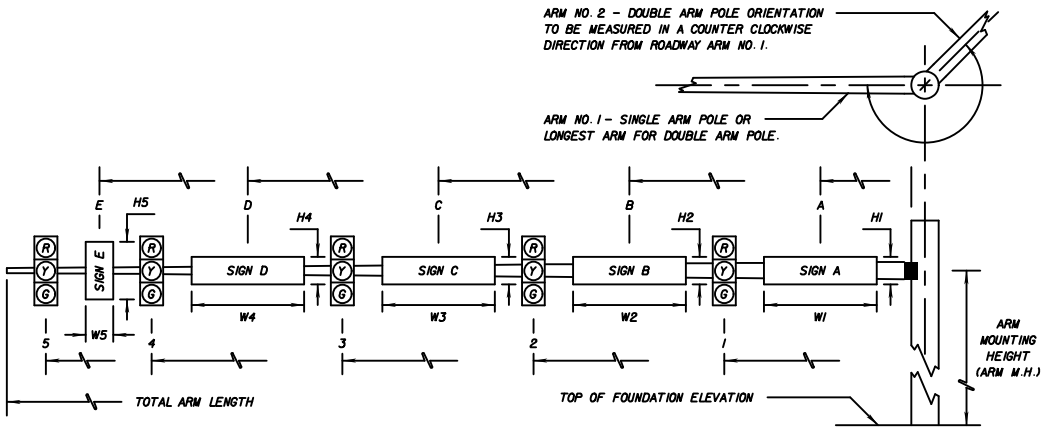
GENERAL NOTES:

1. *Work this sheet with the Signal Designer's "Mast Arm Tabulation". See "Mast Arm Tabulation" for special instructions that include non-standard Handhole location, paint color, terminal compartment requirement, and pedestrian features.*

2. *Work with Index Nos. 17743 and 17745.*

Mast Arm Tabulation Sheet 1 of 2

SPECIAL INSTRUCTIONS					
ID NO.	PED. BUTTON		PED. SIGNALS		HANDHOLE LOCATION



* DENOTES NUMBER OF SECTIONS IN SIGNAL HEAD ASSEMBLY

						SIGNAL DATA															SIGN DATA																		
ID NO.	SHEET NO.	LOCATION BY STA.	TOP OF FOUNDATION ELEVATION	RDWY ARM NO.	CROWN ELEV.	SIGNAL V/H	BACK PLATES Y/N	PED. SIGNAL Y/N	DISTANCE FROM POLE											TOTAL ARM LENGTH	ARM M.H.	∠ BETWEEN DUAL ARMS 90/270	DISTANCE FROM POLE / HEIGHT AND WIDTH OF SIGN																PAINT COLOR
									1	*	2	*	3	*	4	*	5	*				A	H1	W1	B	H2	W2	C	H3	W3	D	H4	W4	E	H5	W5	
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		
				1																																		
				2																																		

Mast Arm Tabulation Sheet 2 of 2

* DENOTES NUMBER OF SECTIONS IN SIGNAL HEAD ASSEMBLY

						SIGNAL DATA																		SIGN DATA																		
									DISTANCE FROM POLE															DISTANCE FROM POLE / HEIGHT AND WIDTH OF SIGN																		
ID NO.	SHEET NO.	LOCATION BY STA.	TOP OF FOUNDATION ELEVATION	RDWY ARM NO.	CROWN ELEV.	SIGNAL Y/N	BACK PLATES Y/N	PED. SIGNAL Y/N	1	*	2	*	3	*	4	*	5	*	TOTAL ARM LENGTH	ARM M.H.	∠ BETWEEN DUAL ARMS 90/270	A	H1	W1	B	H2	W2	C	H3	W3	D	H4	W4	E	H5	W5	PAINT COLOR			
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						
				1																																						
				2																																						

SPECIAL INSTRUCTIONS					
ID NO.	PED. BUTTON		PED. SIGNALS		HANDHOLE LOCATION

SPECIAL INSTRUCTIONS				
ID NO.	PED. BUTTON	PED. SIGNALS		HANDHOLE LOCATION

SPECIAL INSTRUCTIONS				
ID NO.	PED. BUTTON		PED. SIGNALS	HANDHOLE LOCATION

SPECIAL INSTRUCTIONS				
ID NO.	PED. BUTTON		PED. SIGNALS	HANDHOLE LOCATION

Payment

Item number	Item description	Unit Measure
649-3A-BCC	Steel Mast Arm Assembly	EA

Examples

Following are examples for use with the Standard Mast Arm Assemblies Data Table:

EXAMPLE 1

1. Select Arm Type.

   Investigate Arm E1. Compare attachment sizes and locations with design loading tree in Figure 1. All signals and signs are no further from the pole than shown in the Arm E1 design loading tree. Select Arm Type E1.

2. Select Pole Type.

   Use Pole Selection Tables in Index 17743 of the ***Design Standards***. Select Pole Type T1.

3. Determine Arm Mounting Height.

   UB + 10' = 12.5' + 17.5'min. + 2'

   UB = 22'min. Use 22'

EXAMPLE 2

1. Select First Arm Type.

   Designate longest arm as First Arm. For 52' arm, investigate Arm D5. Compare attachment sizes and locations with design loading tree. All signals and signs are no larger than and are no further from the pole than shown in the Arm D5 design loading tree. Select Arm Type D5.

2. Specify shorter arm.

   Enter 27.8' under FAA.

   FAA + FE - Splice = 27.8' + 26.2' - 2' = 52'

   Determine actual tip diameter.

   FBA = FB + (60' - 52') x taper = 7.99" + 8' (0.14"/ft) = 9.11"

3. Select Second Arm Type.

   Select Arm Type D2.

4. Enter angle between arms.

   Angle UF is measured counter-clockwise from the First Arm and must be either 90° or 270°.

5. Select Pole Type.

   Use Pole Selection Tables. Select Pole Type S3.

6. Determine Arm Mounting Height.

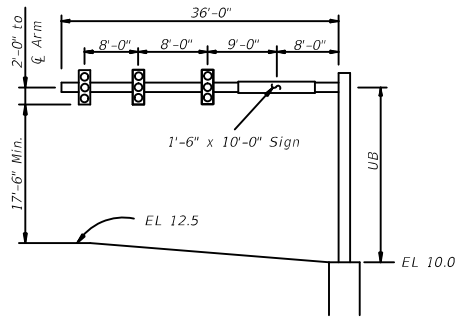
   UB + 10' = 9.5' + 17.5'min. + 2'
   UB = 19' min. Use 20'

7. Specify shorter pole.

   Enter 22' under UAA.
   Determine actual tip diameter.
   UCA = UC + (25' - 22') x taper = 17.53" + 3' (0.14"/ft) = 17.95"

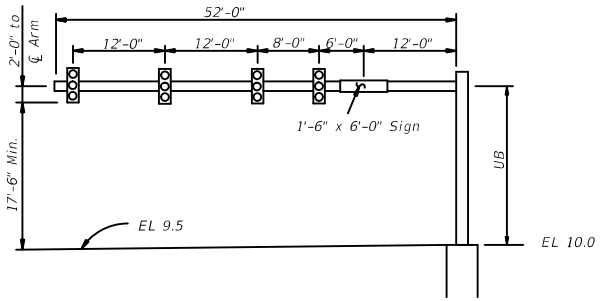
EXAMPLE 1

Single Arm Structure as shown,
110 mph Wind Speed with Signal Backplates.



EXAMPLE 2

First Arm Structure as shown, Second Arm same as Example 1
except 150 mph Wind Speed with Signal Backplates.



STANDARD MAST ARM ASSEMBLIES DATA TABLE

Table Date 01-01-12

STRUCTURE ID NUMBERS	ASSEMBLY NUMBERS (1)	FIRST ARM			SECOND ARM			UF (deg)	LL (deg)	POLE				SPECIAL DRILLED SHAFT (4)					
		ARM TYPE	FAA(2) (ft.)	FBA(2) (in.)	ARM TYPE	FAA(2) (ft.)	FBA(2) (in.)			POLE TYPE	UAA(3) (ft.)	UB (ft.)	UCA(3) (in.)	DA (ft.)	DB (ft.)	RA	RB	RC	RD (in.)
Example 1	E1 - T1	E1								T1		22							
Example 2	D5 - D2 - S3	D5	27.8	9.11	D2			270		S3	22	20	17.95						

TABLE NOTES [Notes Date 07-01-14]:

1. Assembly Number Legend

   Single Arm:
   Arm Type - Pole Type = D# - S#
   = E# - T#

   Double Arm:
   First Arm Type - Second Arm Type - Pole Type = D# - D# - S#
   = E# - E# - T#

2. If an entry appears in columns "FAA" and "FBA", a shorter arm is required. This is obtained by removing length from the arm tip. For these cases the mast arm length shall be shortened from "FA" to "FAA" and the tip diameter shall be increased from "FB" to "FBA".

TABLE NOTES (CONT.):

3. If an entry appears in columns "UAA" and "UCA", a shorter pole is required. This is obtained by removing length from the pole tip. For these cases the pole height shall be shortened from "UA" to "UAA" and the pole tip diameter shall be increased from "UC" to "UCA".

4. The foundations for Standard Mast Arm Assemblies are pre-designed and are based upon the following conservative soil criteria which covers the great majority of soil types found in Florida. Only complete the "Special Drilled Shaft" data information if site conditions dictate drilled shafts with additional foundation capacity.

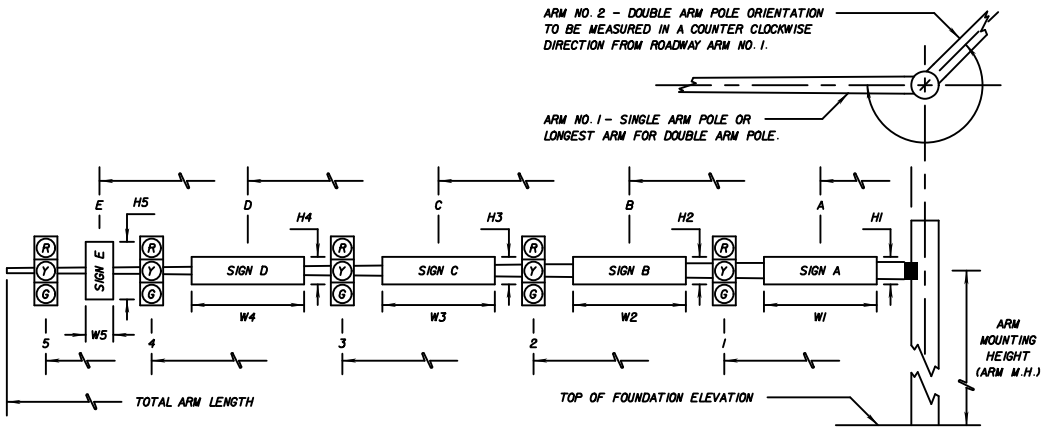
   Classification = Cohesionless (Fine Sand)
   Friction Angle = 30 Degrees (30°)
   Unit Weight = 50 lbs. / cu. ft. (assumed saturated)
   N-blowcount = 15

GENERAL NOTES:

1. Work this sheet with the Signal Designer's "Mast Arm Tabulation". See "Mast Arm Tabulation" for special instructions that include non-standard Handhole location, paint color, terminal compartment requirement, and pedestrian features.

2. Work with Index Nos. 17743 and 17745.

SPECIAL INSTRUCTIONS					
ID NO.	PED. BUTTON		PED. SIGNALS		HANDHOLE LOCATION



* DENOTES NUMBER OF SECTIONS IN SIGNAL HEAD ASSEMBLY

						SIGNAL DATA														SIGN DATA																
									DISTANCE FROM POLE											DISTANCE FROM POLE / HEIGHT AND WIDTH OF SIGN																	
ID NO.	SHEET NO.	LOCATION BY STA.	TOP OF FOUNDATION ELEVATION	RDWY ARM NO.	CROWN ELEV.	SIGNAL V/H	BACK PLATES Y/N	PED. SIGNAL Y/N	1	*	2	*	3	*	4	*	5	*	TOTAL ARM LENGTH	ARM M.H.	∠ BETWEEN DUAL ARMS 90/270	A	H1	W1	B	H2	W2	C	H3	W3	D	H4	W4	E	H5	W5	PAINT COLOR
1	T-4	EXAMPLE 1	10.0	1	12.5	V	Y		17.0	3	25.0	3	33.0	3					36.0	22.0		8.0	1.5	10.0													
				2																																	
2	T-5	EXAMPLE 2	10.0	1	9.5	V	Y		18.0	3	26.0	3	38.0	3	50.0	3			52.0	22.0	270	12.0	1.5	6.0													
				2	12.5	V	Y		17.0	3	25.0	3	33.0	3					36.0	22.0		8.0	1.5	10.0													
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	
				1																																	
				2																																	