***** THIS STANDARD REPLACES FORMER TDMIS-1500, 1501, 1502 *****

2300. GENERAL

This section covers the physical and electrical data on standard primary conductors and those that have been commonly used on overhead distribution systems.

Detailed design data for primaries, pacer cable, street lighting, and other specific conductor applications are covered in their respective sections of the text.

2310. PRIMARY CONDUCTORS

2310.1. Abbreviations

45XLP = 45 mils Cross-Linked Polyethylene Covering
60XLP = 60 mils Cross-Linked Polyethylene Covering
80XLP = 80 mils Cross-Linked Polyethylene Covering
AAC = All Aluminum Conductor
AAAC = All Aluminum Alloy Conductor
ACSR = Aluminum Cable Steel Reinforced
CCW = Copper-Copperweld
HD = Hard Drawn Copper
SD = Soft Drawn Copper

2310.2. Conductor Size

Use conductors shown in Section 2310.4 for all new construction unless otherwise specified by DOP Distribution Engineering. All conductors are concentric-lay round form.

2310.3. Covered Line Conductors

Although tree wire and other covered line conductors offer some electrical protection, it is not insulated conductor and shall not be depended upon in this respect.

2310.4. Standard Line Conductors

Bare aluminum conductors shall supplied in accordance with TDMIS-9061.

TDMIS ID	Code Name	Size (AWG or kcmil)	Type	No. of Strands	Outside Dia. (in.)	Ampacity (A)
WPA3	Azusa	1/0	AAAC	7	0.398	256
WPA4	Cosmos	477	AAC	19	0.792	639
WPA5	Drake	795	ACSR	26/7	1.107	907

Table 2300-1: Standard Bare Aluminum Line Conductor

Covered aluminum conductors shall supplied in accordance with TDMIS-9063.

TDMIS ID	Size (AWG or kcmil)	Type	No. of Strands	Outside Dia. (in.)	Ampacity (A)
WPS1	1/0	AAC	7	0.666	216
WPS2	556	AAC	19	1.120	647

Table 2310-2: Standard Covered Aluminum Line Conductor (Spacer Cable)

Copper conductors shall supplied in accordance with TDMIS-9062.

TDMIS ID	Size (AWG or kcmil)	Type	No. of Strands	Covering	Outside Dia. (in.)	Ampacity (A)
WPC1	6	SD	1	Bare	0.162	125
WPC2	4	SD	1	Bare	0.204	170
WPC3	2	SD	7	Bare	0.292	230
WPC3X	2	SD	7	45XLP	0.373	230
WPC4	2/0	SD	7	Bare	0.414	355
WPC4A	2/0	SD	19	Bare	0.418	355
WPC5	4/0	SD	7	Bare	0.522	480
WPC5X	4/0	SD	7	60XLP	0.626	465
WPC5C	4/0	CCW	12/7	Bare	0.613	480
WPC6X	500	SD	37	80XLP	0.950	785

Table 2310-3: Standard Bare and Covered Copper Lead, Ground, and Tap Conductors

Spacer cable messenger shall supplied in accordance with TDMIS-9063.

TDMIS ID	Size	Overall Dia. (in.)	AW x Wire Dia. (in.)	Al x Wire Dia. (in.)	Breaking Strength (lbs.)
WM1	252 AWA	0.385	5 x 0.1285	2 x 0.1285	11,960
WM2	0052 AWA	0.546	5 x 0.1819	2 x 0.1819	20,420

Table 2310-4: Standard Spacer Cable Messenger

2310.5. Neutral Size

System neutrals shall be installed for all new construction and sized per Table 2310-2 below. The use of secondary or street lighting neutrals as a primary neutral (also called a "common neutral") is allowed if common neutral is appropriately sized. Spacer cable installations may use the messenger wire as a primary neutral as long as it is properly bonded, grounded, and appropriately sized. Where feasible, primary neutrals should be installed when modifying or upgrading existing circuits.

Primary Conductor	Primary Neutral Size (Open Wire)	Messenger Neutral Size (Spacer Cable)
6 AWG CU	6 AWG CU	N/A
2 AWG CU	1/0 AWG AL	N/A
1/0 AWG AL	1/0 AWG AL	252 AWA
2/0 AWG CU	1/0 AWG AL	N/A
336.4 kcmil AL	1/0 AWG AL	N/A
477 kcmil AL	1/0 AWG AL	N/A
556 kcmil AL	477 kcmil AL	0052 AWA

Table 2310-5: Minimum Neutral Size

2310.6. Installation

1. The installation shall be as required by the manufacturer's recommendations. Use recommended rollers and pulling grips. Sag shall be according to the manufacture provided charts and the initial tension documented along with temperature read on a certified thermometer. This data shall be provided to DOP for approval before energizing conductors.
2. Conductors shall be payed out from reels or hand coils. Dragging conductors shall not be permitted.

3. Conductors must be handled with care. Conductors shall neither be trampled on nor run over by vehicles. Each reel shall be examined and the conductor shall be inspected for cuts, kinks, or other injuries. Injured portions shall be cut out.
4. Conductors shall be pulled over suitable rollers or stringing blocks designed for the purpose, properly mounted on poles or crossarm as necessary to prevent binding while stringing.
5. All conductors shall be cleaned thoroughly by wire brushing before splicing or installing connectors or clamps. A suitable oxide inhibitor shall be used before splicing or applying connectors over conductors.
6. Finished installation shall not include more than one splice in any one span and splices shall not be located within 20 feet of a conductor support. No splices shall be permitted over road or highway crossings, rail road crossings, or water crossings.

2310.6.2. Connectors

Aluminum H-Tap compression type sized as appropriate for line and tap conductors.

2310.6.3. Tape Insulation

Tape insulation shall be 1.5% insulation thickness 3M #130C high voltage rubber tape with 5 minimum wraps of 3M 88 vinyl outer tape seal.

2310.7. Method of Measurement

The method of measurement shall be based on a completed open-wire conductor installation or conductor/messenger spacer cable system installation including sag, tension, guy adjustments, spacers, ties, dead end grips, connections, labor, equipment, tools, and supervision required for a complete and operational system.

Measurement shall be from pole to pole, or pole to structure with no additional adders for sag or jumpers.

2310.8. **Basis of Payment**

Items	Unit	Description
TDMIS-2310	1,000 linear feet	*[Conductor size]* overhead primary open wire, [*number of phases]* phase, with neutral
TDMIS-2310	1,000 linear feet	*[Conductor size]* overhead primary spacer cable, three phase, with messenger
TDMIS-2310	1,000 linear feet	*[Conductor size]* overhead primary neutral only

2340. SECONDARY CONDUCTORS AND DISTRIBUTION

The following section applies to new installation of overhead secondary conductors.

In cases where existing secondary conductors are deteriorated, clearances are doubtful, or poles need replacement, consideration should be given to rebuilding the entire secondary in accordance with these standards.

2340.1. General

2340.1.1. Secondary Crib

"Secondary crib" describes the overhead secondary supply conductors, typically 120/240 volt, that are supplied by a distribution transformer located near the load mid-point and that supply individual service drop cables along its route.

2340.1.2. Secondary Voltages

Refer to TDMIS-2360 for available secondary voltages.

2340.1.3. Conductors

The standard single phase, secondary crib cable is a 1/0 AWG 3/C aluminum cable consisting of one base ACSR neutral messenger and two aluminum cable covered conductors continuously wrapped around the

neutral messenger. Applications for this cable include residential, industrial, commercial, and outdoor lighting. Standard secondary conductors are listed in

Quadruplex cables shall be used for all 120/208 V, 277/480 V effectively grounded and 240 V and 480 V not effectively grounded secondaries.

For three-phase line currents greater than 245 amps, 4/C 336.4 kcmil secondary cable should be used.

TDMIS ID	Code Name	Size (AWG or kcmil)	Type	No. of Strands	Ampacity (A)
WSAD1	Shepherd	6	Duplex	7	85
WSAD2	Chow	2	Duplex	7	150
WSAT0	Conch	2	Triplex	7	150
WSAT1	Neritina	1/0	Triplex	7	180
WSAT2	Limpet	336.4	Triplex	19	370
WSAQ1	Costena	1/0	Quad	7	205
WSAQ2	Bronco	336.4	Quad	19	420

Table 2340-1: Standard Aluminum Secondary Conductors

2340.1.4. Conductor Location

In general, secondary conductors shall normally be installed on the street or highway side of the pole. On inside angles, it may be necessary or preferable to attach secondary conductors on the field side of the pole. “Boxing” in a pole by installing secondary cable on the opposite side from that of communication conductors should be avoided.

For rack construction, the neutral shall be located on the top spool of the rack. The grounded conductor of a three-phase delta secondary shall be installed in the top position on the power secondary rack. This grounded phase conductor shall not be used as a system neutral nor shall a system neutral be used as the grounded phase conductor.

When two or more secondary circuits are located on the same pole, the following order is recommended from the top:

1. Single-phase secondary
2. Three-phase four-wire secondary

3. Three-phase, three-wire secondary
4. Street lighting conductor

All grounded neutrals (except secondary neutrals of not effectively grounded primary systems), located on the same pole shall be bonded together.

2340.2. Secondary Crib Design

Good secondary crib design is dependent on knowledge of load. Actual load checks furnish the most accurate information about existing loads and should be used whenever practical. Other tools such as CUBS or GIS data are also available to accurately estimate existing loads.

Good secondary crib design also includes provisions for future load growth. Adherences to the principles in this standard will result in secondary that can grow substantially without major rebuilding.

Gaps between adjacent secondary cribs should be filled in with secondary cable when the gap is less than 400-feet in length. For longer gaps, install a standard primary neutral conductor only, unless future load growth is expected within the area of the gap.

Proper balance must be maintained between length of secondaries, size of conductors, loading of transformers, and overall voltage regulation in service drop, secondary, and transformer installations.

Proper secondary crib design will take into account all of the following:

2340.2.1. Transformer Location

Good secondary crib design will place the distribution transformer in the physical center of the secondary crib run. Adjustments can be made to favor the electrical center of the load, or accommodate other existing pole top equipment.

2340.2.2. Transformer Size

A typical residential secondary crib will have one of three basic load profiles:

1. Gas heat – 8 kW diversified per residence (includes electric range, dryer, and window air conditioner units)
2. Gas heat w/ central air – 10 kW per residence
3. Electric heat – 20 kW per residence

This estimation assumes single family homes less than 3,500 square feet and multi-family homes.

2340.2.3. Length of Secondary Crib

Transformer size, transformer location, secondary crib load, and voltage drop shall determine the length of secondary crib. For evenly distributed 120/240-V loads, Table 2340-1 serves as a guide to determine the approximate length of a straight, 1/0 AWG triplex secondary to provide a 3% voltage drop at the ends with the transformer located in the center.

Total KVA Load	Total Length of Secondary	Length of Secondary from Transformer to End
25 kVA	700 feet	350 feet
50 kVA	350 feet	175 feet
75 kVA	200 feet	100 feet

Table 2340-2: Maximum Length of Secondary Cribs

2340.2.4. Voltage Drop

Voltage drop in secondary cribs should be limited to 3% of nominal.

2340.2.5. Commercial or Industrial Secondaries

In planning commercial and industrial secondaries, consider the overall voltage regulation in the service, secondary, transformer and primary rather than specifically limiting the drop in each of the parts.

The size of secondary and service wires should be determined by consideration of both voltage drop and current. Multiplex cables are recommended if current rating and voltage drops permit. Voltage drop on secondary and service should not exceed 3%. Current should not exceed the values shown in Table 2340-1. It is generally economical to stay well below those values for everything except temporary work. In the case of intermittent loads, the above voltage limitations may be exceeded provided the resulting voltage is satisfactory.

Transformer loading should not exceed 100% of rating where the daily load factor is 100%. However, loading may be increased 0.3% for each 1% decrease in load factor to a maximum of 115% of rating at 50% load factor. The effects of load factor and temperature may be added to permit a maximum of 145% load with a load factor of 50% or less, at ambient temperatures of 0°C/32°F or below.

2340.3. Installation

Secondary conductors shall be installed in accordance with TDMIS-500 and TDMIS-502.

2340.4. Method of Measurement

The method of measurement shall be based on a completed conductor installation including sag, tension, guy adjustments, dead end grips, connections, labor, equipment, tools, and supervision required for a complete and operational system.

Measurement shall be from pole to pole, or pole to structure with no additional adders for sag or jumpers.

2340.5. **Basis of Payment**

Items	Unit	Description
TDMIS-2340	linear feet	Overhead secondary conductor, *[Conductor code name]*

2360. SERVICES

2360.1. General

These standards cover overhead services of less than 600 V and only that portion of each service that is to be installed by DOP. Refer to TDMIS-2340 for sizing conductors and transformers.

Normally, overhead secondary services shall be offered in the following voltages:

1. 120/240 V, single-phase, three-wire (for load not exceeding 50 kVA)
2. 208Y/120 V, three-phase, four-wire (for commercial and multi-unit residential)
3. 480Y/277 V, three-phase, four wire (available by special arrangement and approval only)
4. 240 V and 480 V delta services are not available for new installations

2360.2. Definitions

2360.2.1. Service Drop

The service drop or lateral is the overhead conductor between the last pole or other aerial support on the primary line and the first point of attachment to a building.

2360.2.2. Service Entrance

The service entrance is the conductor between the service drop/lateral and the service entrance switch. DOP will attach the service drop/lateral to the

customer's structure at the service bracket (supplied by and installed by the customer).

2360.3. **Conductors**

2360.3.1. Selection of Conductors

Aluminum multiplex conductors shall be installed for all new and replacement overhead services unless otherwise noted. For new construction, conductor size selected from Table 2340-1 below will be determined by the customer service entrance rating. Use triplex conductors for single-phase services and quadruplex for three-phase, four-wire services. Aluminum service cable 2 AWG and 1/0 AWG triplex and 1/0 AWG and 336.4 kcmil quadruplex shall be used in accordance with information below and the standards that follow in this section. In general, #2 triplex cable shall be used for dwellings up to and including three family where the main disconnect is 200 Amps or less. 1/0 AWG triplex service cable shall be used for large residential services where 2 AWG cable is inadequate. Cable loads should be within limits shown in Table 2340-1. If the length of service is such that the voltage drop may exceed 1%, a larger conductor should be used.

When a customer upgraded a service, the existing service cable can stay in service unless voltage drop or flicker will affect the customer.

Service Entrance		Recommended Conductor		
Type	**Max. Main Disc. Size**	**Size and Type**	**Code Name**	**TDMIS ID**
Single Phase	150 A	2 AWG Triplex	Conch	WSAT0
	200 A	1/0 AWG Triplex	Neritina	WSAT1
	400 A	336.4 kcmil Quad	Limpet	WSAT2
Three Phase	200 A	1/0 AWG Quad	Costena	WSAQ1
	400 A	336.4 kcmil Quad	Bronco	WSAQ2
	800 A	2 x 336.4 kcmil Quad	Bronco	WSAQ2

Table 2340-1: Recommended Service Conductor Sizes

2360.4. Connections to Secondaries

Taps from multiplex secondaries should be located approximately three feet from the pole to minimize pole congestion. Taps may also be made elsewhere in the span if there are right-of-way or clearance problems. Balance the service wire tension at each tap when practicable. If loading cannot be balanced, or if services are very long, they should be dead-ended at the pole.

See TDMIS-500 and TDMIS-502 for service/secondary connectors and splices.

2360.5. Connections at Buildings

See TDMIS-503 for multiplex service attachments at the building.

2360.6. Guying

It is recommended that guys be installed on poles with heavy unbalanced services, particularly when all services are taken off from the same side of a line of poles.

2360.7. Grounding and Bonding

The messenger of multiplex cables shall be connected to the grounded secondary neutral at the pole. It shall also be connected to the customer's neutral for 120/240 V, 120/208 V, or other grounded neutral service. The messenger shall be bonded to the metal mast or riser at the building.

One of the three insulated conductors of a 240 V delta service may be grounded at the pole and at the service entrance box.

2360.8. Installation

Service conductors shall be installed in accordance with TDMIS-500, 502, and 503.

2361. MEASUREMENT AND PAYMENT

2361.1. Method of Measurement

The method of measurement shall be based on a completed conductor installation including sag, tension, guy adjustments, dead end grips, connections, labor, equipment, tools, and supervision required for a complete and operational system.

Measurement shall be from pole to pole, or pole to structure with no additional adders for sag or jumpers.

2361.2. Basis of Payment

Items	Unit	Description
TDMIS-2360	linear feet	Overhead service conductor, *[Conductor code name]*