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8601 TRENCHING REQUIREMENTS

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GENERAL TRENCH AND BACKFILL REQUIREMENTS

1.0 GENERAL

THE REQUIREMENTS SET FORTH IN THIS SPECIFICATION APPLY TO ALL ARIZONA PUBLIC SERVICE COMPANY, HEREINAFTER REFERRED TO AS APS. TRENCHES WHETHER INSTALLED SEPARATELY OR JOINTLY WITH OTHER UTILITIES OR FACILITIES. THE REQUIREMENTS SPECIFIED ARE INTENDED TO BE MINIMUM REQUIREMENTS FOR SAFE, PRACTICAL INSTALLATIONS. WHERE CONFLICTS EXIST BETWEEN THESE SPECIFICATIONS AND OTHER SPECIFICATIONS OF THE CITY, COUNTY OR STATE, THE MORE STRINGENT SHALL APPLY.

1.1 THE CUSTOMER, DEVELOPER, SUBDIVIDER OR THEIR CONTRACTOR HEREINAFTER SHALL BE CALLED "CUSTOMER".

1.2 THE INSPECTOR FOR ALL WORK PERFORMED BY APS FORCES SHALL BE THE FOREMAN OR SUBFOREMAN (SEE 8601, 8.0 AND 28.5 FOR EXCEPTIONS).

1.3 **INCORPORATED BY REFERENCE**

THE FOLLOWING DOCUMENTS ARE INCORPORATED BY REFERENCE:

1.3.1 APS TRENCHING AGREEMENT/REQUIREMENTS.

1.3.2 APS ACCIDENT PREVENTION MANUAL.

2.0 SAFETY

PROTECTION FOR EMPLOYEES AND OTHERS FOR OSHA REQUIREMENTS MUST BE PROVIDED ON ALL WORK. EXCAVATION WORK REQUIRES SPECIFIC ATTENTION TO THE FOLLOWING.

2.1 **PERSONAL PROTECTIVE EQUIPMENT** (SEE APS ACCIDENT PREVENTION MANUAL)

2.1.1 SHORING OF SIDEWALLS (SEE APPLICABLE OSHA REQUIREMENTS) AND SPECIFICATION 8640.

2.1.2 USE OF LADDERS AND OTHER DEVICES FOR INGRESS AND EGRESS OF TRENCH.

2.1.3 USE OF PROTECTIVE BARRIERS FOR TRENCH EXCAVATIONS (SEE APS ACCIDENT PREVENTION MANUAL).

2.2 **SAFEGUARDS**

ALL WORK SHALL BE PLANNED AND CONDUCTED TO ADEQUATELY SAFEGUARD ALL PERSONS AND PROPERTY FROM INJURY AND SHALL TAKE INTO CONSIDERATION WARNING DEVICES AND EQUIPMENT SUCH AS SIGNS, LIGHTS, FLARES, REFLECTORS, FLAGMEN, PLATING, SHORING, BRACING AND ANY OTHER FACILITIES WHICH MAY BE REQUIRED. PERFORMANCE OF THE WORK SHALL BE DIRECTED TO ENSURE COMPLIANCE WITH REASONABLE SAFETY REGULATIONS AND WORK PRACTICES AND WITH ALL APPLICABLE FEDERAL, STATE AND LOCAL LAW RULES AND REGULATIONS INCLUDING BUT NOT LIMITED TO "OCCUPATIONAL SAFETY AND HEALTH STANDARDS" PROMULGATED BY THE U.S. SECRETARY OF LABOR AND SAFETY ORDERS OF THE ARIZONA DIVISION OF INDUSTRIAL SAFETY. THE WORK SHALL ALSO COMPLY ALL LOCAL GOVERNMENTAL BUILDING PERMIT PROVISIONS.

2.3 **PROTECTION OF PROPERTY**

WORK PERFORMED DURING THE NORMAL COURSE OF BUSINESS SHALL BE CONDUCTED SO AS TO NOT DAMAGE, CLOSE OR OBSTRUCT ANY PROPERTY UNTIL PERMITS THEREOF HAVE BEEN OBTAINED.

2.4 **STREET CLOSURES**

LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES REQUIRE ADVANCE NOTICE WHEN WORK IN A PUBLIC RIGHT-OF-WAY REQUIRES A PARTIAL OR TOTAL CLOSING OF THE RIGHT-OF-WAY. ADVANCE NOTICE IS REQUIRED WHETHER OR NOT A PERMIT HAS BEEN OBTAINED FOR THE PERFORMANCE OF THE WORK. PARTIAL OR COMPLETE CLOSURES SHALL NOT OCCUR WITHOUT THE REQUIRED ADVANCE NOTICE, EXCEPT DURING EMERGENCY SITUATIONS.

2.4.1 PARTIAL CLOSURES OF MAJOR OR COLLECTOR STREETS, AND ALL CLOSURES (PARTIAL OR COMPLETE) OF LOCAL STREETS AND ALLEYS REQUIRE A 24-HOUR ADVANCE NOTICE.

2.4.2 COMPLETE CLOSURES OF MAJOR OR COLLECTOR STREETS REQUIRE A 48/HOUR ADVANCES NOTICE.

2.4.3 NOTIFICATION OF PARTIAL OR COMPLETE CLOSURES OF STATE HIGHWAYS OR FREEWAYS SHALL BE HANDLED BY THE RIGHT-OF-WAY AGENT FOR THE AREA INVOLVED.

3.0 PURPOSE

THE PURPOSE OF THIS SPECIFICATION IS TO PROVIDE STANDARD TRENCHING CONFIGURATIONS, GENERAL REQUIREMENTS, AND GUIDELINES FOR TRENCHING, EXCAVATION AND BACKFILL WITHIN APS SERVICE TERRITORY. IT IS NOT THE INTENT OF THIS SPECIFICATION TO INCLUDE EVERY POSSIBLE SITUATION.

4.0 TRENCH EXCAVATIONS

4.1 GRADE

4.1.1 EXCAVATIONS SHALL BE MEASURED FROM FINAL GRADE AND/OR PERMANENT BENCH MARKS (TRUE DATUM), PROVIDED BY THE CUSTOMER. APS WILL PROVIDE FINAL GRADE AND/OR BENCH MARKS (TRUE DATUM) WHERE A CUSTOMER IS NOT INVOLVED.

4.1.2 WHEN APS TRENCHES AND BACKFILLS FOR A CUSTOMER, THE CUSTOMER SHALL ESTABLISH FINAL GRADE AND FLAG ALL ITS PROPERTY CORNERS BEFORE APS WILL SURVEY THE ROUTES. IN ADDITION, EASEMENTS, ALLEYS AND STREETS MUST BE GRADED WITHIN 6 INCHES OF FINAL GRADE BEFORE APS WILL BEGIN CONSTRUCTION. EXCAVATING AND/OR THE INSTALLATION FURNISHED TO APS. CUSTOMER SHALL REIMBURSE APS FOR ANY COSTS INCURRED IN ADJUSTING FACILITIES DUE TO CHANGES IN THE FINAL GRADE. FINAL GRADE SHALL BE STAKED BY THE CUSTOMER (USING BLUE-TOP STAKES) AT LOCATIONS NEEDED TO FACILITATE EXCAVATION (EXCLUDING SERVICE TRENCHES), INSPECTION OF EXCAVATION DEPT. TRANSFORMER AND/OR EQUIPMENT PAD LOCATIONS, STREET LIGHT POLE LOCATIONS, MANHOLE AND SPLICE BOX LOCATIONS.

4.2 DEPTH AND WIDTH

THE TRENCH DEPTH AND WIDTH SHALL BE SPECIFIED FOR EACH LOCATION BY APS WORK ORDER DRAWINGS PRIOR TO START OF EXCAVATION. ADDITIONAL TRENCH DEPTH IS USUALLY REQUIRED AT EQUIPMENT LOCATIONS TO PROVIDE VERTICAL SPACE TO INSTALL THE CONDUIT SWEEPS. SEE 8648 TO DETERMINE WHERE THE ADDITIONAL TRENCH DEPTH IS NORMALLY REQUIRED AT EQUIPMENT LOCATIONS AS WELL AS THE DEGREE OF SLOPE ALLOWED AS THE TRENCH CHANGES DEPTH. EXCAVATIONS SHALL BE MADE TO DIMENSIONS NECESSARY TO ACCOMMODATE APS AND OTHER JOINTLY-USED TRENCH OCCUPANT'S FACILITIES AND TO PROVIDE THE ULTIMATE MINIMUM COVER SPECIFIED HEREIN REGARDLESS OF EXISTING FIELD CONDITIONS. WHERE THE CUSTOMER HAS REQUESTED APS TO INSTALL THE CONDUIT AND PROVIDE THE LABOR TO SHADE THE CONDUIT, THE CUSTOMER PROVIDED TRENCH WIDTHS WHICH EXCEED THE DESIGN WIDTH BY MORE THAN 8 INCHES MAY RESULT IN ADDITIONAL CHARGES TO THE CUSTOMER TO COVER THE ADDITIONAL APS SHADING LABOR (ADDITIONAL WIDTH NECESSARY TO EXCAVATE LARGE ROCKS IS AN EXCEPTION). THE RESPONSIBILITY FOR PROVIDING THE LABOR TO INSTALL THE SHADING MATERIAL VARIES PER 8601, 5.3.

4.2.1 TRENCHES 46 INCHES OR MORE IN DEPTH, MEASURED TO THE TOP OF THE INSTALLED BEDDING MATERIAL, SHALL BE A MINIMUM OF 16 INCHES IN WIDTH WHEREVER A WORKER MUST ENTER THE TRENCH.

4.2.2 TRENCHES 60 INCHES OR MORE IN DEPTH, MEASURED TO THE TOP OF THE INSTALLED BEDDING MATERIAL, SHALL BE A MINIMUM OF 24 INCHES IN WIDTH WHEREVER A WORKER MUST ENTER THE TRENCH.

4.2.3 MINIMUM TRENCH WIDTHS ARE CONTINGENT UPON THE MINIMUM HORIZONTAL SEPARATION REQUIREMENTS BETWEEN FACILITIES SPECIFIED IN 8610 AND CONDUIT SPACING REQUIREMENTS SPECIFIED IN 8601, 17.0.

4.2.4 WHERE RANDOM SPACING BETWEEN ALL CONDUITS IN THE TRENCH IS ALLOWED PER 8610, THE MINIMUM TRENCH WIDTH IS 1-INCH PLUS THE SUM OF THE HORIZONTALLY SPACED CONDUIT OUTSIDE DIAMETERS PLUS 1/2-INCH FOR EACH OF THE HORIZONTALLY SPACED CONDUITS (OVER ONE).

4.2.5 THE SPACE REQUIREMENTS OF OTHER OCCUPANT'S FACILITIES IN A JOINTLY USED TRENCH CAN IMPACT MINIMUM TRENCH WIDTH REQUIREMENTS.

4.2.6 MINIMUM TRENCH DEPTHS ARE CONTINGENT UPON THE MINIMUM DEPTH AND VERTICAL SEPARATION REQUIREMENTS BETWEEN FACILITIES SPECIFIED IN 8601,8606 AND 8610.

4.2.7 ADDITIONAL TRENCH DEPTH FOR APS-APPROVED BEDDING IS REQUIRED IF THE NATIVE SOIL (TRENCH-RUN MATERIAL) DOES NOT MEET THE BEDDING REQUIREMENTS FOR THE FACILITIES TO BE INSTALLED. SEE 8601, 4.6 AND 5.0 FOR GENERAL BEDDING REQUIREMENTS. SEE 8601, 19.0 FOR BEDDING REQUIREMENTS FOR RIGID CONDUIT.

4.2.8 ALL UNDERGROUND CROSSINGS OF DESERT WASHES SHALL BE PARTIALLY ENCASED WITH A MINIMUM 4-INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDES. PARTIAL CONCRETE ENCASEMENT SHALL INCLUDE TOP AND SIDES OF CONDUIT, BUT NOT THE BOTTOM (SEE 8601, 20.0). THE TOP OF THE CONCRETE CAP SHALL BE INSTALLED DEEPER THAN THE ANTICIPATED SCOUR DEPTH. CONTACT ENGINEERING AND STANDARDS TO HELP IN DETERMINING THE MAXIMUM SCOUR DEPTH WHEN NECESSARY.

4.3 STREET CROSSING

THE MINIMUM COVER OVER FEEDER FACILITIES FOR STREET CROSSINGS SHALL BE 42 INCHES UNLESS APPROVED BY APS ENGINEERING. THE MINIMUM COVER OVER PRIMARY AND SECONDARY/SERVICE FACILITIES FOR STREET CROSSINGS SHALL BE 36 INCHES UNLESS APPROVED BY APS ENGINEERING. WHERE PRIMARY CONDUIT IS TO BE INSTALLED SHALLOWER THAN 36 INCHES, THE CONDUIT SHALL BE PARTIALLY ENCASED WITH A MINIMUM 4-INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDES. PARTIAL CONCRETE ENCASEMENT SHALL INCLUDE TOP AND SIDES OF CONDUIT, BUT NOT THE BOTTOM (SEE 8601, 23.0). THE CONDUIT SHALL HAVE A MINIMUM COVER OF 24 INCHES FROM FINAL GRADE. THIS ENCASEMENT RULE SHALL BE APPLIED TO DIRECT-BURIED FEEDER CABLE. RIGID OR INTERMEDIATE STEEL CONDUIT DOES NOT REQUIRE A CONCRETE CAP. LOW-VOLTAGE SECONDARY AND SERVICE CABLE INSTALLED IN PLASTIC CONDUIT WITH A MINIMUM 24-INCH COVER, DOES NOT REQUIRE A CONCRETE CAP FOR SHALLOW STREET CROSSINGS.

4.4 **TRENCH ROUTE**

4.4.1 **STRAIGHT TRENCH**--THE TRENCH CENTERLINE SHALL FOLLOW THE ALIGNMENT SPECIFIED ON THE WORK ORDER DRAWINGS. THE MAXIMUM CENTERLINE DEVIATION FROM THE SPECIFIED ALIGNMENT SHALL BE 8 INCHES, NOT TO EXCEED 4 INCHES IN ANY 10-FOOT SECTION. SERVICE TRENCHES MAY EXCEED THE MAXIMUM DEVIATION FROM THE SPECIFIED ALIGNMENT WHERE NECESSARY OR WHEN SPECIFIED BY APS. UNNECESSARY DEVIATIONS IN SERVICE TRENCHES, SUCH AS TRENCHING AROUND TEMPORARY ABOVE-GROUND OBSTRUCTIONS, VEHICLES AND CONSTRUCTION MATERIAL, SHALL NOT BE ACCEPTABLE.

4.4.2 **TRENCHES HAVING ANGLE POINTS**--TRENCH ANGLE POINTS WHERE NEEDED, CAN HAVE THE INCLUDED ANGLE CUT TO FORM A TRIANGLE HAVING TWO EQUAL LEGS. THE WORK AREA FORMED BY THIS TRIANGLE WILL FACILITATE CABLE PULLING AND/OR TRAINING OR THE INSTALLATION OF CONDUIT SWEEPS. THE LEGEND BELOW MAY BE USED AS A GUIDELINE. SEE ITEM 16.4 FOR STANDARD SWEEP RADII.

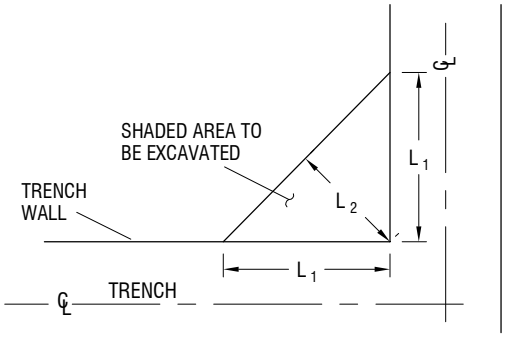
LEGEND:

L2 DIMENSION SHALL EQUAL:

15 INCHES FOR ARMORED OR CABLE-IN-CONDUIT (CIC) FOR LOW VOLTAGE SECONDARY, SERVICE OR STREET LIGHTS AND FOR ALL 24 INCH RADIUS CONDUIT SWEEPS.

22 INCHES FOR 36 INCH RADIUS CONDUIT SWEEPS.

39 INCHES FOR 60 INCHES RADIUS CONDUITS SWEEPS.



4.4.3 CHANGES FOR TRENCH ALIGNMENT OR LOCATION SHALL NOT BE ALLOWED WITHOUT APS ENGINEERING APPROVAL. THIS IS PARTICULARLY IMPORTANT WHEN COMMUNICATIONS ARE USING ENCAPSULATED-TYPE INSTALLATIONS.

4.5 **SEPARATIONS FROM OBSTRUCTIONS**

4.5.1 IT MAY BECOME NECESSARY TO EXCAVATE FOR ADDITIONAL DEPTH OR WIDTH, AS APPROVED BY APS ENGINEERING, WHERE ELECTRIC FACILITIES APPROACH OR CROSS OTHER EXISTING UTILITY LINES (SEWER, STORM, WATER, TELEPHONE, TELEVISION OR OTHER UNIDENTIFIED FACILITIES). APS ELECTRIC FACILITIES MAY BE LAID UNDER OR OVER SAID LINES AS APPROVED BY APS ENGINEERING. DUE TO THE POSSIBILITY OF FUTURE FINAL GRADE CHANGE, IT IS ALWAYS PREFERRED TO GO UNDER SAID LINES. ALL APS FACILITIES CROSSING OVER (ABOVE) SAID LINES SHALL NOT BE SHALLOWER THAN THE MINIMUM ALLOWED COVER FROM FINAL GRADE, REQUIRED BY THE LOCAL GOVERNMENTAL AGENCY, AND/OR OTHER PUBLIC REGULATORY AGENCY, AND/OR AS SPECIFIED HEREIN, UNLESS APPROVED BY APS ENGINEERING. WHERE APPROVED BY APS ENGINEERING, SHALLOW CROSSINGS OF OBSTRUCTIONS SHALL MEET THE FOLLOWING MINIMUM REQUIREMENTS: APS ELECTRIC FACILITIES SHALL BE INSTALLED IN PLASTIC, OR RIGID OR INTERMEDIATE STEEL CONDUIT AS APPROVED BY APS ENGINEERING. THE CONDUIT SHALL BE PARTIALLY ENCASED WITH A MINIMUM 4 INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDES. PARTIAL CONCRETE ENCASEMENT SHALL INCLUDE TOP AND SIDES OF CONDUIT, BUT NOT THE BOTTOM (SEE 8601, 20.0). THE CONCRETE CAP SHALL HAVE A MINIMUM COVER OF 12 INCHES FROM FINAL GRADE IN DEVELOPED AREAS WHERE CURBS AND GUTTERS ARE EXISTING, OR WHERE FINAL GRADE HAS BEEN ESTABLISHED, AND 24 INCHES FROM FINAL GRADE IN UNDEVELOPED AREAS.

4.5.2 ALL CROSSINGS SHALL PROVIDE A MINIMUM 12 INCH CLEAR SEPARATION FROM THE EXISTING UNDERGROUND OBSTRUCTIONS BEING CROSSED OR SUCH GREATER MINIMUM DISTANCE AS MAY BE REQUIRED BY THE LOCAL GOVERNMENTAL AGENCY AND/OR OTHER PUBLIC REGULATORY AGENCY, AND/OR AS SPECIFIED HEREIN (SEE EXCEPTIONS IN 8601, 12.0). MINIMUM SEPARATION REQUIREMENTS FOR CROSSINGS OF APS INTERSTATION COMMUNICATIONS LINES SHALL BE HANDLED ON AN INDIVIDUAL BASIS, CALL THE TELECOMMUNICATIONS ENGINEERING DEPARTMENT. ANY REDUCTION IN THE DEPTH OR WIDTH OF A JOINTLY USED TRENCH MUST BE APPROVED BY APS ENGINEERING AND ALL OTHER PARTIES INVOLVED IN THE JOINT USE.

4.5.3 A MINIMUM 60 INCH CLEAR SEPARATION IS REQUIRED BETWEEN CABLE INSTALLED IN CONDUIT AND THE OUTSIDE WALL OF THE POOL OR ITS AUXILIARY EQUIPMENT. APS FACILITIES SHALL NOT BE INSTALLED BENEATH COOL DECKING.

4.5.4 WHERE FACILITIES ARE TO BE INSTALLED UNDER A BUILDING OR STORAGE TANK, THE CABLE SHALL BE INSTALLED IN CONCRETE-ENCASED PLASTIC CONDUIT. IN THIS APPLICATION THE CONCRETE ENCASEMENT MUST CONFORM TO 8601, 23.1 AND 23.3. THE TOP OF THE CONCRETE ENCASEMENT SHALL BE A MINIMUM OF 24 INCHES CLEAR SEPARATION BELOW THE STRUCTURE FOUNDATION. APS FACILITIES SHALL NOT BE INSTALLED ABOVE OR BENEATH A BURIED FUEL STORAGE TANK.

4.5.5 WHERE FACILITIES ARE TO BE INSTALLED DIRECTLY BENEATH ANY PERMANENT STRUCTURE WHICH RESTRICTS REASONABLE FUTURE ACCESS FOR CABLE MAINTENANCE OR REPLACEMENT, THE CABLE SHALL BE INSTALLED IN CONCRETE-ENCASED PLASTIC CONDUIT (PER 8601, 20.0 AND 23.0) UNLESS OTHERWISE SPECIFIED BY APS ENGINEERING.

4.5.6 WHERE FACILITIES ARE TO BE INSTALLED INSIDE AN APS FOSSIL GENERATION FACILITY, FOLLOW FOSSIL GENERATION PROCEDURE CS DR312300 - EXCAVATION AND BACKFILL DESIGN STANDARD AND GR260533 - ELECTRICAL RACEWAY STANDARD.

4.5.7 WHERE FACILITIES ARE TO BE INSTALLED INSIDE AN APS SUBSTATION FACILITY, FOLLOW SUBSTATION ENGINEERING AND DESIGN PROCEDURE CS-31-0000 - EARTHWORK MATERIAL & INSTALLATION.

4.5.8 JACKETED CABLE AND CABLE INSTALLED IN CONDUIT SHALL MAINTAIN A MINIMUM 12-INCH CLEAR HORIZONTAL SEPARATION WHEN PASSING IN PROXIMITY TO A BUILDING OR STORAGE TANK FOUNDATION. A MINIMUM 8-FOOT HORIZONTAL SEPARATION FROM A FUEL STORAGE TANK OR FUEL LINES IS REQUIRED.

4.5.9 PRIOR TO PERFORMING ANY EXCAVATION, LOCATIONS OF OTHER UTILITIES SHALL BE DETERMINED AND MARKED. A PRIOR NOTICE OF TWO WORKING DAYS IS REQUIRED BY THE LOCAL ONE-CALL LOCATING SERVICE. IN AREAS WHERE A ONE-CALL LOCATING SERVICE IS NOT AVAILABLE, EACH UTILITY MUST BE NOTIFIED INDIVIDUALLY. MECHANIZED EQUIPMENT SHALL NOT BE USED TO EXCAVATE WITHIN 2 FEET OF MARKED AND BURIED FACILITIES UNTIL THE EXACT LOCATION OF THE UTILITY IS DISCOVERED BY HAND DIGGING. THIS PROHIBITION APPLIES TO THE OTHER FACILITIES AS WELL AS APS POLES AND EQUIPMENT. HAND TOOLS USED FOR EXCAVATING NEAR ENERGIZED ELECTRICAL CABLES SHALL BE EQUIPPED WITH HANDLES MADE OF NON-CONDUCTIVE MATERIAL. ONCE THE UTILITY IS UNCOVERED BY HAND-DIGGING, MECHANIZED EQUIPMENT MAY BE USED IN A PRUDENT MANNER TO COMPLETE THE EXCAVATION. OTHERWISE, NO LIMITATIONS APPLY TO THE USE OF TRENCHING EQUIPMENT. SEE 1290 FOR EXCAVATION CLEARANCES NEAR WOOD POLES AND GUY ANCHORS.

4.5.10 EMPTY CONDUITS WHICH HAVE BEEN STUBBED OUT FOR FUTURE ATTACHMENT TO CUSTOMER, MAY BE LOCATED AND EXPOSED BY THE CUSTOMER PERFORMING THE ATTACHMENT, PROVIDED THERE ARE NO OTHER APS FACILITIES WITHIN 2 FEET AND PROVIDED THE CLEARANCE REQUIREMENTS FROM POLES AND ANCHORS AS SPECIFIED IN 1290 ARE MET. SEE 8608 FOR ADDITIONAL UTILITY CROSSING REQUIREMENTS WITHIN THE CITY OF SCOTTSDALE.

4.6 **TRENCH BOTTOM**

TRENCH BOTTOM SHALL BE SMOOTH, FLAT AND WITHOUT SURFACE IRREGULARITIES AND SHALL BE FREE AND CLEAR OF DEBRIS OR ANY ORGANIC MATERIAL. SEE 8601, 5.0.

4.6.1 ANY CHANGE IN LEVEL OF THE TRENCH BOTTOM SHALL BE MADE OVER SUFFICIENT DISTANCE TO GIVE AS GRADUAL A CHANGE IN GRADE AS POSSIBLE. CHANGE IN GRADE SHALL NEVER BE SO ABRUPT AS TO REQUIRE A BEND IN THE CONDUIT OF LESS THAN RADIUS LISTED BELOW:

CONDUIT SWEEPS	RADIUS OF BEND
CONDUIT (STRAIGHT)	160 TIMES OUTSIDE DIAMETER OF CONDUIT OR REFER TO 8644 OR USE THE REVERSE CURVE DATA BOOK OR THE CAD SYSTEM. SEE 8601, 4.6.2 BELOW.

4.6.2 WHEN CHANGING ELEVATIONS BY GRADUALLY BENDING STRAIGHT CONDUIT SECTIONS, A CHANGE IN ELEVATION OF THE TRENCH BOTTOM SHALL NOT EXCEED 1 FOOT OVER A 12-FOOT LENGTH.

4.6.3 LOOSE MATERIAL SHALL BE REMOVED FROM THE TRENCH BOTTOM. LOOSE MATERIAL MAY BE DEFINED AS ANY MATERIAL WHICH WOULD CAUSE SETTLEMENT; CREATE SOFT UNSTABLE CONDITIONS; CONTAMINATE; OR, INTRUDE INTO BEDDING MATERIAL. UNSTABLE SOILS, SUCH AS OLDER TRENCH FILLS OR SOFT NATURAL GROUND, SHALL BE OVER-EXCAVATED A MINIMUM OF 6 INCHES AND REPLACED WITH COMPACTED, APS-APPROVED BACKFILL MATERIAL IN COMPLIANCE WITH THIS SPECIFICATION FOR TRENCH BACKFILL.

4.6.4 WHERE SERVICE TRENCHES INTERSECT OR BRANCH OFF FROM THE MAINLINE TRENCH, THE SERVICE TRENCH BOTTOM SHALL GRADUALLY TAPER UP TO THE SPECIFIED TRENCH DEPTH OR SERVICE STUB LOCATION.

4.7 **SHORING**

ALL EXCAVATIONS SHALL BE OPEN CUT UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS OR APPROVED BY APS ENGINEERING. TRENCH SIDEWALLS SHALL BE CUT PERPENDICULAR TO GRADE LEVEL OR SUFFICIENTLY SLOPED TO MINIMIZE POSSIBILITIES OF TRENCH WALL SLOUGHING OR CAVE-INS. THE AMOUNT OF SLOPE NECESSARY IS DEPENDENT UPON SOIL CONDITIONS ENCOUNTERED. THE JUDGEMENT OF THE CONSTRUCTION PERSONNEL SHALL DETERMINE ADEQUATE SLOPE FOR PROPER SAFETY (SEE APPLICABLE OSHA REQUIREMENTS DETAILED ON 8640). WHERE SLOPING OF THE TRENCH WALL IS NOT PRACTICAL, PROPER SHORING SHALL BE UTILIZED. WORKING CONDITIONS SHALL MEET ALL RULES AND REGULATIONS AS PROMULGATED BY OSHA FOR THE PROTECTION OF EMPLOYEES AND OTHERS.

4.8 **SPOILS PLACEMENT**

WHEREVER A WORKER MUST ENTER A TRENCH, THE TRENCH SPOILS SHALL BE PLACED ON EITHER SIDE OF THE TRENCH AND NO CLOSER THAN 2 FEET FROM THE TRENCH EDGE TO THE TOE OF THE SPOIL. SPOILS SHALL BE SO PLACED TO MINIMIZE INTERFERENCE WITH TRAFFIC AND THE INSTALLATION OF APS FACILITIES.

4.9 **PARTIAL TRENCH OPENING**

CERTAIN PORTIONS OF THE TRENCH MAY BE OPENED IN ANY PROJECT WHICH ARE MUTUALLY AGREED TO IN WRITING BY THE AFFECTED PARTIES. APS SHALL BE THE ONLY AUTHORITY IN DETERMINING THE TIME FOR THE TRENCH TO BE OPENED. LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES MAY LIMIT PORTIONS OF TRENCH OPEN AT ANY ONE TIME.

4.10 **ARTIFACTS**

LEAVE UNDISTURBED AND IMMEDIATELY NOTIFY THE APS ENVIRONMENTAL AND LAND DEPARTMENT MANAGER OF ANY DISCOVERED INDIAN RELICS OR ITEMS WITH ARCHAEOLOGICAL OR HISTORICAL VALUE.

5.0 BEDDING AND SHADING

5.1 THE TRENCH BOTTOM SHALL BE SMOOTH, FLAT AND WITHOUT SURFACE IRREGULARITIES, OTHERWISE A SUFFICIENT AMOUNT OF BEDDING MATERIAL SHALL BE INSTALLED TO PROVIDE THE REQUIRED SURFACE. IF THE BEDDING (WHERE REQUIRED) AND SHADING MATERIAL DOES NOT MEET APS REQUIREMENTS, APS ENGINEERING SHALL SPECIFY WHICH OF THE FOLLOWING ALTERNATIVES SHALL BE UTILIZED:

5.1.1 THE TRENCH-RUN MATERIAL MAY BE SCREENED TO REMOVE THE OBJECTS CAUSING FAILURE; OR

5.1.2 APS-APPROVED MATERIAL MAY BE HAULED IN.

5.2 ALL FACILITIES SHALL BE PLACED ON UNDISTURBED SOIL OR PROPERLY BEDDED TRENCH BOTTOMS. PROPERLY BEDDED TRENCH BOTTOMS SHALL CONSIST OF SUFFICIENT BEDDING MATERIAL WHICH EXTENDS WALL-TO-WALL IN TRENCHES 30 INCHES OR LESS IN WIDTH. TRENCHES OVER 30 INCHES IN WIDTH SHALL PROVIDE AN ADEQUATE LEVEL SURFACE FOR ALL APS FACILITIES.

5.3 SHADING MATERIAL SHALL BE PLACED OVER AND AROUND FACILITIES IN ACCORDANCE WITH THE FOLLOWING MINIMUM REQUIREMENTS:

5.3.1 SHADING OVER ALL APS ELECTRIC FACILITIES SHALL BE A MINIMUM OF 6 INCHES, REGARDLESS OF SOIL CONDITIONS. SEE 8765 AND 8601, 18.12 FOR EXCEPTIONS. CONCRETE-ENCASED CONDUIT DOES NOT REQUIRE SHADING.

5.3.2 IN DIRECT-BURIED CONDUIT INSTALLATIONS A MINIMUM OF 1/2-INCH OF SHADING MATERIAL IS REQUIRED ON THE SIDES OF THE CONDUIT.

5.3.4 THE PARTY RESPONSIBLE FOR INSTALLING A RIGID CONDUIT SYSTEM SHALL BE RESPONSIBLE FOR PROVIDING THE LABOR/EQUIPMENT NECESSARY TO INSTALL THE SHADING MATERIAL. RIGID CONDUIT INSTALLATIONS SHALL BE APPROVED BY AN AUTHORIZED APS REPRESENTATIVE PRIOR TO INSTALLATION OF ANY SHADING MATERIAL BY THE CUSTOMER. AN AUTHORIZED APS REPRESENTATIVE SHALL BE PRESENT WHILE THE APPROVED SHADING MATERIAL IS BEING PLACED INTO THE TRENCH BY THE CUSTOMER OR SHALL INSPECT THE APPROVED MATERIAL AFTER IT HAS BEEN PLACED ON THE APS FACILITY AND PRIOR TO THE BACKFILL MATERIAL BEING INSTALLED INTO THE TRENCH.

5.3.5 APS-APPROVED SHADING MATERIAL MAY BE INSTALLED IN THE TRENCH IN SLURRY FORM, PROVIDED THE MATERIAL MEETS APS REQUIREMENTS WHEN DRY.

5.3.6 WHERE THE CUSTOMER HAS REQUESTED APS TO INSTALL THE CONDUIT AND PROVIDE THE LABOR TO SHADE THE CONDUIT, THE CUSTOMER PROVIDED TRENCH WIDTHS EXCEED THE DESIGN WIDTH BY MORE THAN 8 INCHES MAY RESULT IN ADDITIONAL CHARGES TO THE CUSTOMER TO COVER THE ADDITIONAL APS SHADING LABOR (ADDITIONAL WIDTH NECESSARY TO EXCAVATE LARGE ROCKS IS AN EXCEPTION).

5.3.7 CONDUIT INSTALLATIONS SHALL BE SHADED FOLLOWING INSPECTION APPROVAL OF THE FACILITIES. PREFERENCE IS TO COMPLETE THE SHADING PRIOR TO LEAVING THE JOB SITE AT THE CONCLUSION OF THE WORK DAY WHENEVER PRACTICAL.

5.3.8 THE PARTY RESPONSIBLE FOR PROVIDING THE TRENCHING AND BACKFILL SHALL BE RESPONSIBLE FOR PREPARING THE PAD SITE FOR ALL PROPOSED TRANSFORMER, SWITCHING CABINET OR OTHER EQUIPMENT LOCATIONS.

5.4 WHEREVER A WORKER MUST ENTER THE TRENCH, THE TRENCH SPOIL OR THE APS-APPROVED BEDDING AND SHADING MATERIAL SHALL BE PLACED SO THAT NONE OF THE MATERIAL IS CLOSER THAN 2 FEET TO THE TRENCH EDGE. THE RESPONSIBILITY FOR PROVIDING THE LABOR TO INSTALL THE SHADING MATERIAL VARIES PER 8601, 5.3.

THE FOLLOWING REQUIREMENTS ARE ONLY APPLICABLE WHEN APS HAS CONTRACTED ALL OR PART OF A WORK ORDER (CUSTOMER NOT INVOLVED):

5.4.1 THE PARTY RESPONSIBLE FOR INSTALLING THE APS-APPROVED SHADING MATERIAL MAY SELECT ONE OF TWO METHODS FOR INSTALLING THE MATERIAL. ONE OPTION IS TO INSTALL THE MATERIAL BY HAND ("HAND" METHOD). THE OTHER OPTION IS TO INSTALL THE MATERIAL USING MECHANIZED EQUIPMENT ("MECHANIZED" METHOD).

5.4.2 IF THE "HAND" METHOD IS SELECTED AND A SUFFICIENT VOLUME OF SHADING MATERIAL HAS NOT BEEN PROVIDED, IT SHALL BE NECESSARY FOR THE PARTY RESPONSIBLE FOR PROVIDING THE TRENCH, BACKFILL, APPROVED BEDDING AND THE SHADING MATERIAL, TO REMOVE A PORTION OF THE TRENCH SPOILS FROM THE AREA ALONG THE NEW TRENCH WHICH WILL PROVIDE A CLEAN ENVIRONMENT FOR THE APS-APPROVED SHADING MATERIAL TO BE PLACED AT 15-FOOT CENTER INTERVALS ALONG THE TRENCH. THIS WILL ALLOW THE SHADING MATERIAL TO BE PLACED INTO THE TRENCH BY THE "HAND" METHOD.

5.4.3 IF THE "MECHANIZED" METHOD IS SELECTED, THE MATERIAL SHALL BE STOCKPILED; BY THE PARTY RESPONSIBLE FOR PROVIDING THE TRENCH, BACKFILL, APPROVED BEDDING AND THE SHADING MATERIAL; AT DESIGNATED AREAS APPROVED BY THE AUTHORIZED APS REPRESENTATIVE. THE "MECHANIZED" METHOD MAY BE USED ONLY WHEN CONDITIONS EXIST WHICH ALLOW THE APS-APPROVED SHADING MATERIAL TO BE INSTALLED INTO THE TRENCH WITHOUT FOREIGN MATERIAL FALLING INTO THE TRENCH AND CONTAMINATING THE SHADING MATERIAL OR FALLING ONTO APS FACILITIES.

6.0 APPROVED MATERIAL FOR BEDDING AND SHADING

6.1 APS-APPROVED MATERIAL SHALL BE USED FOR THE BEDDING, SHADING AND SIDES OF FACILITIES.

6.1.1 THE APS-APPROVED BEDDING AND SHADING MATERIAL SHALL MEET THE REQUIREMENTS SPECIFIED IN 8601, 19.1 WHEN THE MATERIAL IS TO BE USED FOR RIGID CONDUIT INSTALLATIONS.

7.0 BACKFILL AND COMPACTION

7.1 GENERAL

BACKFILL BENEATH TRANSFORMER AND EQUIPMENT PADS SHALL BE COMPACTED PER 8601, 29.3. ALL OTHER TRENCH BACKFILL SHALL BE COMPACTED TO A MINIMUM OF 85 PERCENT OF THE MAXIMUM DENSITY AS DEFINED BY AASHTO T 99 OR ASTM D 698 OR ASTM D 2922 AND D 3017, UNLESS OTHERWISE SPECIFIED ON THE WORK ORDER DRAWINGS, OR UNLESS MORE STRINGENT REQUIREMENTS PREVAIL AS DICTATED BY LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES.

7.2 BACKFILLING

SHADING AND BACKFILLING SHALL NOT BE PERFORMED UNTIL ALL FACILITIES ON A PARTICULAR LEVEL ARE PLACED THEREIN AND INSPECTED BY THE TRENCH OCCUPANTS' REPRESENTATIVE(S) TO ENSURE THAT PROPER VERTICAL AND HORIZONTAL SEPARATIONS HAVE BEEN ACHIEVED.

7.2.1 WHEN REPAIRS IN A JOINTLY USED TRENCH ARE TO BE COVERED, THE INITIAL BACKFILL SHALL BE OF APS-APPROVED BACKFILL MATERIAL AND SHALL BE CAREFULLY COMPACTED AROUND THE UTILITIES IN THE REPAIR AREA.

7.3 BACKFILL TIMING

EACH BACKFILL TASK SHALL CONTINUE WITH SUFFICIENT MATERIAL AND EQUIPMENT TO ALLOW THE PROJECT TO BE WORKED IN AN EFFICIENT MANNER.

7.4 COMPACTION METHODS

7.4.1 ACCEPTABLE COMPACTION METHODS ARE HAND-TAMPING WITH PNEUMATIC OR VIBRATING EQUIPMENT, AND/OR JETTING OR IRRIGATION STYLE FLOODING OF EACH BACKFILL LIFT. VEHICULAR-MOUNTED TAMPING EQUIPMENT OR WHEEL ROLLING IS NOT ACCEPTABLE. IRRIGATION STYLE FLOODING MUST BE SO CONTROLLED THAT SOIL EROSION OF THE SHADING MATERIAL DOES NOT OCCUR IN THE TRENCH. BEFORE TAMPING AT LEAST 6 INCHES OF APS-APPROVED MATERIAL MUST BE PLACED OVER THE TOP OF THE FACILITIES TO AVOID DAMAGE (CONCRETE-ENCASED DUCT BANKS ARE AN EXCEPTION).

7.4.2 IF CEMENT SAND SLURRY IS USED OR IF ANY BACKFILL MATERIAL IS FLOODED, TIME SHALL BE ALLOWED FOR THE MASS TO SOLIDIFY UNTIL IT WILL SUPPORT THE WEIGHT OF A PERSON WALKING ON THE STRUCTURE BEFORE THE NEXT ACTIVITY COMMENCES.

7.5 MATERIAL NOT ACCEPTABLE FOR BACKFILL

7.5.1 ROCKS LARGER THAN 3 INCHES IN DIAMETER IN THE 6 INCHES ABOVE APS-APPROVED SHADING MATERIAL. CONCRETE-ENCASED CONDUIT IS THE ONLY EXCEPTION. THE BACKFILL MATERIAL SHALL CONTAIN ENOUGH FINES TO FILL ALL VOIDS.

7.5.2 BACKFILL CONTAINING FOREIGN OBJECTS SUCH AS TRASH, CANS, GLASS, DECOMPOSABLE ORGANIC MATERIAL, OR LAVA.

7.5.3 BACKFILL VOID OF COMPACTIBLE MATERIAL (MUST HAVE SOME FINES).

7.5.4 BACKFILL CONTAINING CONCRETE PIECES LARGER THAN 3 INCHES IN DIAMETER OR ANY ASPHALT MATERIALS.

7.5.5 NATIVE SOIL MATERIAL THAT WILL NOT COMPACT TO ACHIEVE THE SPECIFIED COMPACTION LEVEL (SEE 8601, 7.1).

7.5.6 BACKFILL NOT CONFORMING TO THE REQUIREMENTS OF THE LOCAL GOVERNMENTAL AGENCY OR OTHER PUBLIC REGULATORY AGENCY.

7.5.7 BACKFILL COMPOSED OF SILT (WILL NOT COMPACT TO FULFILL THE REQUIREMENTS OF 8601, 7.1).

8.0 WORK NEAR EXISTING FACILITIES

EXTREME CARE MUST BE EXERCISED WHEN EXPOSING LINES IN A JOINTLY USED TRENCH TO AVOID CONTACTING THE FOREIGN UTILITIES. PERSONAL INJURY AND/OR DAMAGE TO THE UTILITIES MAY RESULT FROM CARELESS EXCAVATION.

PRIOR TO PERFORMING ANY EXCAVATION, LOCATIONS OF OTHER UTILITIES SHALL BE DETERMINED AND MARKED. A PRIOR NOTICE OF TWO WORKING DAYS IS REQUIRED BY THE LOCAL ONE-CALL LOCATING SERVICE. IN AREAS WHERE A ONE-CALL LOCATING SERVICE IS NOT AVAILABLE, EACH UTILITY MUST BE NOTIFIED INDIVIDUALLY. MECHANIZED EQUIPMENT SHALL NOT BE USED TO EXCAVATE WITHIN 2 FEET OF MARKED BURIED UTILITIES UNTIL THE EXACT LOCATION OF THE UTILITY IS DISCOVERED BY HAND-DIGGING. THIS PROHIBITION APPLIES TO OTHER FACILITIES AS WELL AS APS POLES AND EQUIPMENT. HAND TOOLS USED FOR EXCAVATING NEW ENERGIZED ELECTRICAL CABLES SHALL BE EQUIPPED WITH HANDLES MADE OF NONCONDUCTIVE MATERIAL. ONCE THE UTILITY IS UNCOVERED BY HAND-DIGGING, MECHANIZED EQUIPMENT MAY BE USED IN A PRUDENT MANNER TO COMPLETE THE EXCAVATION. SEE 1290 FOR EXCAVATION CLEARANCES NEAR WOOD/STEEL POLES AND GUY ANCHORS.

EMPTY CONDUITS WHICH HAVE BEEN STUBBED OUT FOR FUTURE ATTACHMENT TO CUSTOMER, MAY BE LOCATED AND EXPOSED BY THE CUSTOMER PERFORMING THE ATTACHMENT, PROVIDED THERE ARE NO OTHER APS FACILITIES WITHIN 2 FEET AND PROVIDED THE CLEARANCE REQUIREMENTS FROM POLES AND ANCHORS AS SPECIFIED IN 1290 ARE MET.

ALL UNDERGROUND ELECTRIC TRANSMISSION CROSSINGS, INCLUDING 69KV DIRECT-BURIED CABLE, 69KV HIGH-PRESSURED OIL-FILLED PIPE, AND THE 230KV HIGH-PRESSURE OIL-FILLED PIPE SYSTEMS SHALL HAVE AN APS INSPECTOR PRESENT PRIOR TO EXPOSING THE EXISTING LINE(S). EXCAVATOR SHALL BE RESPONSIBLE FOR COORDINATING WITH THE APS INSPECTOR. NOTICE TO THE APS INSPECTOR ONE WORKING DAY IN ADVANCE SHALL BE CONSIDERED SUFFICIENT, CALL 602-371-7792.

WHEN THE WORK TO BE PERFORMED IS LOCATED BENEATH ELECTRIC FACILITIES, EXTRA PRECAUTIONS SHALL BE TAKEN TO AVOID DAMAGING THE EXISTING FACILITIES. THE ELECTRICAL FACILITIES SHALL BE SUPPORTED IN A MANNER WHICH ENSURES THAT THERE IS NO DAMAGE TO THE FACILITIES. AT NO TIME SHALL THE ELECTRIC FACILITIES BE USED TO SUPPORT ANY WEIGHT NOT ASSOCIATED WITH THE EXISTING ELECTRICAL FACILITIES.

9.0 PERFORMANCE OF WORK

9.1 ALL MATERIAL AND WORKMANSHIP SHALL BE PLUMB AND TRUE AND SHALL COMPLY WITH SPECIFIC REQUIREMENTS OF THE WORK ORDER DRAWINGS AND APS SPECIFICATIONS.

9.2 IF ANY PORTION OF THE COMPLETED SYSTEM FAILS TO OPERATE SATISFACTORILY, THE DEFECT AND ANY DAMAGED PORTION OF THE SYSTEM SHALL BE CORRECTED AS SPECIFIED BY APS ENGINEERING.

10.0 VARIANCES

ALL VARIANCES FROM THE TRENCHING REQUIREMENTS SHALL BE THE RESPONSIBILITY OF THE APPROPRIATE GROUP LEADER.

11.0 GENERAL REQUIREMENTS

11.1 UNLESS OTHERWISE NOTED ON THE CONSTRUCTION SKETCH APS SHALL BE RESPONSIBLE FOR COORDINATING, SURVEYING AND INSPECTING ALL APS ELECTRIC DISTRIBUTION TRENCHES. APS SHALL STAKE ALL SERVICE IN CONDUIT STUB-OUT LOCATIONS WITHIN SUBDIVISION DEVELOPMENTS. APS DOES NOT SURVEY SERVICE TRENCHES UNLESS A PORTION OF THE TRENCH MUST FOLLOW AN EASEMENT OR ROUTE WHICH HAS BEEN DESIGNATED BY ENGINEERING. FOR TRENCHES PROVIDED BY APS, APS SHALL BE RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS FOR TRENCHING REQUIRED BY THE LOCAL GOVERNMENT AGENCY AND/OR OTHER PUBLIC REGULATORY AGENCIES.

11.2 WHEN APS TRENCHES AND BACKFILLS FOR A CUSTOMER, THE CUSTOMER SHALL PROVIDE EASEMENTS FOR THE TRENCH ROUTE WHERE REQUIRED AND SHALL SECURE ALL NECESSARY PERMITS FOR TRENCHING REQUIRED BY THE LOCAL GOVERNMENTAL AGENCY AND/OR OTHER PUBLIC REGULATORY AGENCIES. THE CUSTOMER SHALL ESTABLISH FINAL GRADE AND FLAG ALL PROPERTY CORNERS BEFORE APS WILL SURVEY THE ROUTES. IN ADDITION, EASEMENTS, ALLEYS AND STREETS MUST BE GRADED WITHIN 6 INCHES OF FINAL GRADE BEFORE APS WILL BEGIN CONSTRUCTION. EXCAVATING AND/OR THE INSTALLATION OF UNDERGROUND FACILITIES SHALL NOT BE PERFORMED BY APS UNTIL THE FINAL GRADES HAVE BEEN ESTABLISHED AND FURNISHED TO APS. CUSTOMER SHALL REIMBURSE APS FOR ANY COSTS INCURRED IN ADJUSTING FACILITIES DUE TO CHANGES IN THE FINAL GRADE. FINAL GRADE SHALL BE STAKED BY THE CUSTOMER (USING BLUE-TOP STAKES) AT LOCATIONS NEEDED TO FACILITATE EXCAVATION (EXCLUDING SERVICE TRENCHES), INSPECTION OF EXCAVATION DEPTH, TRANSFORMER AND/OR EQUIPMENT PAD LOCATIONS, STREET LIGHT POLE LOCATIONS, MANHOLE AND PULL BOX LOCATIONS.

11.3 THE PARTY DIGGING THE TRENCH SHALL BE RESPONSIBLE FOR DETERMINING THE LOCATION AND EXISTENCE OF ALL UNDERGROUND INSTALLATIONS INCLUDING ELECTRIC, GAS, WATER, SEWER, TELEPHONE AND OTHER EXISTING UNDERGROUND FACILITIES, BEFORE EXCAVATION BEGINS. EXTRA DEPTH AND/OR WIDTH SHALL BE PROVIDED IN ORDER TO MAINTAIN A 12-INCH MINIMUM SEPARATION (SEE EXCEPTIONS IN 8601, 4.5 AND 12.0) BETWEEN APS CABLE,OR CONDUIT AND ALL CROSSINGS OF OBSTRUCTIONS.

11.4 TRENCHES SHALL BE CONFINED TO DEDICATED EASEMENTS AND/OR RIGHTS-OF-WAY.

11.5 BEFORE INSTALLING ELECTRIC FACILITIES, CLEAR THE TRENCH OF ALL ROCKS, LEVEL BOTTOM OF TRENCH AND INSTALL BEDDING, AS REQUIRED, PER APS SPECIFICATIONS.

11.6 MINIMUM TRENCH WIDTH IS 16 INCHES WHEREVER A WORKER MUST ENTER THE TRENCH.

11.7 WHERE SERVICE TRENCHES INTERSECT OR BRANCH OFF FROM THE MAINLINE TRENCH, THE SERVICE TRENCH BOTTOM SHALL GRADUALLY TAPER UP TO THE SPECIFIED SERVICE TRENCH DEPTH OR SERVICE STUB LOCATION, AS SPECIFIED BY 8601, 4.6.

11.8 THE REQUIRED GROUND RODS OR APPROVED ALTERNATIVES SHALL BE PROVIDED BY APS AND INSTALLED BY THE PARTY RESPONSIBLE FOR INSTALLING THE CONDUIT SYSTEM. SEE 2400 STANDARDS.

11.9 **ENERGIZING CABLES**

11.9.1 TRENCHES CONTAINING PRIMARY CABLE SHALL HAVE A MINIMUM OF 30 INCHES OF BACKFILL (COVER) BEFORE THE CABLE MAY BE ENERGIZED. FACILITIES WHICH HAVE BEEN SPECIFIED AT A FINAL DEPTH WHICH PROVIDES LESS THAN 30 INCHES OF BACKFILL (COVER) SHALL BE COMPLETELY BACKFILLED BEFORE THE CABLE MAY BE ENERGIZED.

11.9.2 TRENCHES CONTAINING SECONDARY OR SERVICE CABLE SHALL HAVE A MINIMUM OF 24 INCHES OF BACKFILL (COVER) BEFORE THE CABLE MAY BE ENERGIZED. FACILITIES WHICH HAVE BEEN SPECIFIED AT A FINAL DEPTH WHICH PROVIDES LESS THAN 24 INCHES OF BACKFILL (COVER) SHALL BE COMPLETELY BACKFILLED BEFORE THE CABLE MAY BE ENERGIZED.

12.0 GENERAL LIMITATIONS

12.1 WHERE ELECTRIC FACILITIES ARE TO BE INSTALLED IN A JOINTLY USED TRENCH WITH OTHER FACILITIES, THE FOLLOWING GENERAL LIMITATIONS SHALL APPLY.

12.1.1 NATURAL GAS (GAS) FACILITIES MAY BE INSTALLED IN A JOINTLY USED TRENCH WHERE ELECTRIC FACILITIES ARE INSTALLED IN A CONDUIT SYSTEM. PROPANE FACILITIES SHALL NOT BE INSTALLED IN A JOINTLY USED TRENCH WHERE ELECTRIC FACILITIES ARE INSTALLED IN A CONDUIT SYSTEM.

12.1.2 WHERE GAS PIPELINES AND ELECTRIC CONDUITS/CABLES CROSS, A MINIMUM VERTICAL SEPARATION OF 12" IS REQUIRED. IF THE CROSSING IS WITH A GAS SERVICE LINE, THIS SEPARATION CAN BE REDUCED 6" IF THE GAS SERVICE LINE IS SLEEVED IN A RIGID PIPE. THE SLEEVE MUST BE LONG ENOUGH SO THAT EACH END OF THE SLEEVE IS A MINIMUM OF 12", MEASURED PERPENDICULAR FROM THE SIDEWALL OF THE NEAREST ELECTRIC CONDUIT/CABLE.

12.1.3 ELECTRIC FACILITIES EXITING PULL BOXES AND PAD-MOUNTED EQUIPMENT IN CONDUIT MAY CROSS WITH A MINIMUM OF 2 INCHES HORIZONTAL OR VERTICAL (ABOVE OR BELOW) SEPARATION FROM COMMUNICATION LINES WHEN APS FACILITIES ARE INSTALLED IN CONDUIT.

12.1.4 UNDERGROUND FACILITIES (EXCLUDING GAS LINES) WHICH ARE IN A JOINTLY USED TRENCH WITH APS ELECTRIC FACILITIES MAY PASS DIRECTLY BENEATH TRANSFORMER PADS BUT, SHALL MAINTAIN A MINIMUM 4-INCH HORIZONTAL SEPARATION FROM THE OUTSIDE EDGE OF OTHER EQUIPMENT PADS TO THE CENTERLINE OF THE UNDERGROUND FACILITY. GAS LINES SHALL MAINTAIN A MINIMUM 1-FOOT HORIZONTAL SEPARATION FROM THE OUTSIDE EDGE OF THE EQUIPMENT PAD TO THE SIDEWALL OF THE GAS LINE.

12.1.5 UNDERGROUND FACILITIES WHICH ARE NOT IN A JOINTLY USED TRENCH WITH APS ELECTRIC FACILITIES SHALL MAINTAIN A MINIMUM 24-INCH HORIZONTAL SEPARATION FROM THE OUTSIDE EDGE OF THE EQUIPMENT PAD TO THE SIDE WALL OF THE UNDERGROUND FACILITY.

12.1.6 APS LOW-VOLTAGE CABLE IN CONDUIT MAY CROSS PRIMARY CABLE (DIRECT-BURIED OR IN CONDUIT) WITHOUT ANY VERTICAL SEPARATION.

12.1.7 WHERE APS LOW-VOLTAGE IS LESS THAN 300 VOLTS:

THERE IS NO MINIMUM VERTICAL SEPARATION REQUIREMENT WHEN APS LOW-VOLTAGE DIRECT-BURIED CABLES ARE CROSSED BY COMMUNICATION SERVICE (DIRECT-BURIED OR IN CONDUIT) CABLES. A 2-INCH MINIMUM VERTICAL SEPARATION IS REQUIRED WHEN APS LOW-VOLTAGE CABLE IN CONDUIT CROSSES (OR IS CROSSED BY) COMMUNICATION SERVICE CABLE IN CONDUIT.

12.1.8 APS OWNED FACILITIES IN CONDUIT MAY BE INSTALLED (ON TOP OF) IN DIRECT CONTACT WITH AN APS-OWNED CONCRETE-ENCASED DUCT BANK.

12.1.9 COMMUNICATION FACILITIES (DIRECT-BURIED OR IN CONDUIT) MAY BE INSTALLED WITH A MINIMUM OF 3 INCHES VERTICAL SEPARATION ABOVE AN APS-OWNED CONCRETE-ENCASED DUCT BANK.

12.2 OPEN TRENCHES PROVIDED BY OTHERS FOR OTHER FACILITIES (WATER, SEWER, ETC.) MAY BECOME BARRIERS FOR APS WORK FORCES. VEHICULAR CROSSINGS OF UNFINISHED TRENCHES ARE SOMETIMES NECESSARY TO PROVIDE ACCESS TO THE REQUIRED WORK AREA. APS SHALL ARRANGE FOR VEHICULAR CROSSINGS WHICH HAVE BEEN SUFFICIENTLY BACKFILLED AND COMPACTED TO PROVIDE A SAFE CROSSING FOR APS VEHICLES, AND ADEQUATE PROTECTION FOR FACILITIES INSTALLED IN THE TRENCH TO BE CROSSED.

INSTALLATION OF CONDUIT-ELECTRIC

13.0 SCOPE

THIS SPECIFICATION PROVIDES FOR PRACTICES WHICH ARE ESSENTIAL FOR PROPER INSTALLATION OF A CONDUIT SYSTEM.

14.0 BASIC MATERIAL

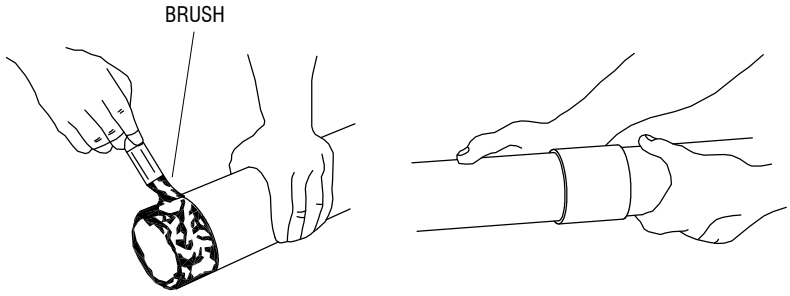
14.0.1 THE CONDUIT, SLEEVES AND FITTINGS USED IN THIS SPECIFICATION ARE THOSE DESIGNED TO MEET THE REQUIREMENTS FOR DIRECT-BURIAL APPLICATIONS. ALL PVC PLASTIC CONDUIT AND FITTINGS SHALL BE GRAY AND SHALL MEET OR EXCEED THE REQUIREMENTS OF ASTM F 512, CELL CLASSIFICATION NO. 12254B. ALL APS PLASTIC CONDUIT AND FITTINGS SHALL MEET THE REQUIREMENTS OF ASTM D 2750, CELL CLASS NO. 2-2-2.

14.0.2 SEE SPECIFICATION 8876 THRU 8895 FOR DETAILS OF CONDUIT MATERIAL AND ACCESSORIES.

15.0 WORKMANSHIP AND INSTALLATION

15.1 A FINE-TOOTH SAW SHALL BE USED TO CUT CONDUIT (I.E. HACKSAW FOR CONDUIT 2 INCHES OR LESS, WOOD SAW FOR CONDUIT GREATER THAN 2 INCHES). THE CONDUIT MUST BE CUT STRAIGHT AND CLEANED OF BURRS. CONDUIT TRANSITIONS FROM SCHEDULE 40 OR SCHEDULE 80 TO DB OR EB CONDUIT SHALL BE CHAMFERED. ALL CONDUIT AND FITTINGS NOT CHAMFERED BY THE MANUFACTURER SHALL BE CHAMFERED IN THE FIELD WITH A KNIFE, HALF-ROUND FILE OR ABRASIVE OPEN MESH CLOTH, TO PROVIDE A SMOOTH TRANSITION WHICH WILL NOT CAUSE SCUFFING OF THE CABLE WHEN IT IS PULLED THROUGH THE CONDUIT DURING INSTALLATION.

15.2 WIPE DIRT AND FOREIGN MATERIAL FROM CONDUIT AND FITTING WITH A CLEAN, DRY CLOTH.



15.3 CHECK FITTING AND CONDUIT FOR A DRY INTERFERENCE FIT. THE ABSENCE OF AN INTERFERENCE FIT WILL PREVENT A GOOD JOINT FROM BEING OBTAINED AND IS NOT ACCEPTABLE.

15.4 **PVC-TO-PVC JOINTS**

15.4.1 APPLY PURPLE PRIMER/CLEANER ASTM F656, APN 32900820, TO BOTH THE FITTING SOCKET AND THE CONDUIT. AVOID PUDDLING OF THE PRIMER. VERIFY ALL SURFACES TO BE JOINED ARE COVERED. THIS PRIMER COAT IS IMPORTANT, AS IT HELPS TO PENETRATE THE HARD INNER SURFACES ON MOST BELL-END CONDUIT AND ON FITTINGS WHICH ARE FABRICATED FROM CONDUIT STOCK. MANY OF THE EXTRUDED CONDUIT STOCKS AND SOME MOLDED FITTINGS HAVE HARD INNER SURFACES, AND ARE MORE DIFFICULT FOR THE CEMENT TO PENETRATE WITHOUT AID FROM THE PRIMER.

15.4.2 APPLY GRAY PVC-TO-PVC CEMENT ASTM D 2564, APN 32900819, TO BOTH PARTS OF THE JOINT, AND IMMEDIATELY PUSH THE JOINT TOGETHER WITH A SLIGHT ROTATING MOTION (IN ONE DIRECTION ONLY). WHEN THE JOINT BOTTOMS OUT, HOLD WITHOUT MOTION FOR 15 SECONDS (1 MINUTE IN EXTREME COLD WEATHER), SO THAT CONDUIT DOES NOT PUSH OUT OF THE FITTINGS. DO NOT TWIST OR DRIVE CONDUIT AFTER INSERTION IS COMPLETE. WIPE OFF ANY EXCESS CEMENT WITH A CLEAN, DRY CLOTH.

15.5 **PVC-TO-ABS JOINTS**

15.5.1 APPLY PURPLE PRIMER/CLEANER ASTM F 656, APN 32900820, TO THE PVC PART OF THE JOINT ONLY. DO NOT USE PRIMER ON THE ABS MATERIAL.

15.5.2 APPLY GREEN PVC-TO-ABS CEMENT ASTM D 3138, APN 32900818, TO BOTH PARTS OF THE JOINT AND IMMEDIATELY PUSH THE JOINT TOGETHER WITH A SLIGHT ROTATING MOTION (IN ONE DIRECTION ONLY). WHEN THE JOINT BOTTOMS OUT, HOLD WITHOUT MOTION FOR 15 SECONDS (1 MINUTE IN EXTREME COLD WEATHER), SO THAT THE CONDUIT DOES NOT PUSH OUT OF THE FITTINGS. DO NOT TWIST OR DRIVE CONDUIT AFTER INSERTION IS COMPLETE. WIPE OFF ANY EXCESS CEMENT WITH A CLEAN, DRY CLOTH. THIS IS EXTREMELY IMPORTANT ON ABS MATERIAL AS EXCESS CEMENT WILL NEEDLESSLY SOFTEN THE ABS MATERIAL AND REDUCE THE JOINT STRENGTH.

15.6 USE OF PRIMERS OR CEMENTS, OTHER THAN THE ONES LISTED ABOVE, WILL RESULT IN UNACCEPTABLE JOINTS.

15.7 A NATURAL BRISTLE BRUSH OR THE APPLICATOR SUPPLIED WITH THE CEMENT CONTAINER SHALL BE USED. PLASTIC BRISTLE BRUSHES SHALL NOT BE USED AS THE PRIMER AND CEMENT WILL DISSOLVE THE BRISTLES. FOLLOW THE MANUFACTURER'S INSTRUCTIONS ON THE PRIMER AND CEMENT CONTAINERS. DO NOT USE ANY CEMENT WHICH SHOWS SIGNS OF THICKENING. SHELF LIFE ON THE UNOPENED CONTAINER IS 3 YEARS FROM THE DATE OF MANUFACTURE STAMPED ON THE CONTAINER.

15.8 THE JOINED MEMBERS SHALL BE CURED UNDISTURBED FOR ONE HOUR OR MORE BEFORE THEY ARE HANDLED OR TRANSPORTED. IN COLD OR DAMP WEATHER, THIS INTERVAL SHALL BE INCREASED TO ALLOW FOR THE SLOWER EVAPORATING OF THE CEMENT. AFTER THIS INITIAL CURE, CARE SHALL BE EXERCISED IN HANDLING OR TRANSPORTING TO PREVENT TWISTING OR PULLING THE JOINT.

15.9 ANOTHER FITTING OR CONDUIT SECTION MAY BE ADDED TO THE OPPOSITE END WITHIN TWO OR THREE MINUTES, IF CARE IS EXERCISED IN HANDLING SO THAT STRAIN IS NOT PLACED ON THE PREVIOUSLY JOINED ASSEMBLY.

15.10 **STEEL CONDUIT**

15.10.1 ALL RIGID OR INTERMEDIATE CONDUITS AND FITTINGS SHALL BE HOT-DIPPED GALVANIZED. ANY PORTION OF STEEL CONDUITS OR FITTINGS WHICH IS NOT TO BE ENCASED IN A MINIMUM 2 INCHES OF CONCRETE SHALL BE HALF-LAPPED TO A 40 MIL THICKNESS WITH POLYKEN NO. 900 2-INCH BLACK TAPE, APN 32907400, OVER POLYKEN NO. 927 BLACK PRIMER, APN 32907405, OR EQUIVALENT.

15.10.2 RIGID OR INTERMEDIATE STEEL CONDUIT SHALL BE INSTALLED WITH THREADED COUPLINGS AND JOINTS MADE UP TIGHT. WHERE THE ENDS ARE NOT THREADED, A GALVANIZED STEEL SPLIT COUPLING AND GALVANIZED STEEL BOLTS SHALL BE USED. CONDUIT SHALL NOT BE CUT WITH A TORCH, WELDED OR BRAZED; HOWEVER, UNDER CERTAIN CONDITIONS AS DETERMINED BY THE APS INSPECTOR, GROUND WIRES MAY BE BRAZED TO THE CONDUIT.

15.10.3 STEEL CONDUIT SHALL NOT BE INSTALLED WITHOUT THE APPROVAL OF APS ENGINEERING.

15.11 **TEMPERATURE**

ALL PLASTIC CONDUIT AND FITTINGS TO BE JOINED SHALL BE EXPOSED TO THE SAME TEMPERATURE CONDITIONS FOR A REASONABLE LENGTH OF TIME BEFORE ASSEMBLY TO PROVIDE A STRONG JOINT.

15.12 **EXPANSION AND CONTRACTION**

DUE TO THE EXPANSION AND CONTRACTION OF PLASTIC CONDUIT 1-1/2 INCHES PER 100 FEET FOR EVERY 22°F CHANGE IN TEMPERATURE, THE FOLLOWING PRECAUTIONS SHALL BE TAKEN.

15.12.1 ALLOW EXTRA CONDUIT FOOTAGE AT EACH TIE-IN FOR CONTRACTION WHEN CONDUIT TEMPERATURE IS HIGHER THAN THAT OF EARTH, OR ALLOW EXTRA ROOM FOR EXPANSION IF THE REVERSE CONDITION EXISTS.

15.12.2 BACKFILL FROM CENTER OF TRENCH BOTH WAYS OR FROM ONE TIE-IN POINT TOWARD THE OPPOSITE END OF THE TRENCH TO COMPENSATE FOR EXPANSION AND/OR CONTRACTION OF PLASTIC CONDUIT.

15.12.3 AFTER THE TRENCH IS BACKFILLED AND COMPACTED AND CONDUIT TEMPERATURE IS THE SAME AS THAT OF THE SURROUNDING SOIL, CONDUIT MAY BE CUT OFF AND MATCHED UP FOR CONNECTIONS WITH TIE-INS.

15.13 **MANDRELING**

WHERE THE PARTY RESPONSIBLE FOR INSTALLING THE CONDUIT ELECTS TO MANDREL, THE MANDREL SHALL BE NO LESS THAN 1/4-INCH TO 3/8-INCH SMALLER (80-PERCENT FILL) IN DIAMETER THAN THE SMALLEST ELEMENT (SWEEPS) DIAMETER IN THE CONDUIT SYSTEM.

15.14 **PULL LINE**

WHERE PULL LINES ARE INSTALLED, APN 32904400 SHALL BE PROVIDED BY APS AND INSTALLED BY CONDUIT PROVIDER.

15.15 THE PULLING CALCULATIONS USED BY ENGINEERING TO CALCULATE TENSIONS ARE PREDICATED UPON THE PROPER USE OF CABLE PULLING LUBRICANT. CABLE PULLING LUBRICANT IS REQUIRED. REFER TO 8895 TO DETERMINE THE QUANTITY REQUIRED.

15.16 THE MAXIMUM SPEED FOR PULLING LINE AND CABLE INTO STRAIGHT (NO SWEEPS OR BENDS) RUNS OF CONDUIT IS LIMITED ONLY BY CONSIDERATIONS NECESSARY TO ENSURE THE SAFE OPERATION OF THE PULLING EQUIPMENT.

15.17 THE MAXIMUM SPEED FOR PULLING LINE AND CABLE INTO CONDUIT WHICH CONTAINS SWEEPS OR BENDS, WHILE USING A MINIMUM 3/8-INCH-DIAMETER STEEL PULL ROPE, IS AS FOLLOWS:

TENSIONS OF 500 POUNDS OR LESS 200 FEET PER MINUTE.
TENSIONS OVER 500 POUNDS THROUGH 1000 POUNDS - 100 FEET PER MINUTE.
TENSIONS OVER 1000 POUNDS THROUGH 4000 POUNDS - 60 FEET PER MINUTE.
TENSIONS OVER 4000 POUNDS - 30 FEET PER MINUTE.

15.18 THE MAXIMUM SPEED FOR PULLING LINE AND CABLE INTO CONDUIT WHICH CONTAINS SWEEPS OR BENDS, WHILE USING A PRELUBRICATED POLYESTER FLAT STRAP, APN 32904400, IS AS FOLLOWS:

TENSIONS OF 200 POUNDS OR LESS - 100 FEET PER MINUTE.
TENSIONS OF 200 POUNDS THROUGH 750 POUNDS - 60 FEET PER MINUTE.
TENSIONS OVER 750 POUNDS - 30 FEET PER MINUTE.

15.19 **USAGE OF SUNBURNED PVC CONDUIT**

15.19.1 CONDUIT AND FITTINGS MAY BE INSTALLED PROVIDED THE CONDUIT IS NOT OLDER THAN 36 MONTHS AT THE TIME OF THE INSTALLATION, FOR THE FOLLOWING SIZES:

5-INCH-DIAMETER	ALL WALL THICKNESSES
4-INCH-DIAMETER	ALL WALL THICKNESSES
3-INCH-DIAMETER	SCHEDULE 40 AND GREATER
2-INCH-DIAMETER	SCHEDULE 40 AND GREATER
1-INCH-DIAMETER	SCHEDULE 40 AND GREATER

15.19.2 SUNBURNED CONDUIT AND FITTINGS MAY BE INSTALLED PROVIDED THE CONDUIT IS NOT OLDER THAN 18 MONTHS AT THE TIME OF INSTALLATION, FOR THE FOLLOWING SIZES:

3-INCH-DIAMETER	DB-120
2-1/2-INCH-DIAMETER	DB-120
1-INCH-DIAMETER	DB-120

15.19.3 SUNBURNED CONDUIT AND FITTINGS MAY BE INSTALLED PROVIDED THE CONDUIT IS NOT OLDER THAN 12 MONTHS AT THE TIME OF INSTALLATION, FOR THE FOLLOWING SIZE:

2-INCH-DIAMETER	DB-120

15.19.4 IF A LIFT OF SUNBURNED CONDUIT IS PAST THE APPLICABLE AGE REQUIREMENT YET APPEARS TO BE USABLE, CONDUIT SAMPLES MAY BE SUBMITTED TO T&D ENGINEERING AND SUPPORT FOR IMPACT TESTING. A TEST REPORT ALLOWING THE INSTALLATION OF THE CONDUIT WILL BE ISSUED PROVIDED THE IMPACT REQUIREMENTS ARE MET. THE CONDUIT MUST BE INSTALLED WITHIN 60 DAYS OF THE TEST REPORT DATE. THE TEST REPORT SHALL BE INCLUDED IN THE WORK ORDER PACKAGE.

15.19.5 CONDUIT WHICH HAS NOT BEEN SUNBURNED CAN BE INSTALLED AT ANY AGE.

16.0 GUIDELINES FOR CONDUIT SWEEPS

16.1 **PLASTIC SWEEPS**

ALL PLASTIC SWEEPS SHALL BE SPECIFIED BY APS ENGINEERING. ALL PLASTIC SWEEPS SHALL BE FACTORY BENT. SECTIONS OF STRAIGHT CONDUIT TO BE BENT (FOR LONG RADIUS BENDS) IN A DITCH SHALL BE FIRMLY STAKED FOR THE DESIRED RADIUS TO PROVIDE A SMOOTH CURVATURE WHICH DISTRIBUTES THE STRESSES UNIFORMLY THROUGHOUT THE RADIUS. THE CONFIGURATION SHALL ENSURE THAT THERE IS NO DEFORMATION OF THE CONDUIT BEFORE OR AFTER BACKFILL OR ENCASEMENT IS COMPLETED. LONG RADIUS BENDS MAY BE INSTALLED UTILIZING 5-DEGREE COUPLINGS AS SPECIFIED IN 8644.

16.2 **STEEL SWEEPS**

AL STEEL SWEEPS SHALL BE SPECIFIED BY APS ENGINEERING. ALL SWEEPS AND FITTINGS SHALL BE HOT-DIP GALVANIZED. ALL STEEL SWEEPS SHALL BE MANUFACTURED WITH AN EXTRUSION PROCESS. SEGMENTAL BENDING OF STEEL CONDUIT IS NOT ACCEPTABLE. ANY PORTION OF STEEL SWEEPS OR FITTING WHICH ARE NOT TO BE ENCASED IN A MINIMUM 2 INCHES OF CONCRETE SHALL BE HALF-LAPPED TO A 40 MIL THICKNESS WITH POLYKEN NO. 900 2-INCH BLACK TAPE, APN 32907400, OVER POLYKEN NO. 927 BLACK PRIMER, APN 32907405, OR EQUIVALENT.

16.3 **FLEX SWEEPS**

16.3.1 FLEX CONDUITS SWEEPS (EXCEPT WHERE SPECIFIED FOR STREET LIGHT FEEDS) SHALL NOT BE INSTALLED WHERE EXITING NEW PAD-MOUNTED ENCLOSURE INSTALLATIONS.

16.3.2 FLEX CONDUIT SWEEPS PREVIOUSLY INSTALLED (EXISTING IN THE FIELD), MAY BE USED IN THE FUTURE.

16.3.3 FLEX CONDUIT MAY BE USED TO MAKE DIFFICULT CONNECTIONS (TIES) BETWEEN SEPARATELY INSTALLED CONDUIT INSTALLATIONS WHERE THE INSTALLATION OF A RIGID CONNECTION IS IMPRACTICAL DUE TO A MISALIGNMENT OF THE CONDUIT(S). SPECIAL EFFORT SHALL BE USED TO ENSURE THE USABILITY OF THE FLEX CONNECTION BY AVOIDING SHARP BENDS. THIS APPLICATION SHALL BE KEPT TO AN ABSOLUTE MINIMUM (SEE 8601, 18.12) CONTRACTORS OR CUSTOMERS SHALL NOT INSTALL FLEX CONDUIT WITHOUT PRIOR APPROVAL FROM APS ENGINEERING. INSTALL THE TRANSITION FROM FLEX TO RIGID CONDUIT USING A PVC COUPLING PER 8880. USE A LIBERAL AMOUNT OF PVC GLUE AND THEN INSERT FLEX CONDUIT INTO THE PVC COUPLING.

16.3.4 TO AVOID MISALIGNMENT OF CONDUITS WHEN ATTACHING TO EXISTING STUBBED SERVICE CONDUIT, THE EXISTING STUBBED CONDUIT ENDS SHOULD FIRST BE LOCATED TO DETERMINE DEPTH, THE ADJUST THE TRENCH DEPTH (IF NECESSARY) WHILE TRENCHING TOWARDS THE SERVICE ENTRANCE SECTION.

16.4 **STANDARD RADII FOR RIGID PLASTIC AND STEEL SWEEPS**

THE FOLLOWING STANDARD RADIUS SWEEPS ARE REQUIRED UNLESS DIVISION ENGINEERING SPECIFIES OTHERWISE.

16.4.1 LOW-VOLTAGE CIRCUITS IN 2-, 2.5- AND 3-INCH-DIAMETER CONDUIT	24-INCH RADIUS
16.4.2 LOW-VOLTAGE CIRCUITS IN 4-INCH-DIAMETER CONDUIT (SMALLEST RADIUS STOCKED BY APS IS 36-INCH)	*24-INCH RADIUS
16.4.3 LOW-VOLTAGE CIRCUITS FOR DUPLEX TRANSFORMER INSTALLATION IN 3-INCH DIAMETER CONDUIT	18-INCH RADIUS
16.4.4 PRIMARY CIRCUITS IN 2- OR 4-INCH-DIAMETER CONDUIT	36-INCH RADIUS
16.4.5 FEEDER CIRCUITS IN 5-INCH-DIAMETER CONDUIT	60-INCH RADIUS
16.4.6 INDIVIDUAL FEEDER PHASES IN 3-INCH-DIAMETER CONDUIT	36-INCH RADIUS

*36-INCH RADIUS SWEEPS ARE RECOMMENDED FOR LOW-VOLTAGE 500 AND 750 KCMIL SERVICES TO FACILITATE CABLE PULLING.

16.5 **5-DEGREE COUPLINGS**

REFER TO 8644 FOR RADII AND OFFSET CRITERIA USING 5-DEGREE COUPLINGS.

16.6 **SPLIT DUCT AND CONDUIT REPAIR**

REFER TO 8886 AND 8887 FOR PVC SPLIT DUCT AND CONDUIT REPAIR APPLICATIONS AND REQUIREMENTS.

17.0 CONDUIT SPACING

SEE 8610 FOR THE REQUIRED MINIMUM VERTICAL AND HORIZONTAL SEPARATIONS REQUIRED BETWEEN FACILITIES INSTALLED IN CONDUIT. MINIMUM SEPARATIONS BETWEEN APS-OWNED CONDUITS DO NOT APPLY AT EQUIPMENT PADS, MANHOLE WINDOWS AND TRANSITION POLES.

17.1 DIRECT-BURIED CONDUIT FOR PARALLEL-CONNECTED SERVICE RUNS SHALL MAINTAIN A MINIMUM 1/2-INCH HORIZONTAL AND 2-INCH VERTICAL SEPARATION BETWEEN CONDUITS MEASURED SIDEWALL TO SIDEWALL.

17.2 CONCRETE-ENCASED CONDUIT SHALL BE INSTALLED PER 8601, 20.0.

17.3 DIRECT-BURIED CONDUIT SHALL MAINTAIN A MINIMUM 1/2-INCH SEPARATION BETWEEN THE TRENCH SIDEWALL AND THE CONDUIT SIDEWALL. THIS SEPARATION IS REQUIRED TO ACHIEVE PROPER COMPACTION.

17.4 RANDOM LAID CONDUITS SHALL MAINTAIN A MINIMUM 1/2-INCH HORIZONTAL SEPARATION BETWEEN CONDUITS, MEASURED SIDEWALL TO SIDEWALL. THIS SEPARATION IS REQUIRED TO ACHIEVE PROPER COMPACTION.

17.5 DIRECT-BURIED CONDUITS SHALL MAINTAIN A MINIMUM 1/2-INCH HORIZONTAL SEPARATION BETWEEN CONDUIT, MEASURED SIDEWALL TO SIDEWALL. THIS SEPARATION IS REQUIRED TO ACHIEVE PROPER COMPACTION.

17.6 SEE 8610 FOR ADDITIONAL VERTICAL AND HORIZONTAL SEPARATION REQUIREMENTS.

18.0 CONDUIT TERMINATION

18.1 WHEN INSTALLING SCHEDULE 40 OR 80 SWEEPS FOR PRIMARY AND FEEDER CABLE AT MANHOLES, VAULTS, PULLBOXES, BOX PADS, A SHORT STRAIGHT SECTION OF DB-120 (OR EB-35 WHERE APPLICABLE) SHALL BE INSTALLED AT THE END OF EACH SWEEP. THE BELLED END OF THE SWEEP WILL NOT FACILITATE THE USE OF THE CABLE BLOWING (PLUG) TOOL. THE BELLED END OF THE SWEEP WILL NOT ACCEPT ANY CONDUIT PLUGS PER 8881.

18.2 ALL DIRECT-BURIED CONDUIT TO BE TERMINATED IN THE WALLS OF A MANHOLE OR VAULT SHALL BE APPROXIMATELY PERPENDICULAR TO THE WALLS AND SHALL BE GROUTED INTO THE WALLS AND CONCRETE ENCASED FOR A MINIMUM DISTANCE OF 10 FEET OUTSIDE OF THE WALLS (PER 8601, 20.0). THE TERMINATED END OF CONDUIT SHALL BE FREE OF SUPPORT FOR A DISTANCE OF AT LEAST 10 FEET FROM THE MANHOLE TO PERMIT ALIGNMENT OF THE CONDUIT AT THE TERMINATION POINT. AFTER CONDUITS HAVE BEEN PROPERLY ALIGNED AND TERMINATED, PROPER COMPACTION (SEE 8601, 30.0) SHALL BE ATTAINED TO PREVENT SHEAR STRESS ON THE CONDUIT(S) AT THE POINT OF ENTRANCE TO THE MANHOLE OR VAULT PRIOR TO CONCRETE ENCASING TO 10-FOOT PORTION. CONDUITS SHALL BE PERPENDICULAR TO WALLS AT THE POINT OF ENTRY.

18.3 IN MANHOLES, CONDUIT SHALL BE TERMINATED INTO MANUFACTURER INSTALLED DUCT TERMINATORS OR END BELLS MUST BE INSTALLED.EXISTING CONDUIT INSTALLATIONS WITHOUT TERMINATORS OR END BELLS SHALL HAVE ADJUSTABLE CABLE LEADER GUARDS, APN 32902595 INSTALLED.

18.4 CONDUIT INSTALLED THROUGH A BUILDING WALL OR INTO A CUSTOMER'S VAULT SHALL BE SEALED (BEFORE AND AFTER CABLE HAS BEEN INSTALLED) INTERNALLY AND EXTERNALLY AGAINST THE ENTRY OF NOISE, MOISTURE AND GAS INTO THE BUILDING OR VAULT. INTERNAL SEALING SHALL UTILIZE EXPANDABLE PLUGS, FOR EMPTY CONDUIT, USE MASTIC SEALER APN 32900835 TO PROVIDE A SEAL AROUND CABLE INSTALLED IN CONDUIT.

18.5 WHERE LOW-VOLTAGE, PRIMARY OR FEEDER CABLES EXIT A BURIED CONDUIT OR SWEEP, THE CONDUIT OR SWEEP ENDS SHALL BE SEALED USING FOAM, APN 00113496.

18.6 WHERE LOW-VOLTAGE, PRIMARY OR FEEDER CABLES EXIT A BURIED CONDUIT END OR SWEEP END, THE CABLE SHALL BE PROTECTED FROM THE SHARP CONDUIT EDGE BY CHAMFERING THE INSIDE EDGE OF THE CONDUIT OR SWEEP OR BY INSTALLING A CABLE LEADER GUARD.

18.7 ALL EXPOSED CONDUIT ENDS SHALL BE "COVERED" AT THE END OF EACH WORK DAY UNLESS ANOTHER MEANS OF ENSURING A CLEAN INTERNAL WALL IS USED.

18.8 STUB-OUTS OR OTHER EXPOSED (ABOVE GRADE OR NOT BURIED AND NOT INSIDE A LOCKED ENCLOSURE) CONDUIT ENDS THAT PROVIDE ACCESS TO ENERGIZED EQUIPMENT SHALL BE "GLUED AND CAPPED" UNLESS CONSTRUCTION CREWS ARE PRESENT.

18.9 ALL BURIED CONDUIT STUBS SHALL BE PRIMERED, GLUED AND CAPPED. EXPANDABLE CONDUIT PLUGS, PER 8881, SHALL BE INSTALLED AT ALL EXPOSED CONDUITS LOCATED IN ALL SECURED/ENERGIZED EQUIPMENT WHICH INCLUDES BUT IS NOT LIMITED TO J-BOXES, PULL BOXES, TRANSFORMERS, ENCLOSURES AND MANHOLES. ALL UNIVERSAL PLUGS FOUND IN EXISTING ENERGIZED EQUIPMENT MUST BE REMOVED AND REPLACED WITH EXPANDABLE PLUGS.

18.10 WHEN AN APS CONTRACTOR LEAVES A CONDUIT SYSTEM (FOR MORE THAN ONE DAY) IN WHICH "OTHERS" WILL BE RESPONSIBLE FOR INSTALLING THE CABLE, ANY CONDUIT ENDS LEFT EXPOSED SHALL BE "PRIMERED, GLUED, AND CAPPED" AND CONDUIT ENDS WHICH ARE NOT EXPOSED SHALL BE SEALED WITH EXPANDABLE CONDUIT PLUGS. SEE 8601, 18.8 FOR EXCEPTION.

18.11 WHEN AN APS CONTRACTOR LEAVES A CONDUIT SYSTEM, TEMPORARILY (FOR MORE THAN ONE DAY) BUT IS ALSO THE RESPONSIBLE PARTY WHICH MUST LATER INSTALL THE CABLE. THEN THE CONDUIT SYSTEM CAN BE PLUGGED OR CAN BE PRIMERED, GLUED AND CAPPED AT THE CONTRACTOR'S DISCRETION.

18.12 WHERE THE CUSTOMER INSTALLS SERVICE CONDUIT IN CONDOMINIUMS AND APARTMENT COMPLEXES (NOT SUBDIVISIONS) PRIOR TO THE EXISTENCE OF APS FACILITIES AND THUS CANNOT COMPLETE THE REQUIRED CONNECTION (TIE) TO APS FACILITIES, THE LAST 8 TO 10 FEET OF THE CUSTOMER INSTALLED SERVICE CONDUIT SHALL BE LEFT EXPOSED AND PLUGGED, TO FACILITATE THE LATER CONNECTION TO APS FACILITIES (SEE 8601, 16.3.3). EMPTY CONDUITS WHICH HAVE BEEN STUBBED OUT BY APS FOR FUTURE ATTACHMENT TO CUSTOMER, MAY BE LOCATED AND EXPOSED BY THE CUSTOMER PERFORMING THE ATTACHMENT, PROVIDED THERE ARE NO OTHER APS FACILITIES WITHIN 2 FEET AND PROVIDED THE CLEARANCE REQUIREMENTS FROM POLES AND ANCHORS AS SPECIFIED IN 1290 ARE MET.

TO AVOID MISALIGNMENT OF CONDUITS WHEN ATTACHING TO EXISTING STUBBED SERVICE CONDUIT, THE EXISTING STUBBED CONDUIT ENDS SHOULD FIRST BE LOCATED TO DETERMINE DEPTH, THEN ADJUST THE TRENCH DEPTH (IF NECESSARY) WHILE TRENCHING TOWARDS THE SERVICE ENTRANCE SECTION.

18.13 WHERE A CONCRETE-ENCASED DUCT BANK IS STUBBED OUT, EACH CONDUIT SHALL EXTEND 1-FOOT BEYOND THE ENCASEMENT TO FACILITATE FUTURE EXTENSION.

19.0 TRENCHING AND BACKFILLING FOR CONDUIT

19.1 THE TRENCH BOTTOM SHALL BE SMOOTH, FLAT, AND WITHOUT SURFACE IRREGULARITIES, OTHERWISE A SUFFICIENT AMOUNT OF APPROVED BEDDING MATERIAL SHALL BE INSTALLED TO PROVIDE THE REQUIRED SURFACE. ADDITIONAL TRENCH DEPTH WILL BE REQUIRED TO PROVIDE SPACE FOR THE BEDDING MATERIAL. THE BEDDING AND SHADING MATERIAL SHALL NOT CONTAIN ROCKS LARGER THAN 1-1/2 INCHES IN THEIR GREATEST DIMENSION THE BEDDING AND SHADING MATERIAL SHALL CONTAIN ENOUGH FINES TO FILL ALL VOIDS. SEE 8601, 5.0 FOR A LIST OF ALTERNATIVES WHEN THE TRENCH CONDITION OR NATIVE SOIL DOES NOT MEET APS REQUIREMENTS AND FOR GENERAL BEDDING AND SHADING REQUIREMENTS.

19.2 EARTH WHICH CONTAINS HEAVY DEBRIS OR FOREIGN OBJECTS SUCH AS TRASH, CANS, GLASS, CONSTRUCTION WASTE MATERIAL, DECOMPOSABLE ORGANIC MATERIAL OR LAVA SHALL NOT BE USED FOR BACKFILL IN ANY PORTION OF THE TRENCH.

19.3 EARTH WHICH CONTAINS ROCKS LARGER THAN 1-1/2 INCHES OR OTHER HEAVY DEBRIS SHALL NOT BE USED UNDER EQUIPMENT PADS OR FOR BACKFILL MATERIAL WITHIN 6 INCHES OF THE DIRECT-BURIED CONDUIT. THE USE OF SUCH MATERIAL COULD RESULT IN EXCESSIVE PRESSURE BEING EXERTED ON THE DIRECT-BURIED CONDUIT, THUS CAUSING DEFORMATION OR DAMAGE. THE SECOND 6-INCH LIFT OF MATERIAL PLACED IN THE TRENCH ABOVE DIRECT-BURIED CONDUIT SHALL NOT CONTAIN ROCKS LARGER THAN 3-INCHES IN THEIR GREATEST DIMENSION. MATERIAL SHALL CONTAIN ENOUGH FINES TO FILL ALL VOIDS.

19.4 ACCEPTABLE COMPACTION METHODS FOR DIRECT-BURIED CONDUIT ARE HAND-TAMPING WITH PNEUMATIC OR VIBRATING EQUIPMENT, AND/OR JETTING OR IRRIGATION-STYLE FLOODING OF EACH BACKFILL LIFT. VEHICULAR-MOUNTED TAMPING EQUIPMENT OR WHEEL ROLLING IS NOT ACCEPTABLE. IRRIGATION-STYLE FLOODING MUST BE SO CONTROLLED SO THAT SOIL EROSION OF THE SHADING MATERIAL DOES NOT OCCUR IN THE TRENCH. BEFORE TAMPING IN AREAS OF DIRECT-BURIED CONDUIT, AT LEAST 6 INCHES OF APS-APPROVED MATERIAL SHALL BE PLACED OVER THE TOP OF THE DIRECT-BURIED CONDUIT TO AVOID DAMAGE.

19.5 INITIAL BACKFILL OF 12" OVER THE TOP OF THE DIRECT-BURIED CONDUIT IS REQUIRED BEFORE FLOODING OR TAMPING IS PERMITTED. ADDITIONAL BACKFILL IN 6" LIFTS SHALL BE INSTALLED AND COMPACTED UNTIL THE DESIRED HEIGHT IS REACHED.

NOTE: CEMENT SAND SLURRY BACKFILL MAY BE USED WHERE REQUIRED BY LOCAL ORDINANCES OR WHERE COMPACTION MUST BE GAINED WITHIN A SHORT PERIOD OF TIME. WHERE CEMENT SAND SLURRY IS USED, THE FOLLOWING MIXTURE AND PROCEDURE IS REQUIRED:

	1 SACK MIX	**1/2 SACK MIX**
CEMENT	1.00 SACK (94 POUNDS)	1/2 SACK (47 POUNDS)
WASHED CONCRETE SAND	2900 POUNDS (APPROXIMATE)	2900 POUNDS (APPROXIMATE)
WATER DESIGN	70.0 GALLONS	70.0 GALLONS
MAXIMUM WATER ALLOWED	75.0 GALLONS	75.0 GALLONS

WEIGHT OF SAND SHALL BE ADJUSTED TO MAKE A 1.0-CUBIC YARD YIELD, DEPENDING UPON ITS SPECIFIC GRAVITY. THE CEMENT SHALL BE PORTLAND CEMENT AND IN ACCORDANCE WITH AASHTO M85 TYPE 1. THE SAND SHALL BE IN ACCORDANCE WITH AASHTO M6. ALL MATERIAL SHALL BE READY-MIXED AND SHALL MEET THE REQUIREMENTS OF THE LATEST ISSUE OF ASTM C94.

19.6 IF CEMENT SAND SLURRY IS USED OR IF ANY BACKFILL MATERIAL IS FLOODED, TIME SHALL BE ALLOWED FOR THE MASS TO SOLIDIFY UNTIL IT WILL SUPPORT THE WEIGHT OF A PERSON WALKING ON THE STRUCTURE BEFORE THE NEXT ACTIVITY COMMENCES.

19.7 THE MINIMUM SEPARATIONS BETWEEN FOREIGN SUBSTRUCTURES AND THE CONDUIT BEING PLACED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE PER APS SPECIFICATIONS.

19.8 BACKFILL BENEATH TRANSFORMER AND EQUIPMENT PADS SHALL BE COMPACTED PER 8601, 29.3. ALL OTHER TRENCHES WILL BE COMPACTED TO A MINIMUM 85 PERCENT OF THE MAXIMUM DENSITY AS DEFINED BY AASHTO T 99 OR ASTM D 698 OR ASTM D 2922 AND D3017, UNLESS OTHERWISE SPECIFIED ON THE WORK ORDER DRAWING, OR UNLESS MORE STRINGENT REQUIREMENTS PREVAIL AS DICTATED BY LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES.

19.9 EMPTY CONDUITS WHICH HAVE BEEN STUBBED OUT FOR FUTURE ATTACHMENT TO CUSTOMER, MAY BE EXPOSED BY THE CUSTOMER MAKING THE ATTACHMENT, PROVIDED THERE ARE NO OTHER APS FACILITIES WITHIN 2 FEET AND PROVIDED THE CLEARANCE REQUIREMENTS FROM POLES AND ANCHORS AS SPECIFIED IN 1290 ARE MET.

19.10 CONDUIT INSTALLATIONS SHALL BE SHADED FOLLOWING INSPECTION APPROVAL OF THE FACILITIES. PREFERENCE IS TO COMPLETE THE SHADING PRIOR TO LEAVING THE JOB SITE AT THE CONCLUSION OF THE WORK DAY.

19.11 A MINIMUM 4-INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDES IS REQUIRED WHERE CABLES ARE INSTALLED IN REDUCED-DEPTH PLASTIC CONDUIT (SEE 8601, 23.3) OR CABLES MAY BE INSTALLED IN A CONCRETE-ENCASED DUCT BANK (SEE 8625 AND 8750) IN EXCAVATIONS WHERE APS FACILITIES ARE AT A REDUCED DEPTH DUE TO ROCK DIGGING CONDITIONS.

19.12 APS-OWNED FACILITIES (DIRECT-BURIED OR IN CONDUIT) MAY BE INSTALLED (ON TOP OF) IN DIRECT CONTACT WITH AN APS-OWNED CONCRETE-ENCASED DUCT BANK.

19.13 COMMUNICATION FACILITIES (DIRECT-BURIED OR IN CONDUIT) MAY BE INSTALLED WITH A MINIMUM OF 3 INCHES VERTICAL SEPARATION ABOVE AN APS-OWNED CONCRETE-ENCASED DUCT BANK.

19.14 BACKFILL OR ENCASEMENT OF CONDUIT WITH MATERIAL CONSISTING OF LESS THAN TWO SACKS OF CEMENT (94 POUNDS) PER CUBIC YARD REQUIRES THE USE OF DB TYPE CONDUIT.

20.0 CONCRETE ENCASEMENT OF CONDUIT

CONCRETE USED FOR THE ENCASEMENT OF CONDUIT(S) OR DUCTBANKS SHALL BE READY-MIXED AND SHALL MEET THE REQUIREMENTS OF THE LATEST ISSUE OF ASTM C 94. CONCRETE ENCASEMENT SHALL CONSIST OF THE FOLLOWING:

20.1 COMPRESSIVE STRENGTH OF 260 MINIMUM PSI TO 300 MAXIMUM PSI. THIS STRENGTH REQUIREMENT IS TYPICALLY PROVIDED UTILIZING 190 TO 200 POUNDS OF CEMENT PER CUBIC YARD (2-SACK MIX). SEE 8601, 20.9, 20.10, AND 21.0 FOR EXCEPTIONS

20.2 AGGREGATE CONTENT SHALL CONSIST OF 40 PERCENT CONCRETE SAND BY WEIGHT AND 60 PERCENT 3/8-INCH MAXIMUM COARSE AGGREGATE. AGGREGATES SHALL BE CLEAN, SOUND AND UNIFORMLY GRADED.

20.3 PORTLAND CEMENT SHALL BE IN ACCORDANCE WITH AASHTO M85 TYPE 1 OR 2.

20.4 WATER REDUCING ADMIXTURE IN PROPORTIONS NOT TO EXCEED THE MANUFACTURER'S SUGGESTED DOSAGE RATE.

20.5 WATER CONTENT SUFFICIENT TO PRODUCE A MINIMUM SLUMP OF 4 INCHES AND A MAXIMUM SLUMP OF 6 INCHES.

20.6 ANY ADMIXTURE USED SHALL BE OF A TYPE AND BRAND THAT WILL NOT IMPAIR THE QUALITY OF THE CONCRETE, ITS REINFORCEMENT, OR CAUSE AN INCREASE IN SET-UP TIME. CALCIUM CHLORIDE IS NOT ACCEPTABLE. FLYASH IS NOT ACCEPTABLE BECAUSE IT INCREASES THE SET-UP TIME. ALL ADMIXTURE USED SHALL MEET THE APPROVAL OF THE APS ENGINEER.

20.7 THE BACKFILL ABOVE THE CONDUIT(S) OR DUCTBANKS SHALL MEET APS SPECIFICATIONS HEREIN.

20.8 THE DRIVER OF THE CONCRETE MIXING TRUCK MUST PROVIDE A TICKET DESCRIBING THE SLURRY MATERIAL. OTHERWISE, THE MATERIAL IS UNACCEPTABLE.

20.9 IN DIRECT-BURIED CONDUIT SYSTEMS, CONCRETE ENCASEMENT OF CONDUIT SWEEPS IS REQUIRED WHEREVER THE SIDEWALL BEARING PRESSURE EXCEEDS 600 POUNDS. THE ENCASEMENT SHALL BE A MINIMUM OF 3 INCHES THICK SURROUNDING THE SWEEPS AND SHALL EXTEND 12 INCHES BEYOND THE SWEEP COUPLINGS. PREMIX CONCRETE (GREATER THAN 300 PSI) MAY BE USED INSTEAD OF THE MIX DESIGN SPECIFIED ABOVE (CONCRETE ENCASEMENT OF CONDUIT) IN CASES WHERE IT IS IMPRACTICAL TO DO OTHERWISE. BACKFILL IN THE GENERAL AREA (EXCLUDING ANY UNDISTURBED SOIL) SURROUNDING THE ENCASEMENT SHALL BE COMPACTED TO A MINIMUM OF 90 PERCENT OF THE MAXIMUM DENSITY BY AASHTO T 99 OR ASTM D 698 OR ASTM D 2992 AND D 3017, UNLESS OTHERWISE SPECIFIED ON THE WORK ORDER DRAWINGS, OR UNLESS MORE STRINGENT REQUIREMENTS PREVAIL AS DICTATED BY LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES.

20.10 CONCRETE ENCASEMENT OF CONDUIT INSTALLED AT A DEPTH SHALLOWER THAN 36 INCHES OR LOCATED BENEATH A BUILDING OR STORAGE TANK FOUNDATION SHALL BE AS SPECIFIED IN 8601, 23.0. CONDUITS WHICH ARE PARTIALLY ENCASED WITH A 4-INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDES AT A DEPTH SHALLOWER THAN 36 INCHES SHALL BE ENCASED PER 8601, 23.0.

20.11 EXTREME CARE SHALL BE EXERCISED TO ENSURE THAT CONCRETE AND OTHER FOREIGN MATTER DO NOT ENTER THE CONDUIT BEING LAID, WHILE ENCASING, OR AT ANY TIME THEREAFTER. THE USABILITY OF ALL CONDUIT SYSTEMS MUST BE ENSURED.

20.12 THE TRENCH DEPTH AND WIDTH FOR CONCRETE-ENCASED CONDUIT OR DUCTBANK SHALL BE SPECIFIED FOR EACH LOCATION BY APS WORK ORDER DRAWINGS PRIOR TO START OF EXCAVATION (SEE 8625 AND 8750).

20.13 A MINIMUM OF 2 INCHES VERTICAL AND HORIZONTAL SEPARATION IS REQUIRED BETWEEN CONDUITS WHEN CONCRETE ENCASED DUCTBANKS ARE INSTALLED.

20.14 SIDEWALLS OF TRENCH SHALL PROVIDE A MINIMUM OF 2 INCHES SEPARATION FROM CONDUIT WHEN CONCRETE ENCASED DUCTBANK IS SPECIFIED. SEE 8625 AND 8750 FOR TRENCH SPACE REQUIREMENTS.

20.15 CONDUIT WHICH HAS BEEN CONCRETE ENCASED OR CAPPED DOES NOT REQUIRE SHADING PRIOR TO INSTALLATION OF THE BACKFILL.

20.16 ALL CONCRETE ENCASEMENTS OR CAPS WITH LESS THAN 36 INCHES COVER SHALL BE A MINIMUM OF 3000 POUNDS PER SQUARE INCH AT 28 DAYS, UNLESS APPROVED BY APS ENGINEERING.

20.17 ALL 750 KCMIL FEEDERS SHALL BE INSTALLED IN CONDUIT. WHERE THERE ARE MORE THAN TWO 5-INCH DIAMETER FEEDER CONDUITS IN THE SAME TRENCH, THEY SHALL BE INSTALLED AND CONCRETE ENCASED PER 8601, 8625, AND 8750.

20.18 WHERE THE SIDEWALL-BEARING PRESSURE WILL EXCEED 600 POUNDS; ENGINEERING SHALL REQUIRE/SPECIFY ON THE CONSTRUCTION DRAWINGS, THAT THE PLASTIC OR STEEL SWEEP(S) SHALL BE CONCRETE ENCASED PER 8601, 20.0, TO A POINT 12 INCHES BEYOND THE ENDS OF THE SWEEP COUPLINGS.

20.19 CONCRETE ENCASEMENT OF CONDUIT INSTALLED WITHIN THE BOUNDARIES OF A SUBSTATION SHALL CONFORM TO THE REQUIREMENTS SPECIFIED IN 8601, 21.0.

21.0 CONCRETE ENCASEMENT OF CONDUIT INSTALLED WITHIN THE BOUNDARIES OF A SUBSTATION

CONCRETE ENCASEMENT OF CONDUIT INSTALLED WITHIN THE BOUNDARIES OF A SUBSTATION SHALL UTILIZE PORTLAND CEMENT, SHALL PROVIDE A MINIMUM 3-INCH CLEAR COVER ON ALL SIDES AND SHALL CONFORM TO THE FOLLOWING:

21.0.1 EXPOSED ENCASEMENTS AND ALL ENCASEMENTS INSTALLED WITH LESS THAN 36 INCHES COVER SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 2000 PSI AT 28 DAYS. SEE 8601, 21.4 FOR EXCEPTION.

21.0.2 ALL ENCASEMENTS INSTALLED WITH LESS THAN 36 INCHES COVER IN HEAVY TRAFFIC AREAS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT 28 DAYS.

21.0.3 ENCASEMENTS INSTALLED WITH 36 INCHES OR GREATER COVER SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 260 PSI AT 28 DAYS. MINIMUM CEMENT CONTENT SHALL BE 2 SACKS PER CUBIC YARD. MAXIMUM AGGREGATE SIZE SHALL BE 1/2 INCH. SLUMP SHALL BE 5-INCH MINIMUM TO 8-INCH MAXIMUM, SEE 8601, 21.4 FOR EXCEPTION.

21.0.4 ALL ENCASEMENTS INSTALLED UNDER FOUNDATIONS OR OTHER UNUSUAL INSTALLATIONS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT 28 DAYS.

21.0.5 WHERE A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI AT 28 DAYS IS REQUIRED, THE MINIMUM CEMENT CONTENT SHALL BE 5 SACKS PER CUBIC YARD. MAXIMUM AGGREGATE SIZE SHALL BE 1/2 INCH. SLUMP SHALL BE 4-INCH TO 6-INCH MAXIMUM.

21.0.6 REFER TO SUBSTATION STANDARDS CS-03-0330 AND DRAWING XE18 IF ADDITIONAL INFORMATION IS DESIRED.

22.0 CONDUIT USED AS SLEEVES

22.1 SLEEVES ARE NOT REQUIRED FOR FUTURE USE. INSTEAD, INSTALL CONDUIT WITH ENDS CAPPED AND ELECTRONICALLY MARKED FOR ATTACHMENT TO A FUTURE CONDUIT SYSTEM.

CONCRETE AND SUBSTRUCTURES

23.0 CONCRETE-GENERAL

23.1 ALL CONCRETE WHICH IS TO BE POURED IN PLACE, UNLESS OTHERWISE PERMITTED BY THE APS INSPECTOR, SHALL BE READY MIXED AND SHALL MEET THE REQUIREMENTS OF THE LATEST ISSUE OF ASTM C 94.

23.2 MANHOLES, PULL BOXES, JUNCTION BOXES, PAD VAULTS, PADS FOR THREE-PHASE TRANSFORMERS OR EQUIPMENT LOCATIONS AND/OR ENCLOSURES SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH APS SPECIFICATIONS.

23.3 COMPRESSIVE STRENGTH OF CONCRETE POURED IN PLACE SHALL BE A MINIMUM OF 3,000 POUNDS PER SQUARE INCH AT 28 DAYS. SLUMP SHALL BE BETWEEN 3 AND 5 INCHES. MAXIMUM AGGREGATE SIZE SHALL BE 3/4-INCH. WHEN CONCRETE ENCASED CONDUIT IS INSTALLED WITH LESS THAN 36" OF COVER OR IS LOCATED BENEATH A BUILDING OR STORAGE TANK FOUNDATION, THE ENCASEMENT MUST BE AT LEAST 3000 PSI CONCRETE. CONDUITS WHICH ARE PARTIALLY ENCASED WITH A 4 INCH CONCRETE CAP ON TOP AND 2 INCHES ON THE SIDE AT A DEPTH LESS THAN 36 INCHES, THE ENCASEMENT MUST BE AT LEAST 3000 PSI CONCRETE.

23.4 GROUT FOR PRECAST TRANSFORMER AND EQUIPMENT PAD WINDOWS OR OPEN-BOTTOMED PULL BOXES AND JUNCTION BOXES SHALL BE PRE-MIX, 71301280 (25-POUND SACK), OR AS SPECIFIED IN 8601, 20.0 OR 23.3 OR A HAND-MIXED EQUIVALENT.

23.5 GROUT FOR CONDUIT ENTRANCES INTO SUBSTRUCTURES SHALL BE PRE-MIX OR AS SPECIFIED IN 8601, 20.0 OR A HAND-MIXED EQUIVALENT.

23.6 CONCRETE ENCASEMENT OF CONDUIT INSTALLED WITHIN THE BOUNDARIES OF A SUBSTATION SHALL CONFORM TO THE REQUIREMENTS SPECIFIED IN 8601, 21.0.

24.0 MATERIAL

24.1 REBAR SHALL BE FREE OF FOREIGN MATERIAL OR COATINGS THAT WOULD REDUCE BOND, AND SHALL CONFORM TO THE LATEST ISSUE OF ASTM A 615.

24.2 WELDED WIRE FABRIC FOR CONCRETE REINFORCEMENT SHALL CONFORM TO THE LATEST ISSUE OF ASTM A 185.

24.3 CEMENT SHALL BE CLEAN, FRESH PORTLAND CEMENT TYPE I OR II.

24.4 AGGREGATES SHALL BE CLEAN, SOUND, UNIFORMLY GRADED AND OF PROPER SIZE FOR WORK BEING CONSTRUCTED, AS APPROVED BY THE APS INSPECTOR.

24.5 WATER SHALL BE CLEAN AND FRESH.

24.6 ANY ADMIXTURE USED SHALL BE OF A TYPE AND BRAND THAT WILL NOT IMPAIR THE QUALITY OF THE CONCRETE AND MUST MEET THE APPROVAL OF APS ENGINEERING. CALCIUM CHLORIDE IS NOT AN ACCEPTABLE ADMIXTURE.

25.0 WORKMANSHIP

25.1 FORMS SHALL BE CONSTRUCTED OF SMOOTH MATERIAL AND SHALL BE TRUE TO LINES AND DIMENSIONS AS DEFINED BY THE SPECIFICATIONS. ONLY APPROVED FORM TIES SHALL BE USED. FORMS SHALL BE TIGHT, OF ADEQUATE STRENGTH, AND COMPLETELY REMOVED UPON COMPLETION OF THE WORK OR AT SUCH OTHER TIME WHEN CONCRETE WILL SUPPORT IMPOSED LOADS.

25.2 WHERE MATERIAL IS TO BE EMBEDDED IN CONCRETE AND TEMPORARILY SUPPORTED BY FORMS, IT SHALL BE HELD SECURELY IN PLACE, USING TEMPLATES IF NECESSARY, TO PREVENT MOVEMENT OR DISPLACEMENT OF THE WORK DURING THE CONCRETE PLACEMENT PROCESS.

25.3 REINFORCING SHALL BE SHAPED AND SPACED AS INDICATED ON THE DRAWINGS AND SECURELY TIED TO PREVENT MOVEMENT DURING CONCRETE PLACEMENT. ALL BARS SHALL BE SECURELY TIED AT INTERSECTIONS. REBAR SHALL NOT BE TACK WELDED. LAPS SHALL NOT BE LESS THAN 48-BAR-DIAMETERS IN LENGTH. THE THICKNESS OF CONCRETE OVER BARS AND OTHER REINFORCEMENT SHALL NOT BE LESS THAN 1-1/2 INCHES UNLESS OTHERWISE NOTED. MATERIALS SHALL BE MEASURED ACCURATELY FOR EACH BATCH AND MIXED THOROUGHLY UNTIL ALL AGGREGATE IS COATED WITH MORTAR.

25.4 ALL COMBINED INGREDIENTS SHALL BE MIXED FOR A MINIMUM OF 1-1/2 MINUTES.

25.5 FORMS SHALL BE CLEAN AND WETTED PRIOR TO PLACING OF THE CONCRETE. CONCRETE SHALL BE PLACED BY AN APPROVED MEANS IMMEDIATELY AFTER MIXING AND IN LAYERS THAT WILL SATISFACTORILY CONSOLIDATE. THE SIZE OF ANY UNIT PLACEMENT SHALL MEET WITH THE APPROVAL OF THE APS INSPECTOR, AND PLACEMENT SHALL BE CONTINUOUS UNTIL EACH UNIT PLACEMENT IS COMPLETED. CONCRETE SHALL BE WORKED INTO ALL CORNERS AND RECESSES UNTIL THOROUGHLY CONSOLIDATED.

25.6 ALL CONCRETE ABOVE GRADE SHALL HAVE A 3/4-INCH CHAMFER ON ALL CORNERS AND EDGES.

25.7 NO FINISHED SURFACE SHALL CONTAIN HONEYCOMB OR SEGREGATION. DEFECTS SHALL BE REMEDIED AS DIRECTED BY THE APS ENGINEER. UNIFORM INTERIOR SURFACES SHALL BE STEEL-TROWELED TO A SMOOTH, DENSE SURFACE. UNIFORM EXTERIOR SURFACES SHALL BE FLOATED, STEEL-TROWELED, AND LIGHTLY BROOMED TO OBTAIN A NON-SKID SURFACE. DRAINAGE SHALL BE SLOPED TO ELEVATIONS INDICATED BY THE DRAWINGS OR AS REQUIRED TO PROVIDE A POSITIVE DRAINAGE. PADS FOR TRANSFORMERS AND EQUIPMENT ARE NOT TO BE SLOPED FOR DRAINAGE.

25.8 WHEN THE CUSTOMER HAS ELECTED TO CONCRETE THE AREA SURROUNDING THE PADS FOR TRANSFORMERS OR EQUIPMENT LOCATIONS, THE PADS SHALL BE SEPARATED FROM THE CONCRETED AREA WITH THE USE OF EXPANSION JOINTS. THE SURROUNDING AREA SHALL BE SLOPED FOR PROPER DRAINAGE.

25.9 SURFACES SHALL BE KEPT CONTINUOUSLY MOIST FOR A PERIOD OF NOT LESS THAN SEVEN DAYS. EITHER WETTING OR AN APPROVED CURING COMPOUND SHALL BE USED.

26.0 STANDARD LOCATIONS FOR PULL BOXES, JUNCTION BOXES AND MANHOLES

26.1 PULL BOXES, JUNCTION BOXES AND MANHOLES SHALL BE LOCATED AWAY FROM STREET CUTTERS OR DRAINAGE AREAS WHEREVER POSSIBLE.

26.2 TO AVOID THE NECESSITY FOR ADDITIONAL CONDUIT BENDS, PULL BOXES, JUNCTION BOXES, PAD VAULTS AND MANHOLES SHALL BE LOCATED IN-LINE WITH NONJOINTLY USED TRENCHES. ALL APS EQUIPMENT, EXCEPT PAD-MOUNTED TRANSFORMERS, AND MANHOLE ENTRANCES SHALL BE OFFSET FROM JOINTLY USED TRENCHES. A MINIMUM 6-INCH CLEAR HORIZONTAL TRENCH SPACE SHOULD BE PROVIDED WHICH WILL ALLOW COMMUNICATION FACILITIES TO BYPASS THE APS EQUIPMENT. SEE THE 1286 THROUGH 1287 SECTION FOR TYPICAL TRENCH OFFSETS.

26.3 MANHOLES SHALL BE INSTALLED WITH THE MINIMUM COVER REQUIRED (SEE 8606 AND 8610).

26.4 PULL BOXES, JUNCTION BOXES AND MANHOLES SHALL BE LOCATED AS SPECIFIED ON THE WORK ORDER DRAWINGS. PULL BOXES AND JUNCTION BOXES SHALL NOT BE INSTALLED IN VEHICULAR TRAFFIC AREAS.

27.0 OBSTRUCTIONS AT PULL BOXES AND MANHOLES

PIPES, SEWERS, CONDUIT BELONGING TO OTHERS, OR SIMILAR OBSTRUCTIONS, SHALL NOT PASS THROUGH A MANHOLE OR ITS WALLS WITHOUT THE CONSENT AND APPROVAL IN WRITING BY DIVISION ENGINEERING. GAS PIPE SHALL NEVER PASS THROUGH A MANHOLE OR ITS WALLS.

27.1 ALL FOREIGN FACILITIES WHICH CROSS ABOVE THE MANHOLE ROOF SHALL MAINTAIN A MINIMUM 12-INCH HORIZONTAL SEPARATION FROM THE OUTSIDE WALL OF THE MANHOLE GRADE-RING TO THE OUTSIDE WALL OF THE FOREIGN FACILITY.

27.2 AFTER THE MANHOLE HAS BEEN INSTALLED, FOREIGN FACILITIES MAY BE INSTALLED DIRECTLY ABOVE THE MANHOLE PROVIDED THE FACILITIES ARE SUITABLY SUPPORTED TO PREVENT THE TRANSFER OF ANY LOAD ONTO THE MANHOLE ROOF.

27.3 WHEREVER PRACTICAL, MANHOLES AND PULL BOXES SHALL BE LOCATED WITH A MINIMUM 24-INCH FREE HORIZONTAL SEPARATION AROUND THE PERIMETER OF THE MANHOLE OR PULL BOX FROM EXISTING OBSTRUCTIONS. AFTER THE MANHOLE OR PULL BOX HAS BEEN INSTALLED, BACKFILLED AND COMPACTED, THE MINIMUM SEPARATION REQUIREMENTS FROM FUTURE OBSTRUCTIONS MAY BE REDUCED TO ALLOW CONTACT BETWEEN THE OUTSIDE MANHOLE OR PULL BOX WALLS AND THE OUTSIDE WALL OF THE PROPOSED FACILITY. OBSTRUCTIONS WHICH PREVENT THE FUTURE USE OF MANHOLE ENTRIES SHALL BE AVOIDED WHEREVER PRACTICAL.

28.0 MANHOLES AND PULL BOXES

28.1 APS APPROVED PRECAST MANHOLES AND PULL BOXES SHALL BE INSTALLED PER APS SPECIFICATIONS. MANHOLES AND PULL BOXES SHALL BE LOCATED AS SPECIFIED ON THE WORK ORDER DRAWINGS. PULL BOXES SHALL NOT BE INSTALLED IN VEHICULAR TRAFFIC AREAS.

28.2 ELECTRIC GROUNDING IN MANHOLES AND PULL BOXES SHALL BE INSTALLED BY APS. SEE 8601, 29.8 FOR GROUND ROD RESPONSIBILITY.

28.3 ALL AREAS EXPOSED TO VEHICULAR TRAFFIC SHALL MEET OR EXCEED AASHTO H 20 LOADING.

28.4 **MANHOLE AND PULL BOX INSPECTION**

28.4.1 INSPECTION AND APPROVALS SHALL OCCUR AT THE PLACE OF MANUFACTURE. THE SUPPLIER SHALL PROVIDE THE QUALITY CONTROL (QC) INSPECTOR SUCH ACCESS TO ITS PLACE OF BUSINESS DURING WORKING HOURS AS IS REASONABLE AND NECESSARY TO DETERMINE THE SUITABILITY OF MATERIAL TO BE SUPPLIED. INSPECTOR SHALL VISUALLY INSPECT THE REINFORCING AND INSERTS PRIOR TO THE POURING OF CONCRETE. THREE CONCRETE TEST CYLINDERS SHALL BE MADE AT THE TIME OF CONCRETE POUR. RESULTS OF THE SLUMP TESTS SHALL BE MAILED TO THE APS OVERHEAR/UNDERGROUND LINE ENGINEERING DEPARTMENT. THE INSPECTOR SHALL BE PRESENT WHEN FORMS ARE REMOVED TO STENCIL "APS APPROVED" ON THE FINISHED MANHOLE OR PULL BOX. A NOTICE OF TWO WORKING DAYS SHALL BE GIVEN TO ENSURE THAT AN INSPECTOR IS AVAILABLE FOR THESE REQUIREMENTS. APPROVAL BY INSPECTOR OR WAIVER OF INSPECTION BY APS SHALL NOT RELIEVE THE SUPPLIED FROM OBLIGATION TO FURNISH MATERIAL IN ACCORDANCE WITH APS SPECIFICATIONS.

29.0 TRANSFORMER AND EQUIPMENT PADS

29.1 APS APPROVED PRECAST PADS FOR THREE-PHASE TRANSFORMERS AND EQUIPMENT LOCATIONS SHALL BE INSTALLED IN ACCORDANCE WITH APS SPECIFICATIONS. PADS SHALL BE LOCATED AS SPECIFIED ON THE WORK ORDER DRAWINGS.

29.2 POURED-IN-PLACE CONCRETE PADS FOR TRANSFORMERS AND EQUIPMENT LOCATIONS SHALL BE INSTALLED IN ACCORDANCE WITH APS SPECIFICATIONS. PADS SHALL BE LOCATED AS SPECIFIED ON THE WORK ORDER DRAWINGS.

29.3 THE BACKFILL BENEATH A TRANSFORMER OR EQUIPMENT PAD (EXCLUDING ANY UNDISTURBED SOIL) SHALL BE COMPACTED TO A MINIMUM 90 PERCENT OF THE MAXIMUM DENSITY BY AASHTO T 99 OR ASTM D 698 OR ASTM D 2922 AND D 3017, UNLESS OTHERWISE SPECIFIED ON THE WORK ORDER DRAWINGS, OR UNLESS MORE STRINGENT REQUIREMENTS PREVAIL AS DICTATED BY LOCAL GOVERNMENTAL AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES. THE BACKFILL MATERIAL SHALL BE COMPACTED AT FINAL GRADE FOR A MINIMUM 1-FOOT CIRCUMFERENCE AROUND THE PAD. SEE 8601, 30.5 FOR COMPACTION REQUIREMENTS AROUND PAD VAULTS

29.3.1 ONE-SACK ABC SLURRY SHALL NOT BE INSTALLED BENEATH EQUIPMENT PADS. THIS IS BECAUSE THE DELIVERY OF EXTRA STRENGTH ABC SLURRY HAS PROVEN TO BE A PROBLEM IN THE PAST.

29.3.2 IF SLURRY BACKFILL IS INSTALLED BENEATH EQUIPMENT PADS, ONE OF THE FOLLOWING OPTIONS SHALL BE UTILIZED:

OPTION 1

HALF-SACK CEMENT SAND SLURRY AS SPECIFIED IN 8601, 19.5.

OPTION 2

FLYASH, TYPE F	250 POUNDS
WATER	50 GALLONS
FINE AGGREGATE(SAND)	3117 POUNDS

OPTION 3

CEMENT	52 POUNDS
FLYASH, TYPE F	240 POUNDS
WATER	55 GALLONS
FINE AGGREGATES(SAND)	2820 POUNDS

EXTRA STRENGTH SLURRY MIXES CAUSE EXTREME DIFFICULTY WHEN IT LATER BECOMES NECESSARY TO EXCAVATE BENEATH THE EQUIPMENT PAD. THE ABOVE OPTIONS WILL BE READILY RECOGNIZABLE WHEN UNLOADING FROM A MIXING TRUCK. IT IS UNLIKELY THAT AN EXTRA STRENGTH MIX WILL BE DELIVERED BECAUSE THERE ARE NO STANDARD USES FOR EXTRA STRENGTH SAND OR FLYASH SLURRY. THE DRIVER OF THE CONCRETE MIXING TRUCK MUST PROVIDE A TICKET DESCRIBING THE SLURRY MATERIAL. OTHERWISE THE MATERIAL IS UNACCEPTABLE.

29.3.3 WHERE THE NORMAL SOIL DOES NOT COMPACT WELL AND WHERE SLURRY IS NOT ACCESSIBLE, MIX TWO SACKS OR PREMIX CONCRETE INTO THE TOP 18 INCHES OF NORMAL SOIL BACKFILL.

29.4 THE BACKFILL MATERIAL INSTALLED BENEATH A TRANSFORMER OR EQUIPMENT PAD SHALL NOT CONTAIN ROCKS LARGER THAN 1-1/2 INCHES IN THEIR GREATEST DIMENSION. THE BACKFILL MATERIAL SHALL CONTAIN ENOUGH FINES TO FILL ALL VOIDS.

29.5 THE BOTTOM OF THE TRANSFORMER OR EQUIPMENT PAD SHALL BE SET AT FINAL GRADE. A BOX PAD MAY BE SPECIFIED IN ANY SLOPING AREA WHERE A BUILD-UP OF THE TRANSFORMER PAD SITE IS REQUIRED.

29.6 THE FINAL GRADE AT THE TRANSFORMER (OR ANY OIL FILLED DEVICE) PAD POSITION SHALL BE COMPACT AND LEVEL TO ENSURE A MAXIMUM 2-DEGREE TILT OF THE PAD. THIS MEANS THAT A 42-INCH SQUARE TRANSFORMER PAD MUST BE LEVEL WITHIN 1-1/2 INCHES FROM SIDE-TO-SIDE AND FRONT-TO-BACK.

29.7 SEE STANDARDS 1278 AND 1279 FOR MINIMUM CLEARANCES (ABOVE FINAL GRADE) AROUND THE PAD PERIMETER OF PAD-MOUNTED EQUIPMENT FOR OPERATING PURPOSES, MAINTENANCE, AND MAXIMUM ALLOWED DEVIATION OF FINAL GRADE WITHIN THE REQUIRED OPERATING SPACE(S).

29.8 THE GROUND RODS (OR APPROVED GROUNDING ELECTRODES PER 2400 STANDARDS) REQUIRED BY THE APS STANDARDS SHALL BE PROVIDED BY APS AND INSTALLED BY THE PARTY RESPONSIBLE FOR INSTALLING THE CONDUIT SYSTEM.

29.9 THE PARTY RESPONSIBLE FOR PROVIDING THE TRENCHING AND BACKFILL SHALL BE RESPONSIBLE FOR PREPARING THE PAD SITE FOR ALL PROPOSED TRANSFORMER, SWITCHING CABINET OR OTHER EQUIPMENT LOCATIONS.

30.0 EXCAVATION AND BACKFILL FOR CONCRETE STRUCTURES AND BOX PADS

30.1 PROPER EXCAVATION SHALL BE PROVIDED TO ENSURE PROPER LOCATION, CORRECT SIZE, CORRECT DEPTH AND ALIGNMENT. THE JOB SITE SHALL BE PREPARED TO PROVIDE ADEQUATE SPACE AND OVERHEAD CLEARANCE FOR EQUIPMENT AND/OR CRANE. ACCEPTABLE BEDDING, BACKFILL, COMPACTION AND RESURFACING SHALL BE PROVIDED.

30.2 ALL SUBSTRUCTURES SHALL BE SET IN RELATION TO FINAL GRADE PRIOR TO BACKFILLING. FINAL GRADE STAKES FOR ALL FOUR CORNERS OF MANHOLES, PULL BOXES AND BOX PADS SHALL BE MAINTAINED UNTIL FINAL BACKFILL AND COMPACTION HAVE BEEN COMPLETED AND ACCEPTED BY THE APS INSPECTOR.

30.3 MANHOLE, PULL BOX AND BOX PAD BEDDING MATERIAL SHALL CONSIST OF 6 INCHES OF COMPACTED SAND OR ROCK NO GREATER THAN 1/4-INCH IN DIAMETER AND SHALL BE GRADED LEVEL AT THE REQUIRED DEPTH.

30.4 TO ENSURE ADEQUATE WORKING SPACE FOR COMPACTING THE BACKFILL, EXCAVATIONS FOR MANHOLES, PULL BOXES AND BOX PADS SHALL PROVIDE AN ADDITIONAL 12-INCH FREE HORIZONTAL SEPARATION FROM THE TRENCH WALL TO THE OUTSIDE WALL OF THE MANHOLE, PULL BOX OR BOX PAD. THIS SEPARATION IS REQUIRED AROUND THE PERIMETER OF THE MANHOLE, PULL BOX OR BOX PAD WHEREVER PRACTICAL.

30.5 BACKFILL AROUND PULL BOX OR BOX PAD SHALL CONSIST OF CLEAN, COMPACTIBLE MATERIAL, SUCH AS SAND AND PEA GRAVEL MIXTURE, OR 3/4-INCH ABC. VOIDS BETWEEN PULL BOX OR BOX PAD AND NATURAL SOIL SHALL NOT BE ACCEPTABLE. BACKFILL SHALL BE PERFORMED AFTER PULL BOX OR BOX PAD HAS BEEN PROPERLY SET AND ALIGNED.

30.6 BACKFILL FOR A MANHOLE SHALL BE PERFORMED AFTER THE MANHOLE HAS BEEN PROPERLY SET AND ALIGNED. VOIDS BETWEEN THE MANHOLE AND THE NATURAL SOIL SHALL NOT BE ACCEPTABLE. WHEN BACKFILLING THE EXCAVATION FOR THE MANHOLE, USE CEMENT SAND SLURRY (OR FLYASH PER 29.0) TO FILL THAT PART OF THE EXCAVATION WHICH IS 60 INCHES DEEP OR DEEPER. THE CEMENT SAND SLURRY SHALL CONSIST OF THE FOLLOWING:

CEMENT	1.00 SACK (94 POUNDS)
WASHED CONCRETE SAND	2900 POUNDS (APPROXIMATE)
WATER DESIGN	70.0 GALLONS
MAXIMUM WATER ALLOWED	75.0 GALLONS

WEIGHT OF SAND SHALL BE ADJUSTED TO MAKE A 10 CUBIC YARD YIELD, DEPENDING ON ITS SPECIFIC GRAVITY. THE CEMENT SHALL BE PORTLAND CEMENT AND IN ACCORDANCE WITH AASHTO M85, TYPE 1, THE SAND SHALL BE IN ACCORDANCE WITH AASHTO M6. ALL MATERIAL SHALL BE READY-MIXED AND SHALL MEET THE REQUIREMENTS OF THE LATEST ISSUE OF ASTM C94.

WHEN BACKFILLING THAT PART OF THE MANHOLE EXCAVATION WHICH IS SHALLOWER THAN 60 INCHES, THE BACKFILL MATERIAL MAY BE THE SAME AS THAT LISTED ABOVE OR, SHALL CONSIST OF CLEAN, COMPATIBLE MATERIAL, SUCH AS SAND AND PEA GRAVEL MIXTURE OR 3/4 INCH ABC WHICH SHALL BE COMPACTED IN PROGRESSIVE 12-INCH LIFTS. WHERE CONFLICTS EXIST BETWEEN THESE SPECIFICATIONS AND OTHER SPECIFICATIONS OF THE CITY, COUNTY OR STATE, THE MORE STRINGENT SHALL APPLY.

THE ABOVE MIX DESIGN WILL BE READILY RECOGNIZABLE WHEN IT'S BEING UNLOADED FROM A MIXING TRUCK. IT IS UNLIKELY THAN AN EXTRA STRENGTH MIX WILL EVER BE DELIVERED BECAUSE THERE ARE NO STANDARD USES FOR EXTRA STRENGTH SAND SLURRY. THE DRIVER OF THE CONCRETE MIXING TRUCK MUST PROVIDE A TICKET DESCRIBING THE SLURRY MATERIAL. OTHERWISE THE MATERIAL IS UNACCEPTABLE.

30.7 BEDDING AND BACKFILL SHALL BE COMPACTED TO A MINIMUM 90 PERCENT OF THE MAXIMUM DENSITY AS DEFINED BY AASHTO T 99 OR ASTM D 698 OR ASTM D 2922 AND D 3017, UNLESS OTHERWISE SPECIFIED ON THE WORK ORDER DRAWINGS, OR UNLESS MORE STRINGENT REQUIREMENTS PREVAIL AS DICTATED BY LOCAL GOVERNMENT AGENCIES OR OTHER PUBLIC REGULATORY AGENCIES.

30.8 IF A HIGH WATER TABLE EXISTS, THE WATER SHALL BE PUMPED FROM THE EXCAVATION TO PERMIT THE MANHOLE TO BE SET WITHOUT ALLOWING THE WATER TO ENTER THE BASE UNIT.

30.9 THE GROUND RODS OR AN APPROVED ALTERNATIVE SHALL BE PROVIDED BY APS AND INSTALLED BY THE PARTY RESPONSIBLE FOR INSTALLING THE CONDUIT SYSTEM.

30.10 THE PARTY RESPONSIBLE FOR PROVIDING THE TRENCHING AND BACKFILL SHALL BE RESPONSIBLE FOR PREPARING THE PAD SITE FOR ALL PROPOSED TRANSFORMER, SWITCHING CABINET OR OTHER EQUIPMENT LOCATIONS.