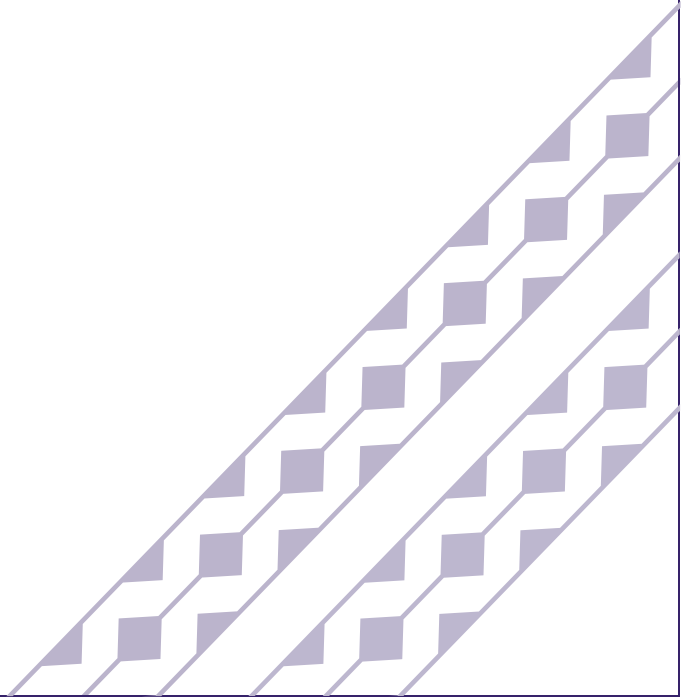




**Hawaiian
Electric**

The information found in this document are general guidelines that may be used to aid in the preparation of your service request proposal. Please be advised that depending on the specific needs and actual conditions of your project, Hawaiian Electric may require your design to comply with different specifications including specifications that include more stringent requirements than those included in these design specification guidelines. For further guidance and clarification on the actual specifications that will apply to your particular project, please refer to instructions issued by Hawaiian Electric's Planner or Engineer who is assigned to your particular (Project/Review Request/...). Additionally, please be advised that Hawaiian Electric reserves the right to require additional modifications to any approved design if it is determined during actual construction that additional modifications must be made to address certain field conditions that were not detected or Hawaiian Electric was unaware of during the design review process.



SCOPE:

This standard provides the details for the construction of HECO's ductlines under typical conditions. Detailed information on many of the approved materials as well as detailed information for both concrete-encased and direct buried conduit installations are shown. See Std. 30-1030 for details on construction of ductlines under special conditions.

GENERAL:

1. PVC Schedule 40 and Schedule 80 conduits shall be used for HECO ductlines. The conduits are to conform to NEMA TC-2, latest revision, and HECO Specification M7001, latest revision. Accessories are to conform to NEMA TC-3, latest revision, and HECO Specification M7001.
2. Refer to Std. 30-1005 Conduit Application Guide for information on the type of conduit to use for various types of installations.
3. Refer to Std. 30-1030 Plastic Ducts, Special Installation Details for conditions not covered by this standard. In addition, for other conditions not covered by either this standard or Std. 30-1030, consult with HECO Engineering.
4. All ductline construction must conform to HECO Specification CS7001, latest revision.
5. All conduit installation must be inspected and approved by a qualified Company inspector before any concrete placement and/or trench backfilling. The contractor shall be responsible for arranging the inspection sufficiently ahead of schedule to enable the Company inspector to be present.
6. Each conduit is to be wire brush cleaned per Specification CS7001. In addition, each conduit must pass a mandrel per Specification CS7001 and as detailed in Std. 30-1030.
7. After cleaning and testing, the contractor is to place a MuleTape Pull Line in each conduit, as directed by the Company inspector. "Mule Tape" is typically a flat polyester woven tape which provides low friction, dissipates side wall load and reduces duct burn through. Pulling tape shall be rated at least 1800# tensile strength with 1 foot interval markings. Joining and splicing of pulling tape is not allowed in duct runs. Both ends of each conduit shall be plugged with plastic plugs.

DATE	INITIAL	REVISION
1-17-73	RM TN ST	
6-5-74	RM TN	
10-29-74	RM TN	
10-5-79	RM TN	
10-24-86	RM TN	
9-94	RM	
10-31-99	CT DH FK	
06-01	CT FK	
11-01-02	CT DH FK	
11-05	CT DH FK	

DRAWN	CT	DESIGNED	APPD	ST	JAR	TN	VEC	REDRAWN	10-31-99		
SUPERSEDES			PLASTIC DUCTS INSTALLATION DETAILS UNDERGROUND STRUCTURES					ORIGINAL	6-13-72		
ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.									30-1035	REV	10
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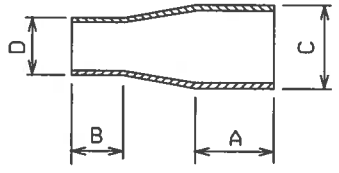
REVISION	DATE	1-17-73	9-11-74	6-5-74	2-24-76	2-12-79	10-31-99	06-01	11-05																																																																	
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<p align="center">PLASTIC CONDUIT (NEMA TC-2)</p> <p align="center">USE: SCHEDULE 40 = CONCRETE ENCASED INSTALLATIONS SCHEDULE 80 = CONCRETE ENCASED AND SELECTED DIRECT BURIED INSTALLATIONS</p> <p align="center">NOTE: CONDUIT MUST CONFORM TO NEMA TC-2 AND ASTM D-1785</p>																																																																										
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ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.	PLASTIC DUCTS INSTALLATION DETAILS UNDERGROUND STRUCTURES																																																																									
SHEET 2 OF 9	ORIGINAL 30-1035	REDRAWN 10-31-99																																																																								

REVISION	DATE	1-17-75	2-12-79	10-24-86	10-31-99	06-01	11-05						
	INITIAL	RM TN ST	RY ST	RM TN	CT DH FK	CT FK	<i>CT DH FK</i>						

REDUCER COUPLING (NEMA TC-3)

USE: A FITTING INTENDED FOR JOINING LENGTHS OF TWO DIFFERENT SIZES OF RIGID PVC CONDUIT, RIGID PVC ELBOW, OR OTHER BEND.

NOTE: REDUCER COUPLING MUST CONFORM TO NEMA TC-3

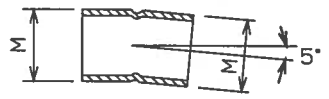


NOMINAL CONDUIT SIZES		HECO STOCK NO.	A	B	C	D
LARGE END (IN.)	SMALL END (IN.)		MINIMUM (IN.)	MINIMUM (IN.)	AVERAGE (IN.)	AVERAGE (IN.)
3	2	000143957	3.250	2.125	3.500	2.375
4	3	000134584	3.375	3.250	4.500	3.500
5	4	000109568	4.375	3.375	5.563	4.500
6	5	000134085	5.375	4.375	6.625	5.563

5° ANGLE COUPLING (NEMA TC-3)

USE: A FITTING INTENDED FOR JOINING TWO LENGTHS OF RIGID PVC CONDUIT TO CHANGE THE DIRECTION OF THE CONDUIT OR TO FORM A CURVE IN THE CONDUIT RUN.

NOTE: COUPLING MUST CONFORM TO NEMA TC-3.



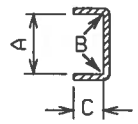
TYPICAL DIMENSIONS

NOMINAL CONDUIT SIZE (IN.)	HECO STOCK NO.	M MAXIMUM (IN.)
2	000143857	2.563
3	000140584	3.719
4	000104534	4.797
5	000145734	5.922
6	000104579	6.016

CAP (NEMA TC-3)

USE: A FITTING INTENDED FOR CLOSING THE ENDS OF UNUSED LENGTHS OF RIGID PVC CONDUIT.

NOTE: CAP MUST CONFORM TO NEMA TC-3



NOMINAL CONDUIT DIAMETER (IN.)	HECO STOCK NO.	A	B	C
		CAP ENTRANCE DIAMETER AVERAGE (IN.)	CAP BOTTOM DIAMETER AVERAGE (IN.)	CAP LENGTH MINIMUM (IN.)
2	000104388	2.393	2.369	1.125
3	000147844	3.515	3.492	1.594
4	000104585	4.515	4.491	1.750
5	000150734	5.593	5.553	1.937
6	000145807	6.658	6.614	2.125

GENERAL NOTES:

- ALL DIMENSIONS IN INCHES.
- THESE ACCESSORIES ARE TO BE USED WITH PVC (POLY-VINYL CHLORIDE) PLASTIC CONDUIT, PER HECO SPEC. M7001.
- PLASTIC DUCT SPACERS SHALL BE CARLON SNAP-LOC SPACERS OR APPROVED EQUAL.

SUPERSEDES	DRAWN	CT	DESIGNED	FK	APPD	ST	JAR	TN	VEC
	ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.								
SHEET 3 OF 9	REDRAWN	10-31-99	ORIGINAL	6-13-72	REV	6			
	30-1035								

**PLASTIC DUCTS
INSTALLATION DETAILS
UNDERGROUND STRUCTURES**

REVISION	DATE	11-05																	
	INITIAL	CBW/mm																	

SUPERSEDES
 DRAWN CT
 DESIGNED FK
 APPD FK
 ENGINEERING STANDARD
 HAWAIIAN ELECTRIC CO. INC.

PLASTIC DUCTS
 INSTALLATION DETAILS
 UNDERGROUND STRUCTURES

REDRAWN
 ORIGINAL JUNE 2001
 30-1035
 SHEET 4 OF 9
 REV 1

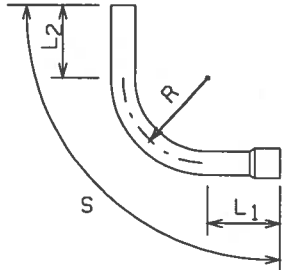
BENDS (NEMA TC-3)

USE: A CONDUIT SECTION INTENDED TO PROVIDE A SMOOTH CHANGE IN DIRECTION IN THE CONDUIT RUN.

NOTE: COUPLING MUST CONFORM TO NEMA TC-3.

90° BENDS

NOMINAL CONDUIT SIZE (IN.)	HECO STOCK NO.	R RADIUS (IN.)	S SWEEP (FT.)	L1 STRAIGHT MINIMUM (IN.)	L2 STRAIGHT MINIMUM (IN.)
2	000148754	24	12.5	2.000	2.000
2	000149857	36	12.5	2.000	2.000
3	000148574	30	12.5	3.125	3.125
3	000145794	36	12.5	3.125	3.125
4	000143054	36	12.5	3.625	3.625
4	000145790	60	12.5	3.625	3.625
5	000140579	36	12.5	4.250	4.250
5	000104759	60	12.5	4.250	4.250
6	000140750	48	12.5	5.250	5.250
6	000140459	60	12.5	5.250	5.250



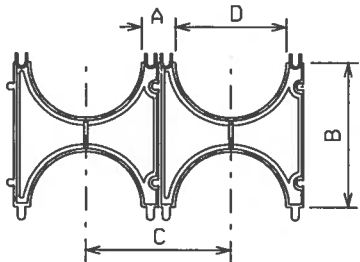
45° BENDS

NOMINAL CONDUIT SIZE (IN.)	HECO STOCK NO.	R RADIUS (IN.)	S SWEEP (FT.)	L1 STRAIGHT MINIMUM (IN.)	L2 STRAIGHT MINIMUM (IN.)
2	---	24	12.5	2.000	2.000
2	---	36	12.5	2.000	2.000
3	---	30	12.5	3.125	3.125
3	---	36	12.5	3.125	3.125
4	---	36	12.5	3.625	3.625
4	---	60	12.5	3.625	3.625
5	---	36	12.5	4.250	4.250
5	---	60	12.5	4.250	4.250
6	---	48	12.5	5.250	5.250
6	---	60	12.5	5.250	5.250

INTERMEDIATE SPACER

NOTE: DIMENSIONS SHOWN ARE FOR CARLON SNAP-LOC SPACERS.
TYPICAL DIMENSIONS

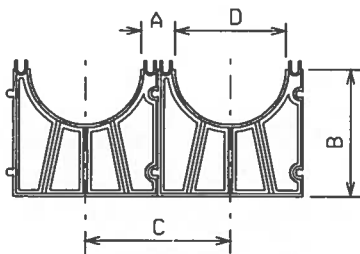
CONDUIT SIZE (IN.)	HECO STOCK NO.	A (IN.)	B (IN.)	C (IN.)	D (IN.)
2	000105834	1.50	3.88	4.12	2.50
3	000150875	1.50	5.01	5.25	3.63
4	000134057	1.50	6.01	6.25	4.63
5	000140574	1.50	7.07	7.31	5.69
6	000158744	1.50	8.14	8.38	6.75



BASE SPACER

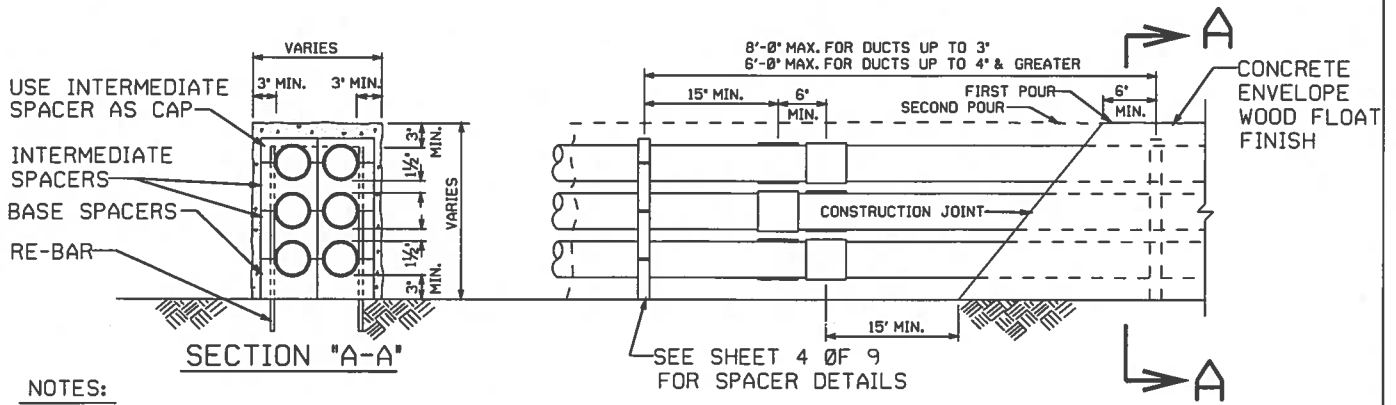
NOTE: DIMENSIONS SHOWN ARE FOR CARLON SNAP-LOC SPACERS.
TYPICAL DIMENSIONS

CONDUIT SIZE (IN.)	HECO STOCK NO.	A (IN.)	B (IN.)	C (IN.)	D (IN.)
2	000108457	1.50	4.25	4.12	2.50
3	000140578	1.50	4.81	5.25	3.63
4	000140745	1.50	5.31	6.25	4.63
5	000140573	1.50	5.84	7.31	5.69
6	000134058	1.50	6.38	8.38	6.75



GENERAL NOTES:

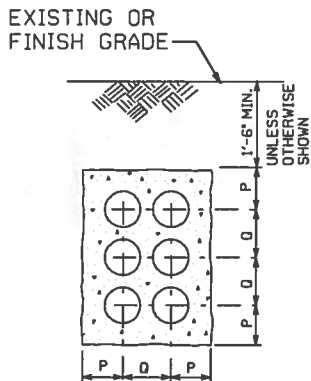
1. ALL DIMENSIONS IN INCHES.
2. THESE ACCESSORIES ARE TO BE USED WITH PVC (POLY-VINYL CHLORIDE) PLASTIC CONDUIT, PER HECO SPEC. M7001.
3. PLASTIC DUCT SPACERS SHALL BE CARLON SNAP-LOC SPACERS OR APPROVED EQUAL.



NOTES:

1. STAGGER COUPLINGS (OR BELLED ENDS).
2. ANCHOR CONDUIT WITH #14 STEEL TIE WIRE AND #4 REINFORCING BARS.
3. CEMENT ALL JOINTS.
4. AVOID STANDING ON CONDUIT.
5. REFER TO STD. 30-1005 FOR ADDITIONAL INFORMATION.

TYPICAL DUCT ELEVATION
6 WAY DUCT LINE SHOWN
 NOT TO SCALE



REFER TO GO-10 OR SPECIFIC PROJECT DRAWINGS FOR DEPTH REQUIREMENTS

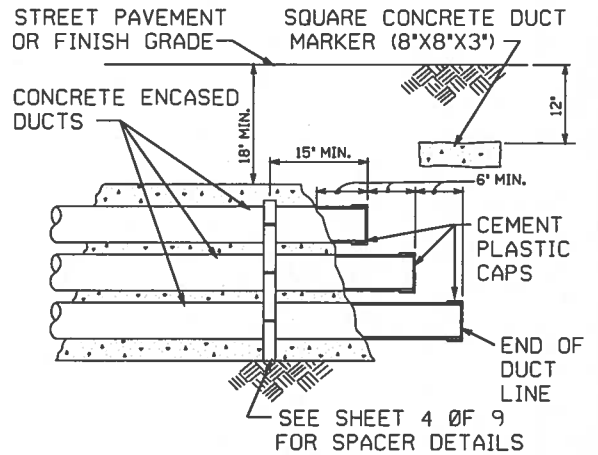
DUCT SIZE	DIMENSIONS	
	P	Q
2	4 ³ / ₁₆	3 ⁷ / ₈
3	4 ³ / ₄	5
4	5 ¹ / ₄	6
5	5 ¹³ / ₁₆	7 ¹ / ₁₆
6	6 ⁵ / ₁₆	8 ¹ / ₈

NOTES:

(DIMENSIONS IN INCHES)

1. MAINTAIN 1 1/2' MINIMUM SPACING BETWEEN DUCTS; 3' MINIMUM CONCRETE ENVELOPE AROUND TOP, BOTTOM AND SIDES.
2. DIMENSIONS ARE MINIMUM DIMENSIONS.

CONCRETE ENCASED
TYPICAL DUCT SECTION
6 WAY DUCT LINE SHOWN



TYPICAL STUB OUT DETAIL
6 WAY DUCT LINE SHOWN

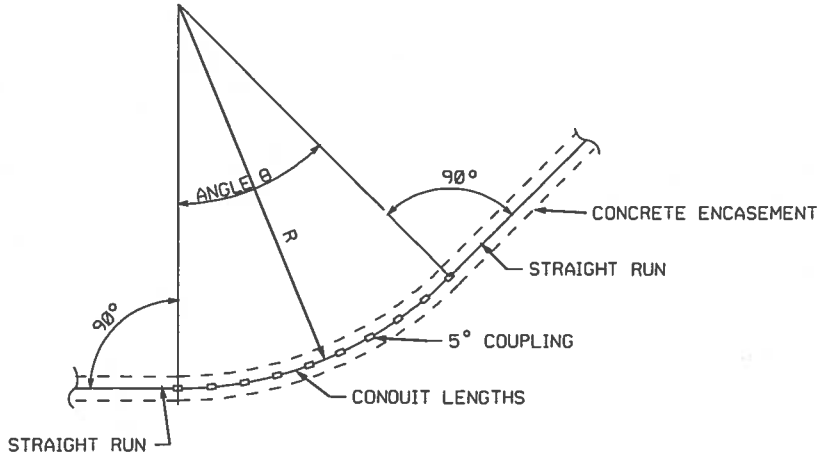
CONCRETE ENCASEMENT DETAILS

DATE 11-05
 INITIAL *CT*
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DRAWN CT	DESIGNED FK	APPD FK	REDRAWN
SUPERSEDES			ORIGINAL JUNE 2001
ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.			30-1035 REV 1
PLASTIC DUCTS INSTALLATION DETAILS UNDERGROUND STRUCTURES			SHEET 5 OF 9

TABLE A

APPROX. RADIUS OF BEND R	LENGTH OF EACH CONDUIT FT. USING 5° BEND AT COUPLING
11'-6"	1
17'-3"	1.5
23'-0"	2
28'-9"	2.5
34'-6"	3
40'-3"	3.5
46'-0"	4
51'-9"	4.5
57'-6"	5
69'-0"	6
80'-6"	7
92'-0"	8



EXAMPLE OF NOTE 3:

RADIUS OF BEND (R) = 60'
 ANGLE OF BEND (θ) = 45°

FROM TABLE A, THE NEAREST VALUE TO 60' RADIUS IS 57'-6", LENGTH OF CONDUIT = 5'
 FROM TABLE B, FOR 45° ANGLE
 NUMBER OF COUPLINGS REQUIRED = 9
 NUMBER OF CONDUIT LENGTHS REQUIRED = 8

NOTES:

THERE ARE 4 METHODS OF FORMING CURVES WITH PLASTIC CONDUIT.

1. "HEAT" BENDING: USE HOTBOX BENDING EQUIPMENT OR APPROVED MANUFACTURERS METHOD. DO NOT USE TORCH OR OPEN FLAME.
2. "COLD" BENDING: LIMIT TRENCH FORMED RADIUS SWEEPS TO 25' MINIMUM RADIUS.
3. 5° ANGLE COUPLINGS MAY BE USED AS SHOWN.
4. FACTORY MADE ELBOWS AND SWEEPS MAY BE USED.

TABLE B

ANGLE OF BEND θ	NUMBER OF COUPLINGS & CONDUIT LENGTHS REQ'D	
	COUPLING	CONDUIT
15°	3	2
30°	6	5
45°	9	8
60°	12	11
75°	15	14
90°	18	17

METHOD OF FORMING CURVES FOR
 CONCRETE ENCASED DUCTS

11-05
 DATE INITIAL
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REFER TO STD. 30-1005 SHEET 11 FOR
 CONCRETE ENCASED EXCAVATION & BACKFILL DETAILS

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ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.			30-1035 SHEET 6 OF 9

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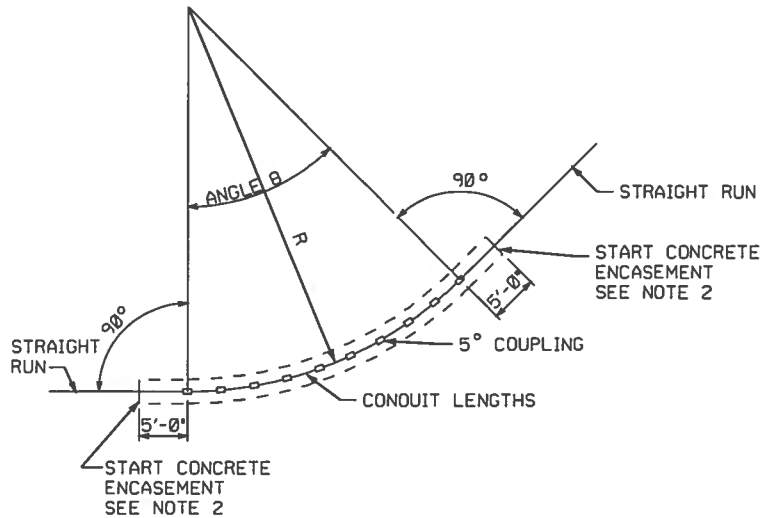


TABLE A

APPROX. RADIUS OF BEND R	LENGTH OF EACH CONDUIT FT. USING 5 BEND AT COUPLING
11'-6"	1
17'-3"	1.5
23'-0"	2
28'-9"	2.5
34'-6"	3
40'-3"	3.5
46'-0"	4
51'-9"	4.5
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69'-0"	6
80'-6"	7
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EXAMPLE OF NOTE 3:

RADIUS OF BEND (R) = 60'
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FROM TABLE A, THE NEAREST VALUE TO 60' RADIUS IS 57'-6". LENGTH OF CONDUIT = 5'
 FROM TABLE B, FOR 45° ANGLE
 NUMBER OF COUPLINGS REQUIRED = 9
 NUMBER OF CONDUIT LENGTHS REQUIRED = 8

NOTES:

- THERE ARE 4 METHODS OF FORMING CURVES WITH PLASTIC CONDUIT.
 - "HEAT" BENDING: USE HOTBOX BENDING EQUIPMENT OR APPROVED MANUFACTURERS METHOD. DO NOT USE TORCH OR OPEN FLAME.
 - "COLO" BENDING: LIMIT TRENCH FORMED RADIUS SWEEPS TO 25' MINIMUM RADIUS.
 - 5° ANGLE COUPLINGS MAY BE USED AS SHOWN.
 - FACTORY MADE ELBOWS AND SWEEPS MAY BE USED.
- PROVIDE 3" MINIMUM CONCRETE ENCASEMENT OVER THE ENTIRE LENGTH OF ALL BENDS EXCEEDING 45°. START CONCRETE 5' BEFORE START OF THE BEND AND CONTINUE TO 5' BEYOND THE END OF THE BEND.

TABLE B

ANGLE OF BEND θ	NUMBER OF COUPLINGS & CONDUIT LENGTHS REQ'D	
	COUPLING	CONDUIT
15°	3	2
30°	6	5
45°	9	8
60°	12	11
75°	15	14
90°	18	17

METHOD OF FORMING CURVES FOR DIRECT BURIED DUCTS

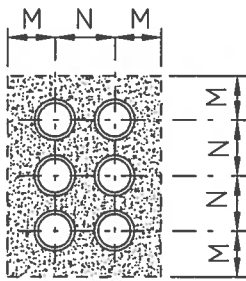
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REVISION

REFER TO STD. 30-1005 SHEET 11 FOR
 DIRECT BURIED EXCAVATION & BACKFILL DETAILS

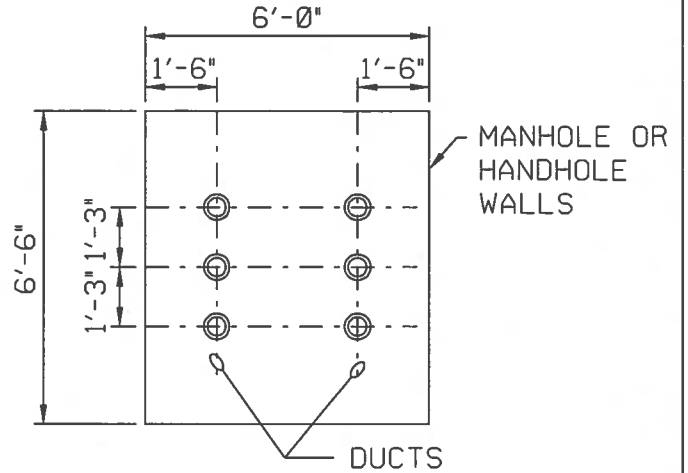
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SUPERSEDES			ORIGINAL JUNE 2001
ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.			30-1035 REV 1
PLASTIC DUCTS INSTALLATION DETAILS UNDERGROUND STRUCTURES			SHEET 7 OF 9

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DUCT DIMENSION		
SIZE	M	N
2	4	5
3	5	6
4	5 1/2	7
5	6	8
6	6 5/16	9

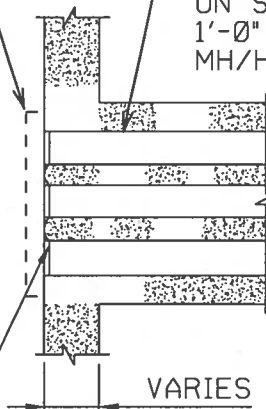
(DIMENSION IN INCHES)



HECO TO INSTALL IN STRUCTURES WITH CABLE: FLUSH BOARD ON INSIDE OF EXISTING MH/HH

CONTRACTOR TO BEND CONDUITS AS REQUIRED PER MINIMUM RADIUS BEND ON SHEET 6. START BEND 1'-0" FROM INSIDE FACE OF MH/HH WALL.

STANDARD END BELLS AT ALL DUCT ENTRANCES UNLESS-OTHERWISE SHOWN OR NOTED.



CONTRACTOR TO INSTALL END BELLS SQUARE TO FLUSH BOARD

TYPICAL CONDUIT ENTRANCE INTO MANHOLE OR VAULT WALLS (6 WAY DUCT LINE SHOWN)

DATE 11-05
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REDRAWN

SUPERSEDES

PLASTIC DUCTS
INSTALLATION DETAILS
UNDERGROUND STRUCTURES

ORIGINAL JUNE 2001

30-1035

REV
2

ENGINEERING STANDARD
HAWAIIAN ELECTRIC CO. INC.

SHEET 8 OF 9

REFERENCES:

Standards:

- 30-1005 Conduit Application Guide
- 30-1006 Ductline Applications
- 30-1015 Typical Duct Encasement Details
- 30-1020 Duct Roll Sections
- 30-1030 Plastic Ducts, Special Installation Details
- 30-9000 References & Standard for UG Ducts & Structures

Specifications:

- M7001 Plastic Conduits & Fittings Constructed With PVC Plastic
- CS 7202 General Conditions
- CS 7001 Construction of UG Facilities
- CS 7003 Construction of Electrical Facilities

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ENGINEERING STANDARD HAWAIIAN ELECTRIC CO. INC.							30-1035	REV	1
						SHEET	9 of 9		